



Request for Qualifications

Stormwater Master Plan

Project #:	1483
RFQ Issued:	Wednesday, February 24, 2021
Submittal Due Date:	Tuesday, March 16, 2021 @ 4 p.m. CST

Public Works Department

REQUEST FOR QUALIFICATIONS

University City is an inner-ring suburb of the city of St. Louis in St. Louis County, in the state of Missouri. According to the 2010 census, the city has a total area of 5.90 square miles (15.28 km²) and a population of 35,371 people. The city is one of the older suburbs in the St. Louis area. Much historic architecture remains in the southern, older portion of the city, particularly along Delmar Boulevard. The northern portions of the city developed mostly after World War II and are more suburban with shopping centers and more automobile-centered development.

The City Council is the legislative and governing body of the City of University City. The City Council has seven members, one of whom serves as Mayor. Each of the City's three wards has two representatives, who are elected to four-year terms. The Council appoints both the City Manager and City Clerk. The City Manager is responsible for the day-to-day operations of the University City government. The University City government is comprised of 12 Departments: Administration, Human Resources, Legislative Services, Finance, Communications and Technology, Economic Development, Fire, Municipal Court, Police, Planning and Development, Parks & Recreation & Forestry, and Public Works. The Public Works Department is comprised of Engineering, Streets, Solid Waste, and Facilities divisions.

The Public Works Department is soliciting qualifications from engineering and planning consulting firms to develop a Stormwater Master Plan for University City. The community is located in the Upper River des Peres watershed and is nearly built-out. River des Peres (RDP), meaning "River of the Fathers" in French, and its tributaries are a natural resource as well as a hazard during flood conditions. The riparian corridor associated with RDP offers many benefits such as locating trails and parks within its proximity and is also a public way often used for the Metropolitan St. Louis Sewer District's and other utilities' underground or overhead infrastructure to better serve the area residents. The management of the River des Peres channel is challenging at best and lies on the shoulders of public agencies having jurisdiction in its reaches. Recently more emphasis is being placed on public-private partnerships to tackle this task with our residents especially being more active in regional initiatives such as River des Peres Trash Bash, University City government maintaining compliance with the area Municipal Separate Storm Sewer System (MS4) permittee regulations and organizations such as River des Peres Watershed Coalition working to raise awareness of this asset throughout the St. Louis metropolitan area. University City Council approved the formation of a new Commission on Storm Water Issues in April 2020 with the Commission beginning its work in the August of that year. This Commission was formed on the heels of a Stormwater Task Force, of which many current Commissioners were members, and that Task Force completed as a result of 2 years' busy work and presented a very detailed report of their findings to University City Council in January 2020. The report is attached to this document for a review. The Commission on Storm Water Issues is advisory to City Council and, along with professional staff, looking forward to the development of the City's Stormwater Master Plan to inform future work in this function area in University City.

Anticipated Scope of Services:

A three-phased study scope is outlined with sample tasks listed under each phase for guidance in the development of consultant qualification submittals as follows:

Phase I – Data collection and analysis: (Consultant to gather data, coordinate input from various entities (City and otherwise), and classify problem areas):

- Attend kick-off meeting with City Project Manager and other City team members.
- Develop Stormwater Concern Form for distribution to residents (by City) for the purpose of collecting and documenting stormwater problems.
- Review existing stormwater studies, reports, complaint logs obtained by the City and obtained by the City from MSD, reports from the Corps of Engineers, and the Storm Water Task Force Citizen Survey.
- Complete necessary field visits to analyze identified stormwater problem areas.
- Map/delineate University City watershed and sewer sheds (this is a field survey as well as data research task) to create a drainage map of University City including important infrastructure location and sizes.
- Use Storm Water Task Force Citizen Survey results to pinpoint areas of storm water complaints to overlay on the drainage map for the development of recommendations for stormwater improvement program priority zones.
- Develop definition to distinguish between public and private stormwater problems.
- Recommend design criteria for stormwater controls applicable to new development and redevelopment projects.

Phase II – Prioritization of improvements: (Consultant to develop a single and objective end-product centered on prioritized or ranked list of projects that the City can use to make decisions on capital improvements):

- In cooperation with City Staff, revisit the problem areas generated by Phase I. From the problem areas cataloged in Phase I, identify specific stormwater projects and conceptual cost estimate for those projects.
- In cooperation with City Staff, review data, analyze conditions and improvements, and recommend methodology for setting priority levels for maintenance and minor improvements work relative to resolutions for storm water issues.
- Identify problem areas where a reasonable accommodation can be made to address water quality in addition to water quantity. Generate an alternate conceptual cost and ranking accordingly.
- Rank the projects and organize the data to aid in City budgeting and grant applications.
- Incorporate, as applicable, MSD project ranking scheme for OMCI tax fund utilization into the City stormwater capital improvement program proposed prioritization system.
- Review City ordinances and codes and recommend revisions to improve water quantity and quality.

Phase III – Implementation: (this phase is not included for a response on this RFQ and it is to be conducted in the future as City Council allocates funding):

- Formulate standards for implementation and develop recommendations to effectively integrate projects with operations and maintenance.
- Identify, assess, and prioritize opportunities for water quality improvement on publicly-owned property.
- Provide recommended program management procedures including an ongoing feedback loop utilization.

The below tasks apply to all phases of the work, as appropriate:

- Obtain public feedback (including up to 2 ea. public meetings) at appropriate phases of work development.
- Present draft work product to City staff for review and comments.
- Provide periodic updates to Commission on Storm Water Issues, obtain feedback.
- Provide mid-study update to City Council, obtain feedback.
- Incorporate review comments and feedback into final work product.
- Conclude the study work with report of findings and recommended actions and present the proposed Master Plan to City Council.

Timeline of Submittal:

Qualification submittals are due at 4 p.m. noon on Tuesday, March 16. Please make an appointment for dropping off documents at City Hall at 6801 Delmar Blvd., University City, Missouri 63130 as the facility is currently closed for public access except for daily limited openings at 9-10 a.m. and 3-4 p.m.

Instructions for Preparing Proposal:

Proposals (3 ea. hard copies) can be assembled in any format including but not limited to a Letter of Interest or Cover Letter, Qualifications package and any applicable Attachments. However, the length of the submittals shall not exceed 15 pages (single-sided) and all submittals shall be provided together with an electronic copy (either emailed to sinan@ucitymo.org or transmitted via a thumb drive).

Please do not contact the City staff for project understanding and instructions beyond what's provided in this document. However, contacting the City staff (Department phone number: 314-505-8560) for clarifications or document submittal arrangements is not restricted.

Selection Process and Criteria:

The statements of qualifications (SOQ) will be evaluated by the City's review committee consisting of various City personnel. The criteria that will be utilized to score the SOQs are listed below:

- Qualifications of firm (25 points).
- Qualifications for Project Manager and Project Team (25 points).
- Relevant Storm Water Experience (25 points).
- Approach (25 points).

Important Considerations:

The scope of this study and master plan development is intended for the selected consultant to assist the City Staff with devising an objective tool and establishing a basis of data systems to utilize for stormwater management. The resulting tool and systems are transparent to residents and property owners, and defensible by the City.

Attachment:

Storm Water Task Force Report

END OF DOCUMENT "REQUEST FOR QUALIFICATIONS – PROJECT #1483"



Storm Water Task Force
6801 Delmar Boulevard, University City, Missouri 63130
Phone: (314) 505-8560, Fax: (314) 862-0694

Storm Water Task Force Report

November 2019

Members of the Task Force:

Todd Thompson, John Tieman, Co-Chairman,
Garry Aronberg, Robert Criss, Tim Cusick, Mark Holly,
Eric Karch, Bobette Patton, Eric Stein

Special Assistance from

Paulette Carr (Councilwoman),
Bwayne Smotherson (Councilman)
Sinan Alpaslan, PE (Public Works Director),
Chris Kalter (Project Manager, Public Works Department),
Mark Zaiontz (Community Development),
Rosalind Williams (Past Interim Director of Community Development)
Gloria Nickerson and Linda Sharpe-Taylor, Volunteers



Storm Water Task Force
6801 Delmar Boulevard, University City, Missouri 63130
Phone: (314) 505-8560, Fax: (314) 862-0694

Table of Contents

1. Executive Summary	1
2. Introduction	3
3. Identify Storm Water Problem	3
3.1. Historical Record	4
3.1.1. MSD Data.....	4
3.1.2. Federal Emergency Management Agency.....	5
3.1.3. US Army Corps of Engineers	7
3.1.4. Survey to identify extent of storm water problems	7
3.1.4.1. Questions.....	7
3.1.4.2. Distribution method.....	9
3.1.4.3. Survey Data Results	9
3.1.4.4. Survey Responses.....	11
3.1.4.5. Observations.....	12
3.1.5. Site visits	13
4. Neighboring Communities Data.	20
5. Mitigation.....	20
6. Prioritization of Problems.	21
7. Storm water Ordinances.	22
8. Early Warning.....	24
8.1. U. City RDP Watershed.....	24
8.2. USGS Gauge at Heman Park.	24
8.3. Conclusions from Preliminary Study.	25
8.4. Progress on Rain Gauges and Flood Prediction.	25
8.5. Components of a FWS.	26
8.6. Acquisition of FWS Components.	26
8.7. New Information Regarding Flooding in Our Watershed.	26
8.8. Future Work for Flood Warning System.	27
9. Cost and Funding.....	28
9.1. Costs	28
9.2. Funding.....	29
10. Conclusions.....	31
11. Recommendations	33



Storm Water Task Force
6801 Delmar Boulevard, University City, Missouri 63130
Phone: (314) 505-8560, Fax: (314) 862-0694

Storm Water Task Force Report November 2019

1. Executive Summary

Recent intense storms have caused loss of life and wide-spread property damage in University City. In mid-2017, The City Council established a Stormwater Task Force to collect data and develop conceptual plans to mitigate stormwater problems in the City.

