

## CHAPTER 5: ELEMENT C. - MANAGEMENT MEASURES

### 5.1 GOALS FOR DEER CREEK WATERSHED

Watershed goals are listed below. Permitted activities will be addressed by the appropriate regulatory authority.

#### A. Maintain and improve water quality and quantity in watershed related to a one-year storm event or less.

1. Capture the first 1.14 inch of stormwater runoff in rainscaping projects to reduce E. coli and nutrient loads in streams.
  - a. Define Green Infrastructure Management Methods
  - b. Engage residential, municipal and commercial audiences in stormwater management.
2. Reduce additional identified pollutant inputs.
  - a. Reach EPA standard for chloride levels in Deer Creek by 2050
  - b. At least 5000 pounds of trash, microplastics, leaf litter, and/or organic debris removed or prevented from entering Deer Creek annually.
  - c. Reduce pet waste through education.
  - d. Illicit discharge detection and elimination (see MSD Phase II NPDES)
  - e. Eliminate 100% of combined sewer overflows by 2030, 85% of sanitary sewer overflows by 2023 and 100% of sanitary sewer overflows by 2033 to reduce E.coli and nutrient loads in streams (MSD)

#### B. Reduce the risk of stream bank erosion, sedimentation, and flooding from a one year or greater storm event.

1. Maintain and improve the natural stream physical stability and reduce stream widening and bank erosion.
  - a. Capture first 2.5 inches of stormwater runoff to improve channel stability and function.
  - b. Assess, implement, and maintain detention systems to manage channel protection.
2. At least 4 linear miles of riparian corridor permanently removed from development and appropriately landscaped to reduce impacts on erosion, sedimentation and creek widening by 2030.
  - a. Support greenway/trail development along riparian corridors.
  - b. Promote invasive species removal and native plant establishment.
  - c. Identify willing landowners for voluntary purchase/sale and permanent removal from development.
  - d. Enhance existing wetlands using a “wetland arboretum” approach, with minimal soil disturbance.
3. Protect groundwater supplies in sensitive karst areas
  - a. Prevent sinkhole contamination
  - b. Prevent groundwater contamination

#### C. Finalize EPA accepted watershed plan updates in 2022 and in 2027.

1. Expand and improve watershed modeling efforts.
2. Continue and refine watershed monitoring efforts.
3. Continue ongoing planning efforts.

Following is a list of management measures objectives, as associated with each goal outlined above.

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## A1 CAPTURE THE FIRST 1.14 INCHES OF RAINFALL IN RAINSCAPING PROJECTS TO REDUCE E.COLI AND NUTRIENTS IN STREAMS

### a. Define Green infrastructure Best Management Practices (BMPs)

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- 1) Green infrastructure systems are defined as strategies to manage stormwater runoff at the local level through the use of natural systems, or engineered systems that mimic natural systems, to treat polluted runoff.
- 2) Identified Best Management Practices in the Deer Creek Watershed include: Raingardens, bioswales, and bioretention; soil amendments and mulching; stormwater harvesting; lawn alternatives, i.e. replacing lawn grass with deep rooted plants; urban tree protection, tree planting, and urban forest management strategies; Rock weirs & filter socks; porous pavement, and green roofs. See [mobot.org/rainscaping](http://mobot.org/rainscaping) for a detailed description of these best management practices. See Appendix 5A for a white paper assessment of the effectiveness of these identified BMP's.

### b. Engage residential, municipal and commercial audiences in stormwater management

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- 1) Engage residential property owners in managing stormwater. (71% of land is privately owned)
  - a. Provide financial incentives for voluntary participation in stormwater management through a rainscaping cost-share program.
  - b. Provide technical support for best management practices through online resources, social media, workshops and webinars.
  - c. Support annual citizen engagement projects in the watershed.
  - d. Involve citizens in local parks maintenance, including tree inventory, tree maintenance, and/or tree planting efforts with emphasis on native trees.
  - e. Encourage downspout disconnections where appropriate. Provide incentives to reroute increased overland flow to rainscaping features.
- 2) Support municipalities to implement stormwater management measures
  - a. Support the development of and implementation of stormwater master plans in each municipality.
  - b. Support the development of municipal planning and zoning efforts that may include a combination of incentives, ordinances, removal of barriers and/or case study implementation.
  - c. Identify and share model ordinances that impact water quality and stormwater quantity, including local and model urban forest management programs.
  - d. Support communities in addressing land disturbance of less than one acre to reduce erosion, and/or contain stormwater.
  - e. Assist municipalities in managing parks and existing public lands for stormwater management.
- 3) Develop strategies to assist commercial entities to engage as responsible watershed stakeholders.
  - a. Target landscaping companies and horticultural industry to receive education on rain gardens and bio-retention systems. Develop a long term rain garden maintenance

- strategy that includes training for landscapers, education for installers, and provide technical assistance.
- b. Encourage retail to stock/sell LID products; rain barrels & attachments, rain garden kits/instructions, rain garden plants, soil amendments, etc.
- c. Identify invasive plants as undesirable and discourage nurseries from stocking; encourage nursery stocking of native plants.
- d. Encourage use of pervious pavement and bioretention in parking lots.

**A2 REDUCE ADDITIONAL IDENTIFIED POLLUTANT INPUTS**

**a. Reach EPA Standard for Chloride Levels in Deer Creek by 2050**

Following is a chart of recommended chloride pollution reduction strategies. For detailed links and resources, see Appendix 4-A.

<b>Chloride Pollution Prevention BMP's</b>
<p><u><b>A. Training/Certification Programs</b></u></p> <ol style="list-style-type: none"> <li>1. Train Municipal Staff</li> <li>2. Train Private Contractors</li> <li>3. Train Property Managers</li> <li>4. Model contracts for private operators</li> </ol>
<p><u><b>B. Legislation/Ordinances</b></u></p> <ol style="list-style-type: none"> <li>1. Laws to protect operators, property owners, and managers hiring certified applicators from liability</li> <li>2. Identify a Code of Practice for the environmental management of road salt</li> <li>3. Model local ordinances                             <ol style="list-style-type: none"> <li>a. Occupational Licensure for Winter Maintenance Professionals</li> <li>b. Deicer Bulk Storage Facility Regulations</li> <li>c. Land Disturbance Activities</li> <li>d. Parking Lot, Sidewalk and Private Road Sweeping Requirements.</li> </ol> </li> </ol>
<p><u><b>C. De-icing with reduced amounts of rock salt</b></u></p> <ol style="list-style-type: none"> <li>1. Understand how much is needed, and adjust based on weather &amp; site conditions</li> <li>2. Document and track how much salt is being used.</li> </ol>
<p><u><b>D. Upgrade winter maintenance equipment</b></u></p> <ol style="list-style-type: none"> <li>1. Purchase newer snowplows with electronic controllers &amp; sensors regulating the amount of salt spread</li> <li>2. Calibrate equipment</li> </ol>

<b>Chloride Pollution Prevention BMP's (cont.)</b>
<p><u><b>E. Use brine/pre-wetting/anti-icing strategies</b></u></p> <ol style="list-style-type: none"> <li>1. Purchase anti-icing equipment</li> </ol>
<p><u><b>F. Test alternative deicers</b></u></p>
<p><u><b>G. Develop municipal salt management plans</b></u></p> <ol style="list-style-type: none"> <li>1. Review existing road maintenance operations</li> <li>2. Inventory salt supplies</li> <li>3. Identify salt vulnerable areas</li> <li>4. Set goals to achieve salt reductions</li> <li>5. Plan for winter conditions</li> <li>6. Adopt weather forecasting and Road Weather Information Systems.</li> <li>7. Use Maintenance Decision Support Systems software (MDSS), to help optimize snowplow routes</li> <li>8. Learn and follow appropriate application rates</li> </ol>
<p><u><b>H. Road design</b></u></p> <ol style="list-style-type: none"> <li>1. Vegetation or snow fences to prevent snow from coming onto the road</li> <li>2. Permeable pavers reduce salt needed by preventing ice formation.</li> </ol>
<p><u><b>I. Change Salt storage practices</b></u></p> <ol style="list-style-type: none"> <li>1. Under permanent roofs on impermeable pads</li> <li>2. Capture and reuse salt-laden stormwater runoff for brine production</li> </ol>
<p><u><b>J. Educate private citizens</b></u></p> <ol style="list-style-type: none"> <li>1. Sidewalk/driveway salt reduction &amp; alternatives</li> </ol>
<p><u><b>K. Set up revolving loan program</b></u></p>

- b. At least 5000 pounds of trash, microplastics, leaf litter, and/or organic debris removed or prevented from entering Deer Creek annually.

- 1) Identify and prioritize parcels in the watershed needing yard waste and organic debris removal as recommended by watershed municipalities.
- 2) Support annual volunteer trash clean-ups in the watershed. (Local as well as larger)
- 3) Pilot test the use of aquatic collectors
- 4) Reduce the volume of homeowner leaf litter entering streams in the watershed. Target outreach to property owners along creeks.