Working with a sparse historical record and a survey collected by the Task Force, we have identified six categories of stormwater problems and a range of mitigation options:

Categories of Stormwater Problem	Mitigation Options
Stormwater runoff between yards causing ponding, flooding, erosion of yards and parks, and damage to houses	City Code revisions to require runoff storage and conveyance to storm sewer systems even for small projects
Basement flooding	Improved grading around houses, sewer lateral cleaning, public sewer improvements
Flooding from the River Des Peres and Engleholm Creek that damages houses and yards	Early warning of floods, buyouts of some low-lying houses, some creek improvements
Erosion of the banks of River Des Peres and Engleholm Creek	Armor of stream banks, adjustment of stream bank to add width, floodplain, conveyance, and storage
Poor stormwater collection in streets causing street and yard ponding, yard erosion, and damage to houses	Improved storm sewer inlets and sewers
Expensive flood protection insurance	City participation in FEMA Community Rating System, public education program regarding private residential flood protection measures

Some of the problems are private problems and should be addressed by property owners at their own expense. But many of the problems are public problems and can only be addressed by government agencies such as the City, Metropolitan St. Louis Sewer District, County, or State.

By extrapolation from similar situations in neighboring communities, we estimate that the cost of the public problems (buyouts and public works improvements) would be about \$40 million – a large cost. Funding would likely come from the following sources:

1. University City Parks and Stormwater Tax
2. Grants from the Federal Emergency Management Agency (FEMA) and administered by the State Emergency Management Agency (SEMA);
3. FEMA Community Rating System (CRS) to lower flood insurance premiums
4. Metropolitan St. Louis Sewer District (MSD) if the Operations, Maintenance, and Construction Improvements (OMCI) property tax is reinstated or new MSD fees or taxes are established;
5. MSD Rainscaping Large Scale Grants
6. Block Grants sponsored by the US Department of Health and Human Services;
7. Missouri Department of Natural Resources Section 319 grants for nonpoint sources water



- quality improvement projects;
- 8. New municipal taxes if the Council determines a new tax is appropriate;
- 9. Neighborhood or community improvement districts – a property tax in a small neighborhood district to pay-off a bond;

These stormwater problems have developed over decades as University City and our neighbors have transitioned from farmland to suburbia: building in floodplains, covering the soil with pavement and roofs, and deferring maintenance of the stormwater conveyance system.

In the past our region has failed to recognize the importance of our creeks, stormwater sewers, detention, and runoff minimization techniques. Now our region is developing the political will to address stormwater problems – the communities around us are developing plans.

Therefore, we recommend that the City of University City develop a detailed Stormwater Plan to address the problems identified by the Task Force and implement the mitigation with a reasonable schedule. The plan should prioritize the mitigation projects so that the most important projects are completed early. The plan should detail appropriate funding.

Schedule, prioritization, and detailed funding are herculean tasks that are beyond the ability of a volunteer citizen-led task force. The City should either hire a consultant or dedicate extensive full-time staff to developing the schedule, prioritization, and detailed funding.

Many of the decisions associated with the scheduling, prioritization, and funding are political. Therefore, input from the public will be important to developing a good plan. We recommend that public input from the Council, public meetings, and public advisory committees be part of the development of the detailed stormwater plan.

City code modifications would require no capital investment and we recommend that development of the code modifications be undertaken now. The Task Force has developed samples and templates. Code modifications should reduce the threshold of applicability for City permits that affect stormwater. Members of the Task Force would be willing to assist with code modifications either as individuals or as a Task Force if the Council were to continue and expand the charter of the Task Force.

The Flood Early Warning system is a very low capital investment that we recommend be developed now. The Task Force subcommittee has invested great effort to establish that a locally driven warning system is feasible and economical.

City officials must determine which public projects are the responsibility of University City and which public projects are the responsibility of other agencies such as MSD, MoDOT, or St. Louis County Highway and Transportation Department.

Infrequent maintenance of the River Des Peres and its tributaries has caused clogging and reduced conveyance. Problems can propagate far from the point of clogging or flow restriction. The channels should be cleared of excessive silt and large debris. The City should identify the agencies responsible for channel maintenance and encourage timely maintenance.



2. Introduction

Recent intense storms such as 2008 (Hurricane Ike), December 2015, and May 2017 created severe problems ranging from wide-spread significant property damage to loss of life prompted the City Council to re-examine stormwater. The Stormwater Task Force¹ was authorized² on June 26, 2017 to examine storm water concerns in University City. The Task Force was charged to work under the direction of the City Council but be citizen-led. The recital portion of the resolution discusses storm water quantity (flooding) problems but is silent on water quality (ecological) problems. Therefore, the Task Force and this report are focused on storm water *quantity* problems.

The resolution charged the task force to consider two phases:

- Phase 1: Collect data to identify, evaluate, and prioritize storm water problems;
- Phase 2: Develop a Storm Water Master Plan of conceptual solutions and costs of prioritized problems.

The resolution charges that solutions and costs of prioritized problems should be based on data gathered by the Task Force including citizen input. Further, written and oral reports should be submitted at the end of each phase.

The Task Force met for the first time in October of 2017 and submitted the Phase 1 report in January of 2019. Phase 2 is now complete, and this report details the work of both phases.

3. Identify Storm Water Problem

To identify the sources and nature of stormwater quantity problems in University City, a subcommittee examined anecdotal information, MSD lists of backups and other complaints, Corps of Engineers (USACE) reports, and FEMA documents. The previous information about stormwater quantity problems had been scattered, incomplete, and out-of-date. The historical data had been considered in isolation and could not be used to quantify and prioritize the City's stormwater problems.

To get current stormwater data and improve the data quality, a succinct survey was developed and distributed widely in the City. The survey results were combined with historical data to clarify types and extent of the stormwater problems. The types of problems identified are listed below:

- Stormwater runoff between yards causing ponding, flooding, erosion of yards and parks, and damage to houses;
- Basement flooding;
- Flooding from the River Des Peres and Engleholm Creek that damages houses and yards;
- Erosion of the banks of River Des Peres and Engleholm Creek;

¹ References: **SWTF and we** – Stormwater Task Force, **City** – City of University City, **Council** – University City Council, **FEMA** – Federal Emergency Management Agency, **FWS** – Flood Warning System, **NWS** – National Weather Service, **RDP** – River Des Peres, **USGS** –United States Geological Survey, **Corps and USACE** – U.S. Army Corps of Engineers, **MSD** – Metropolitan Sewer District.

² City Council Resolution 2017-10

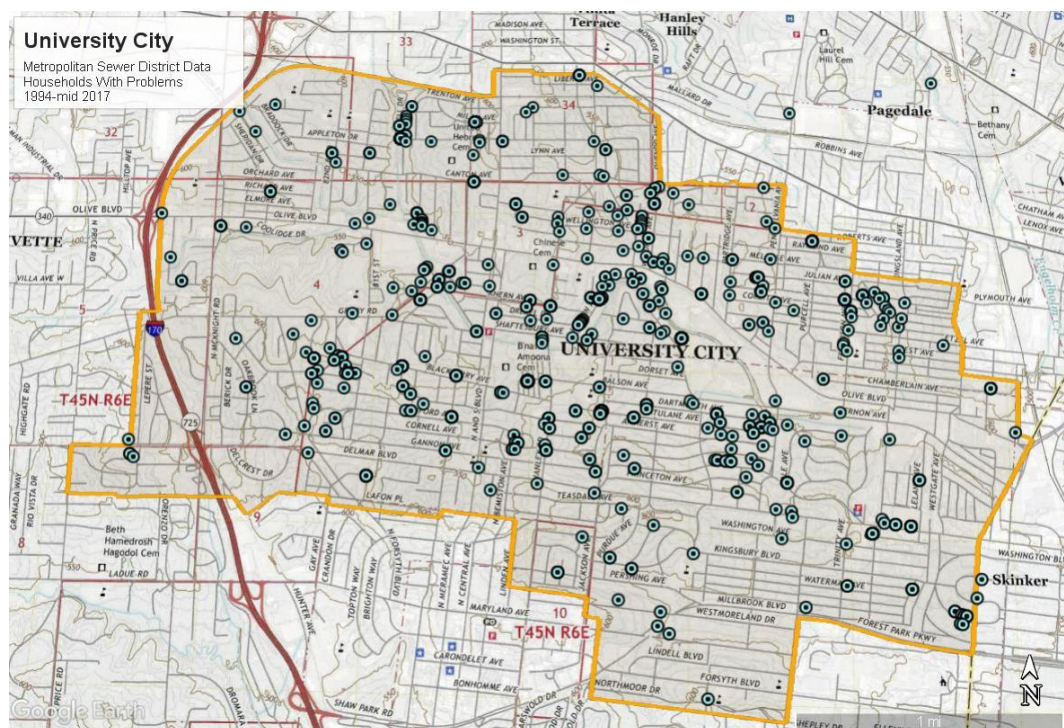
- Poor stormwater collection in streets causing street and yard ponding, yard erosion, and damage to houses;
- Expensive flood protection insurance.

We visited at least one of each type of problem.

3.1. Historical Record

3.1.1. MSD Data

The Task Force first examined a record of complaints supplied by the Metropolitan Sewer District. This data dated back to 1994 and the last entry was for May of 2017. It contained about eight hundred and seventy total reports. However, some households reported multiple incidents and when these were screened to eliminate the multiples, six hundred unique households had reported problems.



These reporting households are distributed across the city and show some areas of concentration indicating something systemic involving adjacent residences. Although this data provides some insights about the extent of water problems in the city it was noted that this data covers over twenty years and it does not provide details regarding the nature of each problem. Therefore, the taskforce desired more contemporary data with more details regarding the nature of problems at each reporting residence.