#### c. Reduce pet waste through education

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- 1) Distribute brochures on pet waste management
- 2) Promote horse manure recycling

#### d. Illicit discharge detection and elimination (see MSD Phase II NPDES).

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- 1) Develop and maintain a map of the area streams, storm sewers and storm sewer outfalls.
- 2) Survey the creeks for illicit connections to storm sewers, illegal dumping, and failing septic systems.
- 3) Develop and implement a program to detect and eliminate illicit discharges into area streams.

#### d. Eliminate 100% of combined sewer overflows by 2030, 85% of sanitary sewer overflows by 2023 and 100% of sanitary sewer overflows by 2033 to reduce E coli and nutrient loads in streams (MSD)

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- 1) Plan for eliminating SSO's and addressing CSO's currently underway by MSD as part of a consent decree.

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### **B1 MAINTAIN AND IMPROVE THE NATURAL STREAM PHYSICAL STABILITY AND REDUCE STREAM WIDENING AND BANK EROSION.**

#### a. Capture first 2.5 inches of rainfall to improve channel stability & function

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- 1) Design rainscaping features that capture 2.5 inches of rainfall
- 2) Conduct seminars on the mechanics of stream dynamics related to flow for planners, public works staff, and developers.
- 3) Explore opportunities to restore pool-riffle-pool sequences in the creek and tributaries.
- 4) Maintain instream flow and explore other opportunities to restore habitat and species diversity.

#### b. Assess, implement, and maintain detention systems to manage channel protection.

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- 1) Assess technical and cost feasibility of regional detention systems.
- 2) Reassess protocols for private on-site basin maintenance and implement best management strategies.
- 3) Assess existing on-site basin facilities for opportunities for channel protection retrofitting (i.e. changing outlet structures to provide channel protection function).

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### **B2 AT LEAST 4 LINEAR MILES OF RIPARIAN CORRIDOR PERMANENTLY REMOVED FROM DEVELOPMENT AND APPROPRIATELY LANDSCAPED TO REDUCE IMPACTS ON EROSION, SEDIMENTATION AND CREEK WIDENING BY 2030.**

#### a. Support greenway/trail development along riparian corridors.

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1) Trail construction along parts of Deer Creek and its tributaries will provide additional public access to the creek, serve to heighten awareness and interest in the creek and its condition, and highlight water quality management strategies to the general public.

**b. Promote invasive species removal and native plant establishment**

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- 1) Implement 5 to 10 model invasive species removal projects.
- 2) Replant native species.
- 3) Engage citizens in invasive species removal efforts.
- 4) Provide invasive species education for planning, public works, and parks and recreation departments, landscape architects, and the general public.

**c. Identify willing landowners located in the floodplain for voluntary purchase/sale and permanent removal from development.**

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- 1) Identify and prioritize parcels for purchase in the riparian corridor and set aside development rights in perpetuity as recommended by watershed municipalities.
- 2) Facilitate the purchase and set-aside of development rights of these properties as prioritized.
- 3) Use FEMA buy out opportunities to buy back floodplains.
- 4) Educate FEMA Administrators at municipalities on floodplain development/ redevelopment restrictions (as a tool for opening floodplains).
- 5) Solicit FEMA and others for additional floodplain buyout funding.
- 6) Explore opportunities to pass municipal ordinances that restrict or eliminate building in the floodplain.

**d. Support appropriate wetland restoration and enhancement.**

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- 1) Establish a wetland arboretum at the corner of Marshall and Brentwood
- 2) Identify and implement other suitable wetland enhancements

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**B3 PROTECT GROUNDWATER SUPPLIES IN SENSITIVE HIGH KARST AREAS.**

**a. Prevent sinkhole contamination.**

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- 1) Assess if pollutants in stormwater are being adequately filtered before entering sinkholes.
- 2) Redirect stormwater to prevent it from directly draining in sinkholes

**b. Prevent groundwater contamination.**

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- 1) Assess the effectiveness of the incorporation of forebays/underdrains in bioretention systems to prevent groundwater contamination in high karst areas.

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**C1 EXPAND AND IMPROVE WATERSHED MODELING EFFORTS.**

- a. Model the existing conditions of the watershed as a basis to compare and evaluate proposed improvements or proposed policies.
- b. Take into account high cost of modeling efforts in a large watershed.
- c. Use the Simple Model and iTree analysis tools to project and assess effectiveness of pollutant reduction from management measures implemented.

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**C2 CONTINUE AND REFINE WATERSHED MONITORING EFFORTS.**

- a. Monitor the effectiveness of at least three demonstration BMP's over a 5 year period to inform future efforts. Recalibrate models based upon empirical data collected.

- b. Monitor effectiveness of bioretention systems – underdrains vs. no underdrains.
- c. Track and make available information on size, scope, location and effectiveness of area BMP's.
- d. Assess aquatic and riparian ecotone species diversity.
- e. Continue ongoing water quality monitoring efforts in Deer Creek.

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### **C3 CONTINUE ONGOING PLANNING EFFORTS**

- a. Utilize the Planting Prioritization Plan to guide the prioritization of watershed projects. (See “Identifying Critical Areas” section of this chapter.)
- b. Convene annual Technical Advisory Group, Community Leaders Task Force, and Steering Committee meetings to achieve regular stakeholder inputs.
- c. Evaluate implementation successes and challenges.

## **5.2 NPDES PERMIT DISCHARGE AND COMPLIANCE INFORMATION**

Metropolitan Sewer District’s Saint Louis County NPDES Phase II Permit requires compliance with six MCM’s (Minimum Control Measures). The following describes their strategy for each of the measures:

### ***Public Education and Outreach***

Implement a public education program to distribute educational materials to the community and conduct outreach activities about the impacts of storm water discharges on water bodies and the steps that the public can take to reduce pollutants in storm water runoff. Activities include 1) distribution of brochures on pet waste management, yard waste, on impacts from businesses, and more; 2) sponsoring a storm water school article contest; 3) developing a storm water pollution prevention video airing four storm water infomercials and 4) seminars for small businesses.

### ***Public Involvement and Participation***

The public is actively involved in implementation of the storm water management program through community groups of all kinds and participation in activities to reduce storm water pollution. Activities include storm drain marking, stream clean-ups, neighborhood trash clean-ups, volunteer presentations and household hazardous chemical collections.

### ***Illicit Discharge Detection and Elimination***

MSD has developed and implemented a program to detect and eliminate illicit discharges into our MS4 and area streams. They developed and maintain a map of the area streams, storm sewers, and storm sewer outfalls. Activities include surveying the creeks for illicit connections to storm sewers, illegal dumping, and failing septic systems.

### ***Construction Site Storm Water Runoff Control***

Land disturbance programs must be implemented to reduce pollutants in storm water runoff from construction activities that disturb the land. The BMPs required by the program focus primarily on erosion and sediment control. Activities include St Louis County government implementing a new Land Disturbance

Code, requiring storm water pollution prevention plans for all major land disturbance projects disturbing one acre or more of land, and the implementation of the model Land Disturbance Ordinance by all municipal co-permittees .

### ***Post-Construction Storm Water Management***

A program to address storm water runoff from new development and redevelopment projects must be implemented to reduce pollutants in storm water runoff from developed property. The program must ensure that BMPs are in place to prevent or minimize water quality impacts. Structural BMPs include storm water detention ponds, infiltration basins, filter strips and more. Activities in the plan include revising MSD's rules, regulations and engineering design requirements for storm water drainage facilities, adopting ordinances to support changes to engineering design requirements, and submitting a storm water funding mechanism based on impervious area for voter approval.

### ***Pollution Prevention/Good Housekeeping for Municipal Operations***

An operation and maintenance program that has the ultimate goal of preventing or reducing pollutant runoff from municipal operations will be implemented by all co-permittees. Activities in the plan include developing a model operation and maintenance program, initiating a training program to educate the municipal employees, assessment by municipalities of their existing ordinances pertaining to trash and pet waste management, and development of model ordinances for trash and pet waste management for municipalities to adopt.

In addition MSD has various educational videos available regarding storm water management, trash disposal, pet waste, household chemicals, motor oil disposal, yard waste, and development. These videos are available for viewing on the MSD web site <http://www.stlmsd.com/MSD/PgmsProjs/PhaseII>

## **5.3 LOCAL MUNICIPALITY STORMWATER MANAGEMENT PLANS**

### **5.31 City of Brentwood Flood Mitigation Master Plan**

Stormwater flooding has inundated the area along Deer Creek between Hanley Road and South Brentwood Boulevard 26 times since 1957, creating significant public safety issues and causing property damage. The Deer Creek Flood Mitigation project includes the planning, design and construction of improvements to the Deer Creek channel and floodplain to alleviate ongoing flooding problems and protect properties from frequent flooding. These updates will also provide a greater opportunity for businesses to move to the area.