MSD has prepared eight preliminary mitigation studies as part of MSD's Operation, Maintenance, and Construction Improvement program (OMCI). Those eight sites

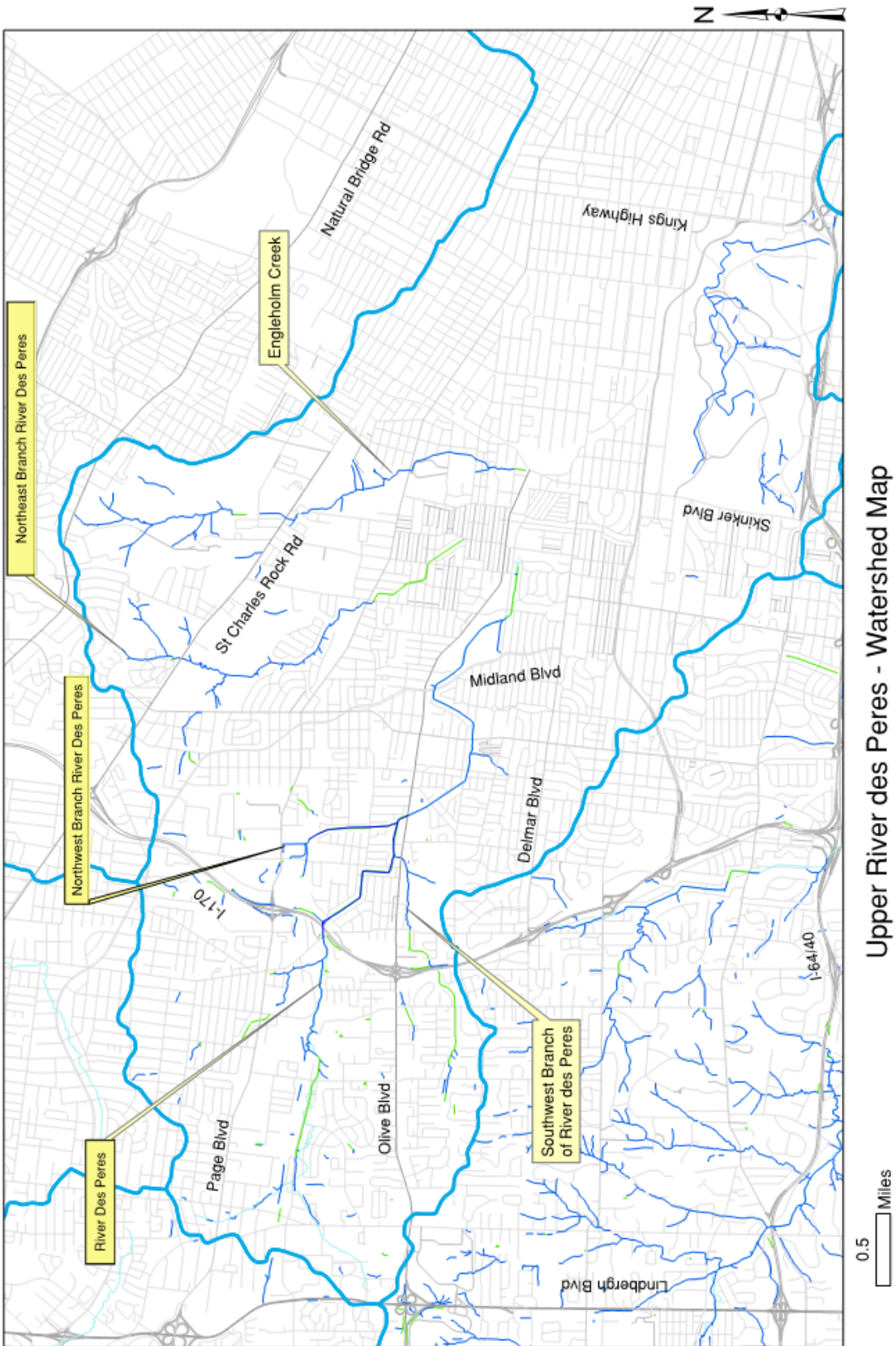
overlap with the complaint record discussed above. The eight sites are listed below:

- Fairview Avenue (yard ponding - new storm sewer);
- 7591 Amherst – Blackberry (creek bank stabilization);
- 8200 Block of Olive (creek bank stabilization);
- Pennsylvania-Kingsland (creek bank stabilization);
- Milan (yard ponding and erosion - new storm sewer);
- Jackson-Ahern (yard flooding and ponding - new storm sewer);
- Amherst (basement and street flooding - new storm sewer);
- Cornell (Yard ponding - new storm sewer).

3.1.2. Federal Emergency Management Agency

In the 1980s, the Federal Emergency Management Agency (FEMA) studied flooding in University City as part of a flood insurance program. The FEMA study identified River Des Peres and five of its tributaries as sources of significant flooding in University City. Experience over many decades both before the FEMA study and after the study has confirmed that the flooding of the six streams threaten life and property. The six FEMA-designated floodplains are described below and shown in shown in Figures 1 and 2:

- River Des Peres (RDP), 18,500 feet long, flows downstream to the southeast and east from near I-170 at Woodson Road to Vernon Avenue at the eastern City Limits. River Des Peres flows past houses, apartments, business, along Hafner Court Glenside Place, and Mona Avenue, though the campus of University City High School, along Wilson Avenue, and though Heman Park. The width of the 100-year flood plain varies from 200 to 1,700 feet
- Northwest Branch of River Des Peres, 3,400 feet long, flows downstream to the south from near Barber Jordan School to the main branch of RDP near Hafner Court behind Royal Bank. The Northwest Branch of RDP flows past homes and apartments. The width of the 100-year flood plain varies from 50 to 400 feet.
- Northeast Branch of River Des Peres, 4,500 feet long, flows downstream to the southeast from near Pennsylvania at Canton Avenues to the main branch of RDP near Kingsland and Vernon Avenues. Part of the Northeast Branch flows in a culvert. The width of the 100-year floodplain varies from 50 to 600 feet.
- Engelholm Creek, 3200 feet long in University City, flows downstream to the southeast from Plymouth Avenue to the main Branch of RDP near Vernon Avenue at the eastern city limits. The width of the 100-year floodplain varies from 600 to 1,100 feet.
- Southwest Branch of River Des Peres, 4,700 feet long, flows downstream to the east from near I-170 south of Olive Boulevard past homes, businesses, and Ruth Park to the Main Branch of RDP at 81st Street. The width of the 100-year floodplain varies from 50 to 200 feet.
- Unnamed Branch of River Des Peres, 3,200 ft long, flows east from near Gay Avenue at Tulane Court to the main branch of RDP near North & South Road at Shaftsbury Avenue. Most of the unnamed Branch runs in an underground culvert. Nevertheless, the width of the 100-year floodplain 50 to 300 feet wide.



Upper River des Peres - Watershed Map

Figure 1. River Des Peres in University City

3.1.3. US Army Corps of Engineers

The Corps of Engineers has been studying mitigation of floodplain stormwater damage since 1988 but those studies have not identified new stormwater problems.

In a 1988 study, the US Army Corps of Engineers (USACE) recommended widening and lining with rock 13,300 feet of the main channel of the River Des Peres. This type of work is generally known as channelization. Only about 3,500 feet of the widening and rock lining was completed.

More recently, since the 1988 study, other flooding mitigation methods have been evaluated – such as buying and removing low-lying houses and dedicating the land as open space (buyouts). In a 2009³ study, the USACE found that *"[s]ubstantial flooding results during and after intense rainfall events. This is the most serious stormwater problem in the watershed."*

A USACE study identified the cost-benefits for the Wilson Avenue buyout and helped the City get funding to complete that mitigation.

In 2013 through 2018, USACE has continued studying flooding along the River Des Peres in University City to establish cost-benefits for several additional floodplain buyout options.

3.1.4. Survey to identify extent of storm water problems

The taskforce developed a short survey that residents could use to report the nature and frequency of storm water problems at or near their homes. Residents could respond electronically, by mail, or by hand delivery so that residents with varying degrees of computer access could provide their input. The survey questions were modelled on similar questionnaires from other communities and from professional expertise of task force members.

Three hundred responses were received in thirteen months and is an excellent complement to the MSD data that was accumulated over twenty years. Many respondents reported no significant problems while many others that did experience problems had never previously reported a stormwater problem.

3.1.4.1. Questions

The task force had examined questionnaires used by adjacent St Louis County municipalities to address storm water issues. In addition, some members of the task force have professional experience in storm water management. Thus, we developed a survey to identify the nature of storm

³ Draft General Reevaluation and Environmental Report. Jan 2009. P1

water problems, locations where these problems occur, and determine whether the problem had been reported previously. A copy of the survey is exhibited below.

We, the **University City Storm Water Task Force**, want and need your input. Our challenge is to better understand the extent and nature of storm water drainage issues in our community. Below is a brief survey to get us started. Your input is essential to understanding where and what type of storm water issue(s) you may have. You may communicate your survey input by doing one of the following:

- Complete the survey below, fold then tape shut, add a stamp, and return via US postal mail.
- Complete the survey online by going to <https://www.surveymonkey.com/r/ucitystormwater>

Name _____ (provide name and a way to contact you)

Address _____ Email _____ Phone _____

Survey Questions

	YES	NO	Frequency (check square)		
			More than once a year	Once a year	Every few years
Do excessive puddles or standing water develop on/or near your property after storms?					
IN your yard, do flash flooding or intense high-speed gushes of water, occur after a rainstorm?					
After a storm, does your basement flood?					
Is soil washed away, causing erosion in your yard after a storm?					
Does water rise and overflow onto or nearby your property from a river or stream after a storm?					
Near your house, is the soil or ground around a creek bank washed away or eroded after a storm?					
Do excessive puddles or standing water develop in the street(s) near your property after a storm?					
Do nearby streets flood after a storm?					
If water has entered your home, please circle the best description of the circumstance: A. Leaks in the walls or floor. B. Windows or window wells. C. Doors D. Basement floor drain	A	B	C	D	
Have you ever reported storm water problems to (circle any that apply): A. Metropolitan St. Louis Sewer District (MSD) B. St. Louis County C. University City D. Your Insurance Company E. Other (specify) _____	A	B	C	D	E



3.1.4.2. *Distribution method*

Initially a link to the survey in Survey Monkey was put on University City's web page with an announcement in ROARS. Copies of the survey were also provided for people that preferred filling it out by hand.