#### **IMPLEMENT IMPROVEMENTS INCLUDING:**

- Streambank stabilization
- Native vegetation planting
- Natural floodplain restoration (benching and widening)

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**THE IMPROVEMENTS WILL:**

- Improve public safety
- Revitalize an underutilized area of the City by creating an opportunity for the development of the entire Manchester Road corridor in the City
- Reduce emergency response and flood clean-up costs and increase taxable revenue
- Reduce number of flood-prone properties
- Restore floodplain

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### 5.32 City of Clayton Stormwater Master Plan

The City of Clayton, MO is experiencing redevelopment where large areas of small ranch homes are being replaced by larger homes that take up a much larger portion of the lot. This redevelopment, combined with the stormwater problems that have historically occurred in Clayton, is aggravating an already serious urban drainage problem. Although the city has limited redeveloped parcels to a maximum of 55% impervious coverage, this increased coverage has created a stormwater drainage concern for the impacts on both the redeveloped lots and surrounding properties.

The City retained CH2M HILL in January, 2006 to provide engineering services necessary to perform a Citywide Stormwater Study. In particular, the study emphasizes the use of low impact development (LID) technologies as an alternative to, or in conjunction with, conventional stormwater management techniques to solve stormwater problems. The study also includes a review of the City's ordinances and Urban Design District standards and makes recommendations to improve stormwater management.

***Key elements of the study include:***

- Delineation of major and minor watersheds within the City limits on a master map and determine hydrologic characteristics within the City of Clayton
- Interviews with City Staff and City Officials
- Surveys of the public
- Review of complaint records and previous engineering studies
- Identification of the potential causes for flooding, erosion and sewer backups
- Identification of development issues related to stormwater
- Review of the City's development related ordinances and policies, and preparation of recommendations to address these development issues.
- Development of a prioritized list of projects including a conceptual scope of work for each project for financial project planning

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### 5.33 City of Creve Coeur Stormwater Master Plan

The City of Creve Coeur experiences multiple stormwater problems within its boundaries. To benefit its citizens, the City has identified the need to assess the multitude of drainage related problems by updating its last Watershed Plan done in 1999 to develop a new path to implement comprehensive and technically sound solutions to these problems. Many of the problems stem from increased runoff from development. Changes



in land use have a major effect on both the quantity and quality of stormwater runoff. Urbanization, if not properly planned and managed, can dramatically alter the natural hydrology of an area because it increases impervious cover. Impervious cover decreases the amount of rainwater that can naturally infiltrate into the soil and increases the volume and rate of stormwater runoff. These changes lead to more frequent and severe flooding, streambank erosion, and therefore potential damage to public and private property.

One solution that helps mitigate these effects is to enacting ordinances requiring elements of low-impact development (LID). LID is a stormwater management system that works by utilizing the natural processes of the water cycle. LID treatment networks are designed not to exceed the carrying capacity of a site's landscape and can incorporate a number of stormwater best management practices such as rain gardens, vegetated filter strips, bioswales, pervious pavement, and green roofs.

The scope of the Watershed Management Plan Update has been to review the existing Master Plan, collect the available watershed information (including a stormwater questionnaire distributed to citizens in 2010), evaluate known problems, develop appropriate project alternatives to solve them and prioritize the projects in a fair and equitable manner.

55% of the City of Creve Coeur lies within the Deer Creek Watershed.

For further details see <https://bit.ly/2WXYTVJ>

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### 5.34 City of Frontenac Stormwater Master Plan

The City of Frontenac Stormwater Master Plan is based on the recommendations made in the Stormwater Needs Assessment (EDM, 2005). The Stormwater Needs Assessment discussed four levels on which stormwater issues occur and made recommendations for each. This document addresses the first level: Physical Stormwater System. This first level is discussed below along with the recommended objectives to the City of Frontenac.

In many municipalities, the distinction is made between public and private stormwater problems. The municipality will typically resolve the public problems leaving the private problems to the homeowners. With such a strong passage of the half-cent sales tax, and the nature of many of the returned questionnaires, it does not appear that the City of Frontenac needs to make this distinction. However, stormwater projects the city does undertake should be done in a fair, efficient and effective manner with an eye to system-wide impacts.

***The objectives the city adopted are:***

- Correct the noted deficiencies in the stormwater system
- Ensure proposed solutions do not create additional problems
- Resolve problem areas efficiently, understanding the comprehensive needs of the city
- Prioritize problem areas to ensure critical problems are resolved first
- Plan for future development within and adjacent to the city, which may impact the stormwater system

This master plan addresses the above objectives and lays out a clear plan for problem resolution. A hydraulic model has been developed to evaluate the effects of the solutions proposed herein. Solutions are prioritized according to financial, safety, and environmental properties. They consider economies of scale and are grouped accordingly.

The following specific tasks were accomplished in producing this part of the Master Plan:

**L1-1 Survey:** Structure data not currently in the MSD database was surveyed to include top and flow-line elevations as well as missing structures. Approximately 450 manholes, inlets, and outfalls as well as incoming and outgoing pipe sizes and types were surveyed in the field. Top elevations for an additional 280 inlets, manholes, and end of pipes (flow-lines) were also surveyed. Approximately 80 creek-sections were surveyed along with 25 bridges and culverts with road profiles. Surveying was done by Burdine and Associates.

**L1-2 Hydraulic Model:** The existing MSD dynamic hydraulic model of the existing system was expanded using XPSWMM. Hydrology was developed for over 1050 nodes (places for water to enter the model). Characteristic-hydraulic field data was obtained for 26,000 feet of open channels. Eighty-six open channel cross-sections were added to the model along with 25 bridges. Seven detention basins were added to the existing conditions model and five more added to the proposed detention basins model. Survey data was integrated into the existing model. The model was checked to determine missing data, which was obtained and the model refined. Numerous attempts to calibrate the model were made, but MSD results could not be duplicated. The majority of the reason for this is credited to use of a newer version of XPSWMM. Results in the main channel do in general more closely resemble the HEC-2 results used to map the floodplain. Both existing and future conditions were run and are documented herein.

**L1-3 Additional Problem Areas:** Additional areas of concern are identified in the hydraulic model. Stormwater problems in commercial areas, based on results from a city mailing to commercial operations in Frontenac, are analyzed, mapped and have conceptual solutions developed. The master plan also accounts for additional residential questionnaires.

**L1-4 Conceptual Solutions:** Conceptual solutions are developed and grouped according to sub watersheds for problems identified in the needs assessment and this master plan. Conceptual solutions are developed in written form and an exhibit is produced. Proposed solutions are analyzed with the existing conditions hydraulic model and impacts are documented. Cost estimates are developed and a benefits analysis is performed. Problem groups are prioritized and a stormwater capital improvement plan is developed.

**L1-5 Identify Financial Benefits:** As with most capital improvement projects, implementation of stormwater projects tends to increase property values. This task evaluates the change in property values that will accompany implementation of the conceptual solutions. This shows the dollar value of the improvement to the resident of Frontenac.

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#### Frontenac Stormwater Master Plan Update Fy2020

This update consists of accounting for additional stormwater concerns identified since the completion of the original Master Plan, dated June 2007, as well as changes to planned projects. Completed projects are now shown as existing infrastructure on the appropriate figures.

All the hydraulic models have been updated to account for inaccuracies found since the Master Plan was released. The existing conditions dynamic hydraulic model (XPSWMM) is updated for completed projects and the results are presented. Additional proposed solutions and changed solutions are evaluated in the XPSWMM model. Different alternatives are evaluated for Monsanto-Sunswept Creek in the Glen Abbey-Oak Gate area.

The Hurricane Ike storm event of September 14, 2008 is evaluated for severity and documented flooding is compared with the hydraulic model results. A summary of stormwater projects proposed by the St. Louis Metropolitan Sewer District (MSD) is presented. The 5-year Stormwater Improvement Plan is updated as well as a prioritized summary of all projects.

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### 5.35 City Of Richmond Heights Storm Water And Sewer Management Program

Although the City lies within the St Louis Metropolitan Sewer District (MSD), there was a need to assess the storm sewer system. The location, capacity, condition, and shortcomings of the existing system were assessed in 2001.

The Richmond Heights stormwater management program began with several goals.

These goals are:

- Delineation of major watersheds within the city limits (Subwatersheds Plate).
- Determine characteristics (Hydrological and Hydraulic)
- Conduct surveys and interview with city officials and residents.
- Review of complaint records and previous engineering studies.
- Identify the potential causes for flooding, erosion and sewer backups.
- Identify possible solutions and costs to fix the problems based on experience and best engineering judgment.
- Develop a prioritized list of projects for financial planning.