Ninety-seven responses were received from February through early May of 2018. In mid-2018, the Task Force decided to insert the survey in ROARS which is distributed to all residences in the city to provide a more robust response. By January of 2019 a total of three hundred and twenty responses were received. These included some additional results from Survey Monkey as well as the mailed-in inserts from ROARS. A handful of addition responses came in after processing of the data began and are not included in the data summaries.

As mentioned above, the storm water survey of residents was made available both through the internet via Survey Monkey and as an insert in the University City Newsletter ROARS (Residents, Outreach, Activities, Retailers, Services) which is distributed to all residential addresses in the city. The ROARS insert had the survey on one side and a return address on the other side so that the insert could be tri-folded and stamped for return through the mail.

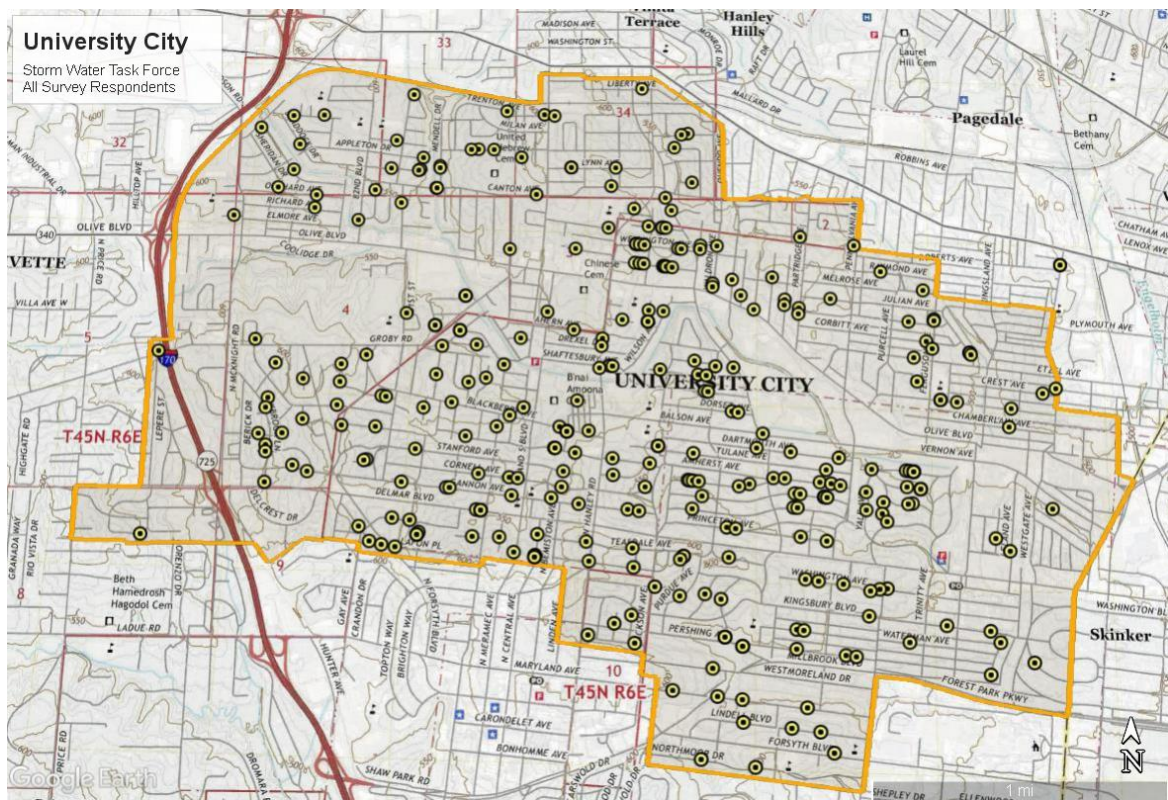
3.1.4.3. *Survey Data Results*

Survey Monkey is an on-line software that collects and summarizes survey data. Responses can also be reported into a spreadsheet for more detailed segmenting of the data. The on-line survey has the advantage of legibility, but narrative responses were more reticent. The presence of the full-page insert in ROARS reinvigorated the on-line responses also.

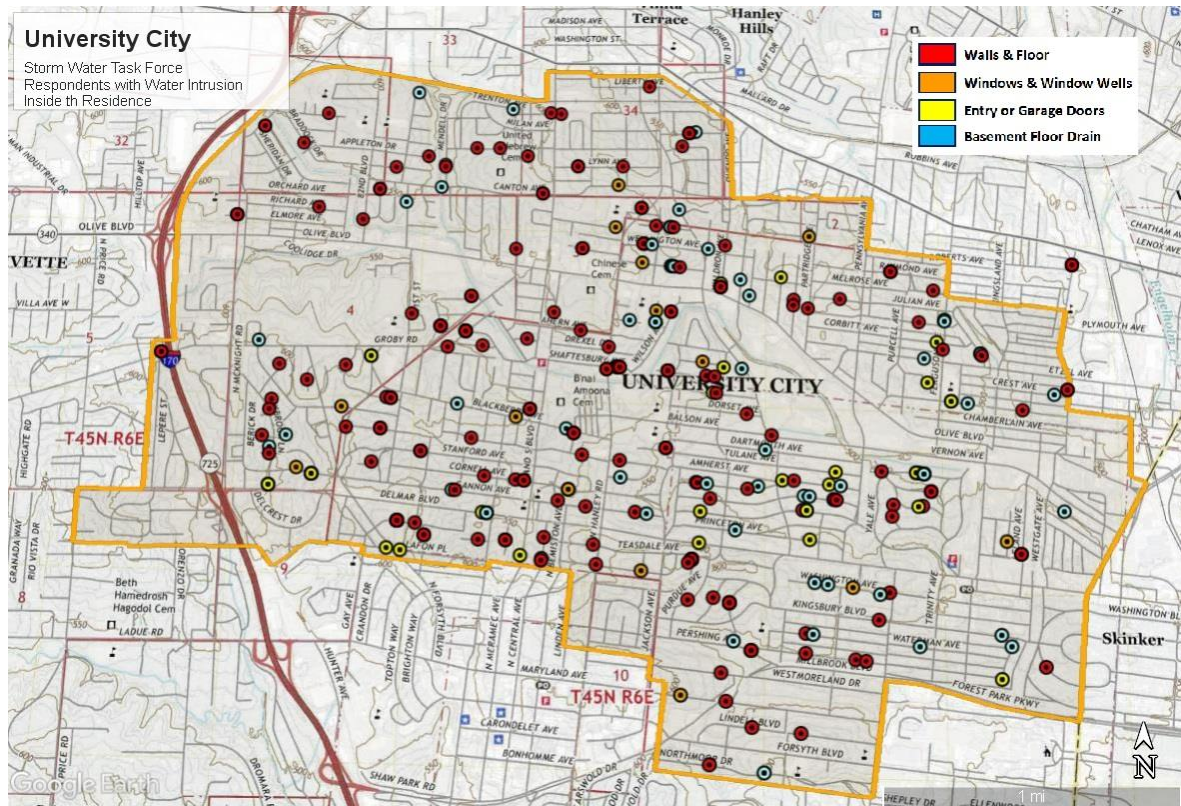
The question regarding soil erosion in respondents' yards was inadvertently omitted from the on-line survey so this phenomenon is under-reported in the data. Out of the 320 survey responses, 136 were paper. Using the rate of positive response to the missing question in the paper surveys one can infer that an additional forty-five reports of yard erosion would have been reported in the Survey Monkey.

The map below indicates the locations of respondents.

All the quantitative responses to the survey questions were mapped using Google Earth. This helped the Task Force examine the locations of positive response to specific questions. Denser groupings in a specific area might indicate an overall problem with sewers, topography or surface permeability. This helped determine candidate areas for site visits.



The location of residences that have experienced water intrusion during storms and the nature of intrusion is shown below.



3.1.4.4. Survey Responses

The following tabulations represent a summary of the responses returned from the surveys. The most observed phenomena was standing water which was reported by almost two thirds of the respondents.

Question	More than once a year	Once a year	Every few years
Do excessive puddles or standing water develop on/or near your property after storms?	182	19	12
In your yard, do flash flooding or intense high-speed gushes of water, occur after a rainstorm?	75	21	21
After a storm, does your basement flood?	88	26	38
Is soil washed away, causing erosion in your yard?	78 est.	0	0
Does water rise and overflow onto or nearby your property from a river or stream after a storm?	26	1	7
Near your house, is the soil or ground around a creek bank washed away or eroded after a storm?	19	6	2
Do excessive puddles or standing water develop in the street(s) near your property after a storm?	111	16	8
Do nearby streets flood after a storm?	75	16	31

If water has entered your home, please circle the best description of the circumstance:

Leaks in Walls or Floor	141
Windows or Window Wells	33
Doors (Entry & Garage)	39
Basement Floor Drain	82

Have you ever reported storm water problems to:

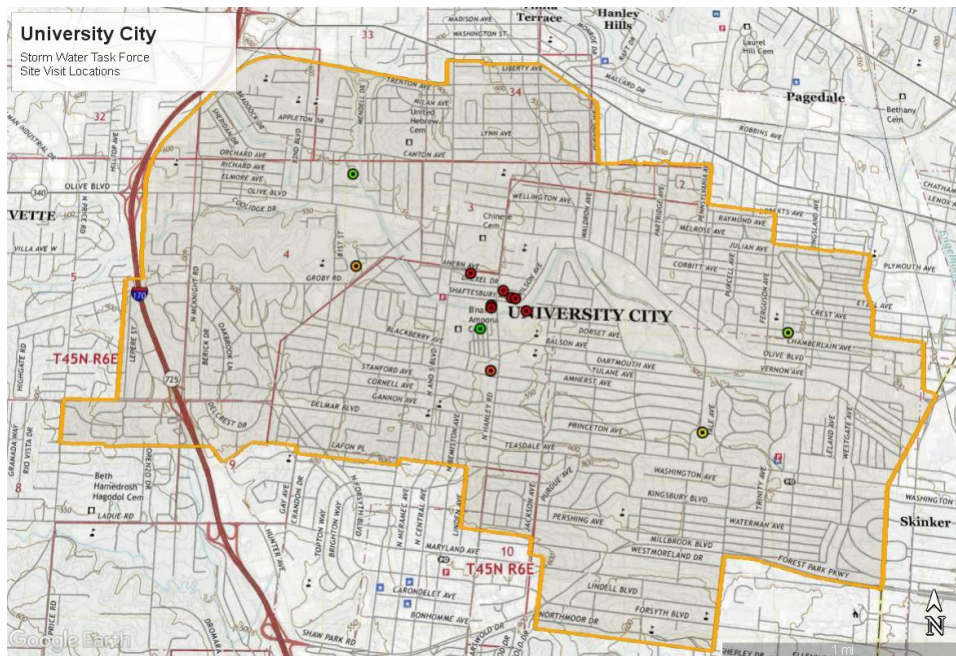
University City	61
Metropolitan St. Louis Sewer District (MSD)	95
Saint Louis County	11
Your Insurance Company	50
Other	76

3.1.5. Site visits

Members of the task force visited a wide sample of stormwater sites that were identified through the survey and in the older historical record. We visited at least one of each type of stormwater problem. The data obtained from the site visits is summarized in the following tabulation. The first column of tabulation is a list of all the currently identified stormwater problems.