In June 2001, 17 improvement projects were identified. Of these 17 projects, 10 projects have been completed as of November 12, 2010.

## 5.4 IDENTIFYING CRITICAL AREAS

It has been determined that mean E. coli loads for all sources during rain events are many times greater than those measured during base flow.<sup>1</sup> Therefore a key mechanism for reducing bacteria load as well as other pollutants is the reduction of overland stormwater runoff that carries those pollutants.

Deer Creek Watershed Alliance has identified 11 Best Management Practices that reduce stormwater runoff, as described in this chapter, primarily by improving soil permeability through landscaping changes. In order

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<sup>1</sup> p. 30, "Occurrence and Sources of E. Coli in Metropolitan St. Louis Streams", Oct. 2004-2007–USGS, MSD

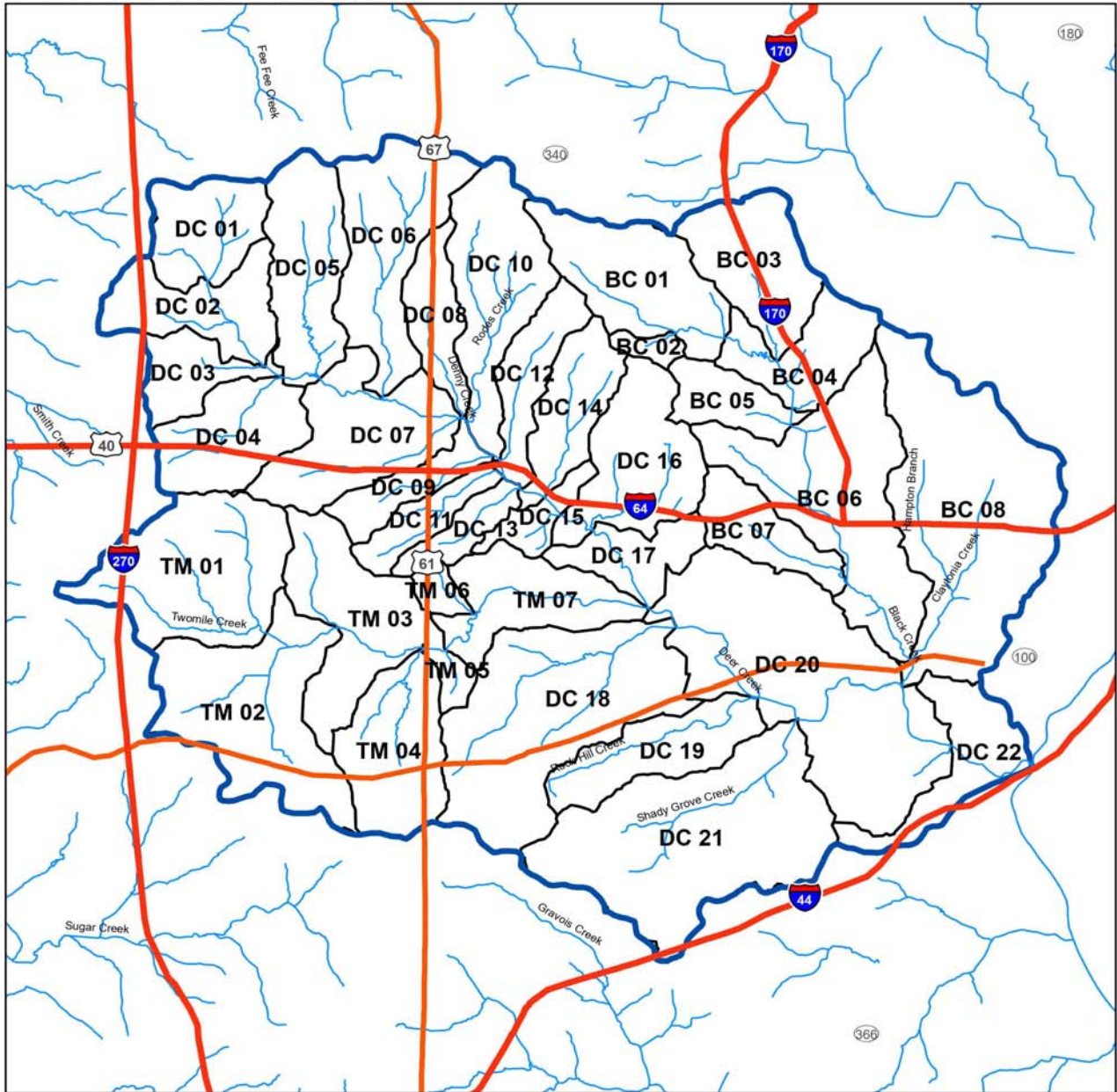
to identify critical areas, the Alliance hired Davey Resource Group to pinpoint five variables that will maximize the effectiveness of those practices on stormwater runoff, as well as assigning a weight for each variable. (See Chart 4-A)