A summary of our 20 site visits is listed below:

- Six sites were in a floodplain;
- Four had severe stream bank erosion problems;
- Three had basement backup problems but only one of the basement backup problems may be from high water in the public storm system;
- At least five houses had runoff problems caused by drainage from neighbors or the street.
- At least two had basement leakage through walls caused by poor drainage around the house.
- Visits to the River Des Peres and Engleholm Creeks revealed conveyance blockages.



Storm Water Category	Location	Notes
Basement flooding and bank erosion	7425 Shaftsbury	<p>Two stormwater problems occur at the subject site: basement backup and erosion on the adjacent stream bank.</p> <p>The first floor of the house lies in the 500-year floodplain. However, the basement may lie below the 100-yr floodplain of the NW Branch of RDP. The basement has flooded through the sewer lateral. MSD has not been helpful because sewer backup has not been sufficiently frequent to trigger MSD's backflow preventer installation program.</p> <p>Creek bank erosion has occurred. The resident has installed a RR tie retaining wall to protect the backyard and west side yard.</p>
Bank Erosion and Flooding	1035 N Hanley	<p>The household had not responded to the survey, but committee members were aware of flooding from anecdotal information. The house is in the RDP floodway. Significant creek bank erosion and gullyng that has progressed within five feet of the house. The foundation of the house has become severely cracked. A backflow preventer had been installed.</p>
Bank Erosion	7591 Amherst	<p>The household had not responded to the survey, but committee members were aware of bank erosion from anecdotal information. The house is in the RDP floodway. Significant creek bank erosion has progressed within ten feet of the house. The creek banks are steep. The thalweg is about 12 feet below the historic top of bank. The daughter of the longtime owner reported that when the daughter was a little girl growing up in the house, she could walk across the creek.</p>
Bank Erosion	980 Bernard College	<p>The household had not responded to the survey, but committee members were aware of creek bank flooding from anecdotal information. A resident indicated a concern with erosion on the right bank of RDP west of N Hanley near Bernard College Drive. (The site is opposite the 1035 N Hanley site.)</p> <p>The right bank is tiered and has a floodplain bench that allows high water to spill onto a 200-ft wide floodplain.</p>
Flooding and Bank Erosion	River Des Peres and Engelholm Creek	<p>Reduced conveyance and clogging of stream channels exist along the RDP and its tributaries due to lack of maintenance in the channel. Flooding can propagate far upstream from the point of flow restriction and bank erosion is exacerbated near the restriction. The photo below is an example of the flow restrictions observed. Please see the appendix for additional details.</p>



Two of the three box culverts beneath Kingsland Ave. on Engelholm Creek are severely clogged by a sand bar and overlying vegetation. Note USGS gauging station 07010035 near the bridge deck in the upper right center of the photo. Photo date Oct 20, 2019.




Low water crossing as in photo 5, taken three days later showing blocked culverts after elevated streamflow on October 26. Photo date October 28, 2019.

Basement flooding	6740 Bartmer	A new sanitary service lateral had recently been installed but water continues to enter his basement through the walls. Drainage around the house is poor roof downspouts draining through the inter-house space.
Basement Flooding	7550 Ahern	<p>The resident responded to the survey and indicted flooding. During the site visit, the resident explained that the house has two water problems: basement backups and leakage of water through the walls during extended wet weather.</p> <p>Basement backups through the floor drain were corrected one or twice a year with a drain cleaning service to remove tree roots and debris from the sewer lateral. Roof drains draining along the foundation likely exacerbate the basement foundation leakage.</p>
Basement Flooding and Flood Insurance Cost	8011 Briar Court	<p>The resident had not responded to survey but did attend one of the Task Force meetings. The residence is within the FEMA floodplain of RDP Northwest Branch. The basement was flooded in 2011 and perhaps other storms when the nearby Northwest Branch of the RDP was in flood. Water entered through basement windows.</p> <p>The homeowner has installed glass blocks in the basement windows as informal flood proofing. There is a stormwater inlet in her backyard also. Neighbors have also flooded.</p> <p>The high cost of flood insurance is of concern for this household. An elevation certificate was discussed but may not be of much value at the subject site.</p>
Flooding	1039 N Hanley	<p>A survey response indicated flooding. This house is in the floodway NW Branch of RDP. Flood water has entered her basement through her back door.</p> <p>A backflow preventer check valve had been installed.</p>
Flooding	7427 Chamberlain	<p>The household had not responded to the survey, but committee members were aware of flooding from anecdotal information. The subject house plus five neighboring houses are in the 100-year floodplain of the RDP and all have had water in basements usually through outside basement stairwells but some though first floor doorways.</p> <p>Some of the householders have installed short concrete berms around stairwells as a floodproofing or flood minimization measure.</p>
Flooding	7467 Shaftsbury	<p>The household had not responded to the survey, but committee members were aware of flooding from anecdotal information. The house lies in the 100-year floodplain. While the resident has lived in the house the last four years, water has not reached to his first-floor threshold but has flooded the front half of his front yard.</p> <p>He has a check valve in the sanitary sewer service line to prevent basement backups.</p>



Flooding	7475 Shaftsbury	<p>The subject house is in the 100-year floodplain. The survey response indicating a flooding problem. No one was home during the evening of our visit. An outside stairway and doorway give access to the basement and likely was the source of flooding into the basement. The outside stairway to the basement is typical construction in the neighborhood.</p> <p>The site is across the street from the Wilson buyout.</p>
----------	--------------------	---

Yard Flooding	7490 Drexel	A survey response indicating flooding. No one was home during the site visit. The house is much higher than the RDP floodplain, but the garage was set low on the lot and much runoff is be directed to the garage, including that from roof downspouts.
Yard Flooding	1009 Glenside Place	<p>The resident responded to survey and attended one of the Task Force meetings and described large amount of storm runoff passing through her backyard and onto the front yard. The runoff has cracked her patio and caused both erosion and sedimentation in her back yard, requiring removal of her former pool.</p> <p>The site visit revealed that the yard is part in steeply sloping terraced residential area straddling two subdivisions. Drainage is west to east across subject site. Backyard is flat but at the base of a steep 10-ft high terrace with several gullies. Runoff from the rear half of three higher yards concentrates into the subject site.</p> <p>Near the NE corner of the house, a small sink hole was visible. The sink hole is indicative a soil loss through a broken sewer lateral, downspout joint, or foundation crack.</p>
Yard flooding	7330 Chamberlain	<p>The household had not responded to the survey, but committee members were aware of yard flooding from anecdotal information.</p> <p>Drainage from rear and neighboring yards flow through subject yard causing yard ponding and water in basement.</p> <p>Recent impervious area increase (extensive addition of driveway area) of neighbor has greatly exacerbated the problem.</p>
Yard flooding	800 block of Barkley Sq. 7500 Block of Blackberry Lane Behind 829 N Hanley	<p>Only one of four or five affected households responded to the survey, but committee members were aware of yard flooding from anecdotal information. On the 2.3-acre Journey Fellowship site, a church but formerly Kol Rinah Synagogue, a large roof and parking lot of impervious area drains to the west and north onto about a half dozen residential lots.</p> <p>The original grate inlet was clogged during our visit. A double inlet had recently been installed but may not be optimally located to prevent large volumes of runoff from escaping the site.</p> <p>During our site visit, we observed that some of the overland flow may be bypassing the inlets and entering neighboring yards through damaged curbing along the north property line of the large parking lot.</p>

Street Flooding and Yard Flooding	7431 Wellington	<p>The household did respond to the survey and gave additional information to the task force during a meeting. A visit by Task Force members revealed that the 7400 block of Wellington is downhill from the 7400 block of Carleton.</p> <p>There are no inlets on the Carlton cul-du-sac and gutter flow overtops the curb and drains through the yards of Carlton and Wellington. It is likely that gutter drainage west along Carleton was cut off when N Hanley was realigned decades ago.</p>
Street Flooding and Yard Flooding	7000 Block of Delmar and 600 Block of Vassar	<p>The households on Vassar had not responded to the survey, but committee members were aware of yard flooding from anecdotal information. Information from Public Works officials and SWTF members indicate that inadequate inlets in the gutter of the 7000 block of Delmar cause gutter flow to overtop the curb and drain to the north through Lewis park.</p> <p>Drains in Lewis Park are not efficient and funnel stormwater into yards on Vassar. Drainage from residential lots along Lewis Park exacerbate the stormwater problem.</p> 



4. Neighboring Communities Data.

To gain insight into stormwater problems, solutions, and funding, a subcommittee of the Stormwater Task Force (SWTF) reviewed data from neighboring communities: Clayton, Brentwood, Ladue, Town and Country, Creve Coeur, St. Charles, St. Peters, and Metropolitan St. Louis Sewer District. Some of these communities used citizen panels to help develop plans and selection of consulting engineers.