<b>CHART 4-A: Priority Ranking Variables</b>	<b>Dataset Source</b>	<b>Weight</b>
Proximity to Floodplain	FEMA Flood Zones	0.30
Canopy Fragmentation	Urban Land Cover	0.20
Proximity to Hardscape	Urban Land Cover	0.15
Slope	Elevation Data	0.15
Soil Erosion (K-factor)	SSURGO Soils	0.10

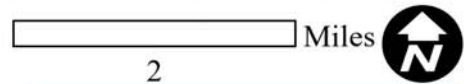
The planting location polygons were created by taking all grass/open space and bare ground areas and combining them into one dataset. Non-feasible planting areas such as agricultural fields, recreational fields, major utility corridors, airports, buildings, etc. were removed from consideration. Using zonal statistics, the priority grid raster was used to calculate an average value for each planting location polygon. The averages were grouped and each piece of land was assigned a priority rating from 1 (Very Low) to 5 (Very High).

The process was further refined by identifying which Deer Creek subwatersheds have the highest percentage of land with either High or Very High ratings, and the subwatersheds were prioritized accordingly. Deer Creek Watershed Alliance has determined that the sub-watersheds with the highest rankings are the most critical areas to address first in reducing stormwater runoff in the watershed. See Map 4-A for an alphanumeric identification of each sub-watershed, Chart 4-B for a priority ranking of the sub-watersheds. Sub-watersheds that had already been prioritized prior to this ranking process are noted as Focus Areas.

### Deer Creek Sub-watershed



- Legend**
- Interstates
  - Highway
  - Streams
  - Deer Creek Watershed Boundry
  - Subwatersheds



Deer Creek Watershed Alliance  
 a project of MISSOURI BOTANICAL GARDEN

Sources: Deer Creek Watershed:  
 USDA Natural Resources Conservation Service  
 Geospatial Data Gateway;  
 United States Geological Survey;  
 St Louis County GIS Service Center



<b>CHART 4-B: DEER CREEK SUBWATERSHEDS RANKED BY RATIO OF SQ FT OF PRIORITY AREA TO SQ FT OF SUBWATERSHED AREA</b>					
<b>Year</b>	<b>Priority Order</b>	<b>Subwatershed</b>	<b># of Property Owners</b>	<b>Municipality</b>	<b>Tributary Name/Notes</b>
1	1	DC 02	384	Creve Coeur	
1	2	TM 05	45	Warson Woods/Huntleigh	
2	3	TM 01	852	Des Peres, Country Life Acres, Crystal Lake Park, Frontenac, Town & Country	
3	4	DC 17, DC13, DC 15, DC 12	490	Ladue	Small subwatersheds in same municipality
4, 5, 6	5	TM 02	1608	Des Peres, Frontenac, Kirkwood	Claychester Creek
		DC 06			<i>Monsanto-Sunswept: Focus Area #1</i>
7, 8	6	BC 01	956	Ladue, University City, Olivette	
8	7	TM 06	47	Ladue, Huntleigh	
9	8	TM 03	546	Frontenac, Kirkwood, Huntleigh	
10	9	TM 07, DC 16	362	Ladue, Huntleigh	
11,12	10	DC 05	725	Creve Coeur, Westwood, Frontenac	Windrush Creek
12	11	DC 03	100	Creve Coeur, Westwood	
12	12	BC 05	251	Ladue, Clayton, Richmond Heights	
		DC 19			<i>Rock Hill Creek: Focus area #2</i>
13	14	DC 07	634	Frontenac, Ladue, Creve Coeur	
		DC 10			<i>Pebble Creek: Focus Area #2</i>
14	15	DC 04	242	Town & Country, Westwood, Frontenac	
15, 16	16	TM 04	913	Kirkwood, Huntleigh	
		DC 08			<i>Denny Creek: Focus Area #2</i>
17	17	DC 09	201	Frontenac, Ladue	
17	18	BC 07	415	Richmond Heights, Brentwood	
18, 19, 20	19	DC 18	2782	Glendale, Kirkwood, Rock Hill, Warson Woods, Ladue	Sebago Creek