Our urban-like neighbors, Brentwood and Clayton, were concerned with only a few problems. However, the few problems could be catastrophic. Brentwood experiences frequent out-of-bank deep flooding of Deer Creek which is similar to the flooding along River Des Peres and its tributaries in University City. Brentwood has recently embarked on a flood control project along Deer Creek south of Manchester between Brentwood Boulevard and Hanley Road. Brentwood's flood control program includes buyouts, stream realignment, and in-stream and bankside storage. The program is to be funded by Brentwood taxes, MSD funds, and Federal government grants.

Most stormwater problems are caused by community-wide development. Therefore, community-wide resources are appropriate to address the stormwater problems.

MSD addresses the few backups reported in Brentwood and Clayton.

Our suburban-setting neighbors, Ladue, Town & Country, Creve Coeur, St. Peters, report creek-related problems but few storm sewer related problems:

- Basement flooding from creek stormwater overflowing into houses.
- Erosion of creek banks.
- Erosion of yards.
- Ponding in yards.
- Ponding in streets.
- Failed detention basins.

Our suburban-setting neighbors did not report significant concern with basement backups.

Ladue, Town & Country, Creve Coeur, St. Peters, and Brentwood have stormwater plans. Each of the plans identify stormwater mitigation projects and have prioritized the projects. The plans were prepared by consulting engineers with review by community officials. Ladue and Creve Coeur have citizen stormwater advisory committees.

5. Mitigation.

Mitigation of the problems identified⁴ in University City will be site specific but fall into the following general categories:

- Public projects:
 - Re-grading of multiple yards to direct runoff away from structures and to nearby

⁴ Stormwater problems in University City: ponding in yards, ponding in streets, basement backups, erosion of creek banks, flooding of creeks, flooding of yards, erosion in yards, high cost of flood insurance.

- inlets or street gutters;
- Buy-out of homes that are frequently flooded;
- Stream bank erosion mitigation such as armor of the stream bank by rock or vegetation;
- Public early warning of flash flooding;
- Addition of storm sewers, inlets, and street gutters;
- Adjustment of sewers, inlets, and street gutters;
- Stringent city code to minimize flooding and ponding;
- Detention – large basins;
- Detention – widely distributed small basins.
- Provide educational information regarding self-help measures.
- Self-help (private)
 - Small-scale yard re-grading to direct water away from structures;
 - Re-direction of roof drains away from structures;
 - Frequent removal of root obstructions from laterals;
 - Flood-proofing of structures such as adding curbs around basement windows and doors, adding watertight windows and doors;
 - Flood insurance even for houses outside of the FEMA floodplain;
 - Elevation certificates and negotiation with insurance agents to reduce insurance premiums after self-help measures are completed.

Extensive site-specific analysis is necessary to identify appropriate mitigation for each of the scores of problems. City officials will need to develop policies to determine which problems are public (City or MSD) and which are private problems. The public versus private problem definition is fraught with political implications. The SWTF has not undertaken that policy development but could assist with it if the SWTF charge is expanded. It is likely that the public versus private definition would benefit from a series of open house discussions.

Further, City officials will have to decide what kind of assistance to provide homeowners for self-help such as list of plumbers, landscaping contractors, and foundation dewater contractors; floodproofing methods; flood insurance agents; and FEMA ombudsman.

6. Prioritization of Problems.

MSD and some of the neighboring communities use a prioritization process to assign points to each identified project. Ranking projects in an objective way is critical for both political reasons (perception of fairness) and the practical need to plan capital improvements with a budget that is insufficient to address all projects. The assignment of points is typically related to the severity of problem generally categorized into the following key factors:

- Life, Health, Property
- Structural damage & number affected
- Basement flooding
- Yard erosion
- Yard ponding
- Street ponding
- Frequency

Examples of prioritization tools are attached as an appendix.



7. Storm water Ordinances.

The Stormwater Ordinance Subcommittee reviewed current City ordinances to suggest revisions or new ordinances. The Subcommittee recognizes that:

- Based on a review of the charge of the Stormwater Task Force, the focus should be protecting property from stormwater damage from excess stormwater volume. The SWTF recognizes that water quality (i.e. pollution) is also a problem, but the City is already addressing water quality problems as part of the Municipal Separate Storm Sewer (MS4) program (land disturbance) and addressing stormwater volume also improves stormwater quality.
- Revising codes has implications that extend beyond the reach of the Stormwater Task Force, but our focus is limited to reducing damaging stormwater volume and flow rates.
- The best way to develop new ordinances is to first identify a comprehensive list of the City's stormwater problems, develop conceptual solutions for each, then write ordinances to address those problems. Development of ordinances and codes is a years-long process that should be guided by the principles listed below.
 - Municipal codes are made available by most municipalities online. The committee reviewed University City code, then reviewed the codes of neighboring communities and local regulators to identify potential ordinances that could be adapted to University City to address the range of problems identified by the survey committee.
 - Current University City codes pertaining to land disturbance are found in various sections of the municipal code. It would be useful for both municipal officials enforcing the code as well as developers attempting to design per code to consolidate this disparate information into one land disturbance section.
 - Most ordinances appear to be more useful at preventing new stormwater problems associated with future development, but there are some that can begin to rectify existing stormwater problems. Potential ordinances that could address stormwater volume problems in University City include the following.

We recommend consideration of the following ordinances provisions:

- No project, modification or grade change of any size should increase stormwater runoff on adjacent properties or cause sedimentation or erosion.
- MSD land disturbance permitting (and the associated stormwater quantity controls) addresses projects with a disturbance of 1 acre or greater. The Task Force recognizes that the potential for infill in University City is likely to fall below this threshold. For example, Town & Country reduces the permitting threshold to 2,500 square feet⁵. Because University City lots are generally smaller than Town & Country, a lower threshold (perhaps 1,000 square feet) is appropriate.

⁵ Town & Country Section 415.080 A.2.b

- The 2009 MSD Legal Impediments to Stormwater Best Management Practices Workgroup provided recommendations to reduce impervious area associated with off-street parking required by City code. Code could encourage reduced stall dimensions and efficient stall configurations like 45-degree angle parking. Phantom parking would allow a development to use fewer parking spaces than required by code, with the understanding that reserved green space would be activated (i.e. paved) if proven necessary. The City could also allow developers to provide “parking studies” to demonstrate that a reduced number of spaces is adequate.
- Increased use of detention and decrease of impervious surfaces should be encouraged:
 - Webster Groves⁶ **“If any existing impervious surface is removed during construction or development, that area shall be considered as pervious for the purpose of calculating the differential runoff from the new construction.”** For example, when constructing a new house on a lot where a house was torn down, the lot will be treated as if it had been entirely undeveloped, thereby requiring 100% of the stormwater to be addressed. The same could apply to a homeowner replacing 100 square feet of patio with a 200 square feet home addition, the differential would be based on the full 200 square feet. This is one way that an ordinance can address existing stormwater problems in addition to minimizing future problems.
 - Town & Country⁷ indicates that “Facilities for storm drainage **shall be designed and constructed so as to prevent any increase in the rate of storm runoff into the water shed over that which existed prior to development...**”
- Reduce erosion
 - Town & Country⁸ requires that “Every land development or subdivision **shall make adequate provisions to accommodate or dispose of stormwater and prevent damage to off-site streets and downslope of adjacent properties** due to soil erosion or siltation by means of sodding, erecting silt barriers, **detention storage areas**, sewers, catch basins, culverts, terracing, walls and other facilities or combination of similar methods per the requirements of this Article....” This language provides City staff with the flexibility to require detention and/or rain gardens for infill development.
 - Town & Country⁹ requires that “**Water shall not be directed through a pipe, culvert, hose, spout or drain which discharges within ten (10) feet of an abutting property line.**” This statement is a good bare minimum that is not currently in the U City ordinances. Roof drains can carry a lot of water and discharge even as far as 10 feet from a property line can cause problems to neighbors. However, this statement would be useful when taken together with U City section 405.49 C.6, and a lower threshold on projects that require a land disturbance permit.

⁶ Webster Groves Code Chapter 82.100.

⁷ Town & Country Code Section 415.100 A

⁸ Town & Country Code Section 415.100 C

⁹ Town & Country Code Section 415.100 J

- Town & Country¹⁰ requires “Provision of a system which mitigates one hundred fifty percent (150%) of the flow rate increase identified in Section 415.105(A)(2) above **by storing a volume equal to one hundred fifty percent (150%) of the calculated volume for the fifteen-year, twenty-minute design storm. This shall then be designed with a release mechanism which allows for dissipation over a twelve-hour-to-thirty-six-hour period using small orifice structures** or Metropolitan St. Louis Sewer District-approved volume reduction best management practices.” This ordinance attempts to address existing stormwater problems in addition to minimizing future problems.

8. Early Warning

A comprehensive initial report from the FWS¹¹ subcommittee was submitted on April 3, 2018 that reported preliminary studies on RDP flooding, surveyed principles, components and issues underlying a warning system, and made preliminary recommendations. Much of that report is still relevant and available, with the information in parts A through D, F and G remaining largely unchanged, while significant updates to part E will be reflected in this report.

The Corps of Engineers¹² also recommended that a flood warning system be established for the River Des Peres watershed.

8.1. U. City RDP Watershed

The portion of the RDP that flows through the city drains storm water from a watershed (basin) that is roughly bordered by a line along Lackland Rd. in Overland on the north, a line meandering between Lindbergh and Ashby/Warson Rd. on the west, along Old Bonhomme Rd. dipping into Clayton on the southwest side, then eastward along Delmar to Skinker. From there, it is bounded on the east by a line extending northward to a point near UMSL. This represents an area of approximately 9 square miles.

8.2. USGS Gauge at Heman Park

The USGS gauge in Heman Park (#07010022, AKA “gauge 22”) has been in place since 1997 and measures both gauge height (stage) and stream flow (discharge). Gauge height is the level of water in the channel in feet relative to a selected zero point and stream flow is the rate of flow in units of cubic feet per second (cfs). Flood stage for this location is defined by the NWS as a gauge height of 14 feet, which corresponds to about 3250 cfs streamflow. Readings are taken and recorded every 5 minutes and periodically telemetered to satellite. Current (to last hour) and historical records are available from a USGS online site.

¹⁰ Town & Country Code Section 415.105 A.3.

¹¹ Acronyms: **FWS** – Flood Warning System, **NWS** – National Weather Service, **RDP** – River Des Peres, **USGS** –United States Geological Survey, **USACE** – U.S. Army Corps of Engineers, **MSD** – Metropolitan Sewer District

¹² Draft General Reevaluation and Environmental Report, Jan 2009.

Gauge data indicates that at least one flood has occurred annually in 14 of the last 22 years, with multiple floods in some years. Six floods with gauge height readings of over 16 feet have occurred and these floods usually caused significant damage in flood-prone neighborhoods such as Wilson Ave, Mona Drive, Hafner Ct., near the Groby Rd. bridge, etc. The worst, on 9/14/2008, produced a gauge reading of 17.4 feet. It caused the loss of two lives on Wilson Avenue and damage sufficient to classify us as part of a disaster area.

8.3. Conclusions from Preliminary Study

Early on, the FWS subcommittee compared data from gauge 22 with NWS rainfall records at Lambert Field for the six worst floods over the last 21 years. This resulted in some important conclusions:

- While the USGS gauge is crucial for analyzing stream behavior, it is of no use as a flash flood warning input because the river rises too rapidly during a flash flood.
- Rainfall as measured at Lambert is not a reliable predictor of our RDP flooding (because heavy rains in this area are often highly localized).
- Taken together, these conclusions lead to a third, which is that rain measurements in the watershed, both historical and current, are required for any flood warning system.

8.4. Progress on Rain Gauges and Flood Prediction

Following these conclusions, we searched for other rain gauges that might be in existence and discovered that MSD operates six gauges in or near our watershed in order to collect engineering data for Project Clear studies. MSD graciously honored our request for access to online data from these gauges. This put at our disposal years of rain gauge readings recorded every 5 minutes to accompany years of USGS stream gauge readings, also recorded at five-minute intervals. This allowed the studies necessary to see if our floods can be reliably predicted by rainfall measurements, which is a prerequisite for developing a warning system.

An extensive study on this data spanning 2008-2018 was completed in May by subcommittee member Bob Criss¹³. Further studies are ongoing. The results show a statistical correlation between rainfall measurements and USGS gauge levels that is significant enough to serve as the basis of a warning system.

In preliminary tests on two recent flood events (May 29 & July 22) the Criss protocol predicted peak stage within 5% and 3% of actual, respectively, and did so with 50 and 35 minutes lead time. A historical study performed by Dr. Criss on other major rainfall events from 2008-2014 shows that around 7% and 50 min to be typical.

Dr. Criss is currently evaluating variations of this protocol. He also believes that even better prediction algorithms may eventually be possible based on mathematical modeling

¹³ Dr. Criss is Emeritus Professor of Earth and Planetary Science at Washington University.

of stream response to rainfall, as opposed to this empirical statistical approach, but this is in the future. Meanwhile, based on the results at hand, we conclude that there is basis for continuing with the development of a warning system.

8.5. Components of a FWS

The main components of a warning system are river and rainfall gauges (the latter possibly augmented by weather radar), a communications system to transmit gauge readings to a control center, a control center with equipment to receive the transmissions plus a computer equipped with software to store, process and display the data, issue reports, run forecasts, and in the case of a fully automated system, disseminate information and warnings. Coupled with this is a plan for dissemination of warnings and required responses. Fortunately, the most difficult to obtain assets are already in place: the stream and rainfall instruments and the historical data described above.

8.6. Acquisition of FWS Components

For a flash flood warning system, rain gauge data must be acquired in almost real-time (updated every 5 minutes) because flash floods develop so quickly that predictions must be updated often. We were initially hopeful that we could use the MSD rain gauges to get such measurements, but their system was not designed for real-time applications and even if it were, getting data from an intermediary's site instead of directly from the instruments complicates matters.

We have thus obtained a quote for the equipment necessary to establish our own three-gauge network, using the same vendor and equipment as MSD. Advances in electronic technology make this surprisingly affordable. The cost of a three-gauge system, consisting of NWS-specification 8-inch tipping-bucket rain gauges, lithium battery-powered data recorders that transmit data via cell phone links to the FWS computer, annual cell service, and software for displaying and analyzing the data would cost approximately \$11,000. Thus, everything before the FWS computer is an integrated system and close to being turn-key.

On-site training is available for an additional fee. Installation of the gauges themselves does not require specialized labor and no power or data wiring is required at the gauge sites, but we would have to arrange for suitable sites, two of which might be outside of U. City (Overland / Olivette). Perhaps those cities could assist in obtaining suitable sites. Additional costs would be the FWS server and obtaining computer support for configuring it, downloading data and implementing the prediction algorithms.

8.7. New Information Regarding Flooding in Our Watershed

On August 2019, Dr. Criss identified that inter-basin transfer of runoff from another watershed into ours may be occurring, possibly adding runoff equivalent to another 3 square miles. Such transfer can occur, for instance, when a spring gathers runoff from one basin and carries it underground to an outlet in another. Or a storm water system

can have an inlet in one basin and its outflow in another. To investigate this, we need detailed engineering information regarding public infrastructure. We may need help from the Public Works Department to obtain them.

Additionally, we observed debris from the July 22 flood hanging from the I-Beams under the Pennsylvania Bridge over the RDP near Vernon, suggesting that the bridge was impeding flow. Gauge 22 data shows that on the more serious floods, the channel flow rate stalls for a prolonged time around the peak flow point, suggesting that at some point downstream, something is backing up flow during larger floods. While this could occur if the tunnel reaches capacity, we believe the cross-sectional area under the bridge should be investigated.

Investigations of conveyance restrictions are currently hindered by the paucity of City-maintained records of basic relevant flood information and reports, such as bridge surveys, high water marks, facilities maps, and USACE channel cross-section data. This needs to be corrected.

8.8. Future Work for Flood Warning System

NWS, USGS and USACE all offer FWS development services. But as the city has seen with the USACE, and as Dr. Criss has observed from working with the USGS/NWS, these agencies charge significant amounts of money for their efforts. News reports indicate that the City of DeSoto and Jefferson County will spend at least \$53,000 through 2020 for a USGS-based FWS at Joachim Creek, with ongoing costs afterward. We believe that a decision on whether to develop a warning system hinges on a cost-benefit analysis and we suspect the costs of using these agencies would not justify the benefits.

Coincidentally, just as this report was being written, we were contacted by the USGS (on August 5), suggesting that they might be able to develop an FWS for U. City and sending descriptions of systems they have designed for other sites in Missouri, including the one at Joachim Creek. Nevertheless, we recommend that a self-developed system would be best and that the city, assisted by this subcommittee, proceed with the development of our own prototype system. If the city wishes to do so, we recommend proceeding as follows:

- Research / select suitable gauge locations and make necessary arrangements. One or two will be west of U. City. Solicit location help from Olivette and Overland if needed.
- Purchase and install the system described in 8.6 above.
- Hire IT consultant (scientific programmer) to assist with configuring the FWS server, automated real-time downloading of gauge data, and implementation of the preliminary prediction protocol described above.
- Involve the fire department in the development of the system. Consider placing the FWS computer at the department. If the system as described were in place and using only the prediction protocol developed so far, emergency responders would have significantly better information at hand regarding possible flooding than they do now.
- Continue to develop, test and refine prediction algorithms.

- Gather and study the information described above regarding inter-basin transfer.
- During development, confine FWS predictions to city staff, first responders and task force members; no public warnings issued.
- Explore how warnings will be disseminated to the public when we get to that stage. We envision nothing as dramatic as blowing sirens; we have noted the use of some type of text alert in other warning systems and should research those further. Also consider dispatching first responders to known, flood-prone trouble spots to observe and stand ready.
- Starting with the next flood (or perhaps retroactive to this year's May 29 flood), city staff or first responders should begin collecting information about water depth and damage in the flood-prone neighborhoods so this can be correlated with gauge 22 readings. Flood warnings will be based on predicted levels at gauge 22, so residents of these neighborhoods need to know what that means to them. With a proper database, that information can be included in the warning.
- Ask the city's attorney about any legal concerns associated with a warning system, such as liability for false positive or negatives. Clear phrasing of a warning that acknowledges it is a probability-based forecast may minimize such concerns.

If the city elects to proceed, further reports from this subcommittee will be forthcoming when appropriate.

9. Cost and Funding.

9.1. Costs

A subcommittee was established to estimate the magnitude of costs for the University City stormwater program and to identify potential funding options.

At present, there is good cost estimate information available for floodplain buyouts (Corps of Engineers (USACE) report titled "River Des Peres – University City 2013 Economic Update"), but limited information for the remaining stormwater problems.

The USACE report provided cost estimates for floodplain buyouts. The report identified a cost of \$19.5 M for a buyout of 97 structures within the 5-year floodplain for buyout, which includes the assessed value, demolition, moving expenses and replacement housing costs. This does not include those 26 homes that had already been bought out along Wilson Blvd in 2011.

Total Construction Cost	
River Des Peres	5 Year Buyout
Total Project	\$19,403,100
Vernon to Kingsland	\$0
Midland to Vernon	\$221,600
Hanley to Midland	\$4,451,700
Olive to Hanley	\$11,123,600
82nd to Olive	\$3,606,200
I-170 to 82nd	\$0
October 2013 Price Levels	

Data from the Sources and Problem Identification and Neighboring Communities committees show that the range of stormwater problems in University City are similar to those of nearby municipalities. Extrapolating cost based on the University City population of 35,000 and a land area of 5.9 square miles, the stormwater program other than buyouts would cost between \$40 and \$190 million, say \$115 million.

	Ladue	Town & Country	Saint Peters	Average
Number of projects	57	38	100	
Total cost of stormwater program	\$114,000,000	\$8,300,000	\$125,000,000	
Population	8576	10975	56076	
Square mileage of city limits	8.59	11.9	21.2	
Cost per capita	\$13,293	\$756	\$2,229	\$5,426
Cost per square mile	\$13,271,246	\$697,479	\$5,896,226	\$6,621,650

For initial planning, a total City stormwater program budget should be \$ 40 million (\$19.5 M for flood buyouts and \$20.5 M for capital projects).

9.2. Funding

Potential funding sources were researched by speaking with municipal officials, area experts, and conducting internet research.

Seven options are realistic and, therefore, are higher priority funding options. However, an additional seven funding sources are also discussed below. The list is not exhaustive and will continue to evolve.

- University City Parks and Stormwater Tax – The City currently collects approximately \$1.2 million per year. Some of this money services debt on existing facilities, like Centennial Commons. This money is not necessarily split 50/50 each year between parks and stormwater, because projects and priorities shift from year to year. The City could consider increasing the portion of this tax allocated to stormwater in the future.
- FEMA Grants - FEMA awards flood mitigation grants annually that could support the City's floodplain buyout program. The grants are competitive and the need for the

money is nationwide. The program requires a City funding match. The City has been awarded grants in the past, but it is expected that this money will be tied up for some time with recent major natural disasters that occurred nationwide. We understand that the proposed City budget (as of June 4, 2019) contained \$750,000 for the City's share of floodplain buyouts.

- FEMA Community Rating System (CRS) - The CRS program is a voluntary incentive program that recognizes and encourages community floodplain management activities that improve safety and lower flood risk. It uses a Class rating system that is similar to fire insurance rating to determine flood insurance premium reductions for residents. Entry level communities gain a 5% reduction on flood insurance premiums for their residents, with each class gaining an additional 5%. Activities our City has already taken (i.e, Wilson Ave buyouts), are retroactively eligible to help raise our class. <https://www.fema.gov/national-flood-insurance-program-community-rating-system>
- Missouri State Emergency Management Agency (SEMA) grants – SEMA's Mitigation Management Section offers grants (non-disaster and post-disaster) to local communities for projects to break the cycle of damage, reconstruction, and repeated damage. Examples of applicable mitigation projects include flood buyouts; replacing community-owned culverts and low water crossings; and stabilizing stream banks. https://sema.dps.mo.gov/programs/mitigation_management.php
- MSD Stormwater Funding - MSD currently collects \$30 million per year for stormwater projects, and that money is used to fund a list of over 500 stormwater projects throughout the MSD service area, which have a total cost of \$550 million. New projects are being added each year. Only a small handful of these projects are in University City, and at the current (negligible) funding rate it will take decades to complete that list. Voters rejected in 2019 a proposal by MSD to institute a dedicated fee to increase the speed with which these projects are completed. The City could consider supporting future efforts by MSD to institute a dedicated stormwater fee.
- MSD OMCI (Operations, Maintenance, and Construction Improvement) funds are an option that should be considered. Most of University City is in an MSD OMCI taxing district. The tax rate was set to zero in 2017 by public vote to equalize MSD rates. However, the tax can be re-established. MSD officials believe that the tax can be reestablished without a public vote in an OMCI district. In the past, the University City OMCI district accumulated several hundred thousand dollars per year. The SWTF understands that MSD is using the balance of the University City OMCI funds to support the USACE study. MSD presented to council (September 2019) their plan to re-establish the taxes with an option that would allow the City to administer half of the funding generated from these taxes to fund the City's priority stormwater issues.
- MSD Rainscaping Large Scale Grants Program - MSD's Project Clear includes \$100 million in rainscaping investments, and this program was recently extended to include portions of University City. While these grants have yet to fund a municipally-led project, we understand that City staff are working with MSD to understand the types of projects that might apply for this grant. <https://www.stlmsd.com/what-we-do/stormwater-management/rainscaping-large-scale-grants-program>

- The following are the remaining seven lower priority potential funding sources
 - Missouri State Revolving Funds could be explored for stormwater / flood control basins
 - Neighborhood Improvement District (NID) would be a citizen-led option for smaller projects.
 - Community Improvement District (CID) would be a citizen-led option for larger projects.
 - Block Grants appear to be appropriate for projects on the same scale as CIDs but must be used in middle to low income neighborhoods.
 - TIGER Grants are on the order of millions of dollars, and University City would be required to provide a match. TIGER grants fund transportation projects (i.e. renovation of the Olive Blvd corridor) and could be used to address stormwater issues within the footprint of that project.
 - Section 319 Nonpoint Source Grants are water quality focused rather than the stormwater volume but may help with some of the problems.
- It is not clear who has the responsibility to mitigate the stormwater problems. For example, debris accumulates under some bridges owned by the State of Missouri or St. Louis County. However, those agencies are underfunded and are slow to recognize and act on problems. Many neighboring communities undertake at least some maintenance near State or County bridges. City officials must determine which public projects are the responsibility of University City and which public projects are the responsibility of other agencies such as MSD, MoDOT, or St. Louis County Highway and Transportation Department.

10. Conclusions

1. *Types of Problems.* There are six types of stormwater problems in University City:
 - a. *Stormwater runoff between yards* causes ponding, flooding, erosion of yards and parks, and damage to houses;
 - b. *Basement flooding*;
 - c. *Flooding from the River Des Peres and Engleholm Creek* that damages houses and yards and endangers public safety;
 - d. *Erosion of the banks* of River Des Peres and Engleholm Creek;
 - e. *Poor stormwater collection* in streets causing street and yard ponding, yard erosion, and damage to houses;
 - f. *Expensive flood protection insurance.*
2. *Number of Problems.* Although the Stormwater Task Force identified over 350 stormwater complaints through anecdotal reports, survey responses, and MSD stormwater-related complaints, the actual number of stormwater problems in University City is likely much smaller because the identified complaints overlap.
3. *Public and Private Problems.* The six types of stormwater problems can be classified as public or private problems. Public problems require the City and other government agencies to mitigate. Some public problems may affect only one property but are caused by poor public infrastructure. Private problems can be mitigated by a single property owner.

4. *Mitigation of the problems* is very site specific and will involve at least one of the techniques listed below:
 - a. Public projects:
 - 1) Re-grading of multiple yards to direct runoff away from structures and to nearby inlets or street gutters;
 - 2) Buy-out of homes that are frequently flooded;
 - 3) Stream bank erosion mitigation such as armor of the stream bank by rock or vegetation;
 - 4) Public early warning of flash flooding;
 - 5) Addition of storm sewers, inlets, and street gutters;
 - 6) Adjustment of sewers, inlets, and street gutters;
 - 7) Stringent City code to minimize flooding and ponding;
 - 8) Detention – large basins;
 - 9) Detention – widely distributed small basins.
 - 10) Provide educational information regarding floodplains and self-help measures to minimize flood damage to homes.
 - 11) Participate in FEMA Community Rating System (CRS).
 - 12) Begin stream cleaning and maintenance to minimize flow restrictions.
 - b. Private self-help projects:
 - 1) Small-scale yard re-grading to direct water away from structures;
 - 2) Re-direction of roof drains away from structures;
 - 3) Frequent removal of root obstructions from laterals;
 - 4) Flood-proofing of structures such as adding curbs around basement windows and doors, adding watertight windows and doors;
 - 5) Flood insurance even for houses outside of the FEMA floodplain;
 - 6) Elevation certificates and negotiation with insurance agents to reduce insurance premiums after self-help measures are completed.
5. *Funding for Mitigation* will require more resources than are now available to the City. A combination of grants, federal assistance, and local generated tax funds will be necessary. City officials must determine which public projects are the responsibility of University City and which public projects are the responsibility of other agencies such as MSD, MoDOT, or St. Louis County Highway and Transportation Department.
6. *A flash flood warning system* is feasible to warn residents living in the floodplain. Significant assets for the development of a system are already in place, as described in Section 8.
7. Significant problems with reduced conveyance and clogging of stream channels exists along the River Des Peres and its tributaries due to lack of maintenance in the channel. Problems can propagate far from the point of clogging or flow restriction.

11. Recommendations

1. The Stormwater Task Force recommends that an engineering consultant should be engaged to complete the tasks listed below:
 - a. Each complaint should be studied and consolidated into unique projects that can be mitigated.
 - b. Each project should be classified as public or private.
 - c. Each public project should be prioritized by an objective method and that prioritization list should be the basis for selecting capital improvement projects.
 - d. The prioritization method should be developed by the engineering consultant working closely with City officials. City officials must approve the prioritization method. The prioritization method used by Metropolitan St. Louis Sewer District should be the basis for the prioritization method
2. The Stormwater Task Force recommends the City discuss with MSD re-establishing the Operation, Maintenance, Construction Improvement tax (OMCI) and other operation and maintenance taxes to accumulated funds for stormwater projects in University City.
3. The Stormwater Task Force recommends that cooperation with the US Army Corps of Engineers continue for establishing the benefits and costs of buyouts of property in the FEMA floodplains and that the City pursue FEMA buyout grants.
4. The Storm Water Task Force recommends that the city proceed with development of the flash flood warning system described in section 8 as soon as possible – even before adoption of the other recommendations.
5. The Stormwater Task Force recommends that the city acquire and maintain a library of relevant floodplain and flood warning information as described in 8.7 and 8.8.
6. The Stormwater Task Force recommends the city provide educational information regarding living near floodplains and self-help home protection measures that can be undertaken by homeowners.
7. The Stormwater Task Force recommends establishing a method to collect and file ongoing stormwater complaints.
8. The Stormwater Task Force recommends that City staff investigate the feasibility of participating in FEMA's Community Rating System to help reduce residents' flood insurance premiums.
9. The Stormwater Task Force recommends implementation of the following key ordinances at a minimum:
 - a. No project, modification or grade change of any size should increase stormwater runoff on adjacent properties or cause sedimentation or erosion.
 - b. Require MSD land disturbance permitting (and the associated stormwater quantity controls) for a lower threshold project size (i.e. 1000 square feet versus MSD's threshold of 1 acre).



10. City officials must determine which public projects are the responsibility of University City and which are the responsibility of other agencies such as MSD, MoDOT, or St. Louis County Highway and Transportation Department.
11. Consider improving channel conveyance in the River Des Peres and its tributaries and identify the agencies responsible for channel maintenance.

C:\Users\garon\Dropbox\UCity Stormwater Taskforce\ReportsToCity\2019_Nov_UC_SWTF_REPORT.docx