Louisville MSD

Watershed Master Plan

JULY 2022

Safe, clean waterways

Louisville and Jefferson County
Metropolitan Sewer District

Watershed Master Plan

July 2022

EXECUTIVE SUMMARY

This report provides an update of the 2017 Watershed Master Plan (WMP). The WMP was developed for Louisville Metro by the Louisville and Jefferson County Metropolitan Sewer District (MSD). MSD assumed responsibility of the community's public stormwater system, along with the flood protection system, in 1986. The basis of this WMP was MSD's original Watershed Master Plan, which was created in 1988 as part of the Stormwater Drainage Master Plan, and the 2010 Stormwater Management Master Plan, which was the most recent update of that plan. The purpose of this plan is to help effectively manage present and future regional stormwater drainage in Louisville Metro.

It should be noted that the WMP is not a flood study or a floodplain management program. The primary objective for the WMP is the promotion of stormwater drainage management practices in the context of a regional program. This plan was prepared in coordination with the floodplain management plan, which is part of the Louisville Metro Hazard Mitigation Plan. Furthermore, water quality is addressed in more detail through the State of the Streams Report, which trends stream health data to support the Municipal Separate Storm Sewer System Permit (MS4) and the Integrated Overflow Abatement Plan (IOAP). The WMP can be considered a precursor to the Stormwater Master Plan that is recommended in the Critical Repair and Reinvestment Plan, MSD's 20-year Comprehensive Facility Plan. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

The Watershed Master Plan is comprised of three sections. The first section gives a detailed comprehensive overview of the Louisville Metro watershed. This section contains:

- General description of the watershed area, stream names, soils and land use for the entire county
- Detailed description of the regulations and policies for stormwater management including those for stormwater discharge rates, floodplain management, water quality (MS4) and the Floodplain Management and Erosion Prevention and Sediment Control Ordinances
- Description of county wide programs (Critical Repair and Reinvestment Plan, Amended Consent Decree Projects, and Drainage Response Initiative) used to recommend stormwater improvements

The second section provides an overview for each of Louisville Metro's eleven sub-watersheds. Each subsection provides the following information:

- General description including watershed area, stream names, soils and land use
- Completed stormwater improvement projects such as regional detention basins, large and small scale drainage projects
- Current hydrologic and hydraulic models available for the particular watershed
- Watershed specific requirements for new development such as 1.5:1 compensation for fill added to the floodplain or requiring post developed stormwater discharge rates to be less than pre-developed levels
- List of recommended stormwater improvement projects that correspond with the Critical Repair and Reinvestment Plan, Amended Consent Decree Projects, and Drainage Response Initiative planned for the next three years

The third section includes maps for each watershed. These maps include an aerial map, drainage map, soils map, land use map, and floodplain map for each individual watershed. Larger watersheds were broken into two or three sections for clarity in the maps.

DESCRIPTION OF STUDY AREA

All areas affecting surface water runoff in Louisville Metro, which for the purposes of this report includes all of Jefferson County, Kentucky, are included in the WMP. Louisville Metro is a river city located along the Ohio River. The area is drained by two major drainage systems: the Ohio River and the Salt River. The Salt River drains into the Ohio River at the southwestern end of Jefferson County. A large portion of Jefferson County lies within the broad floodplain of the Ohio River; however, about 17,600 acres of this floodplain, including downtown Louisville, are protected by a 28.9 mile long flood protection system. The flood protection system, which was built by the U.S. Army Corps of Engineers, protects the area from Beargrass Creek to Pond Creek.

Four distinct topographic regions exist within Louisville Metro. These topographic regions are the Flood Plain, Knobs, Central Basin, and Eastern Uplands. The Flood Plain and Central Basin regions are both characterized as generally flat, while the Knobs and Eastern Uplands regions are both characterized as generally hilly. Elevations in Louisville Metro range from about 382 feet above sea level, which is the pool stage of the Ohio River below the McAlpine Lock and Dam, to in excess of 900 feet along the southern boundary.

STORMWATER MANAGEMENT REGULATIONS

Through the WMP, MSD Design Manual, Louisville Metro Floodplain Management Ordinance, and Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance, a watershed-by-watershed approach to regional management of stormwater drainage is taken. Other permits, such as the Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities and the MS4 permit also affect the stormwater policies in Jefferson County.

New development in Jefferson County is required to mitigate proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25 and 100 year storm events as detailed in the MSD Design Manual. The NRCS Type II, 24 hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

New development in the combined sewer area is restricted to detaining the post-developed 100-yr flows to the pre-developed 10-year flows in order to help reduce the flows in the combined sewer system during rain events. Examples of mitigation techniques include building detention basins, oversizing onsite stormwater pipes, and using green solutions such as pervious pavement and rain gardens to reduce peak flows and overall runoff volumes.

Floodplain compensation is required throughout Jefferson County for any fill placed in the fully developed local regulatory floodplain as stated in the Louisville Metro Floodplain Management Ordinance. Floodplain compensation of 1.5 times the displaced storage capacity is required in the following watersheds: Beargrass Creek, Cedar Creek, Chenoweth Run, Goose Creek, Harrods Creek, Mill Creek, Ohio River, Pennsylvania Run, and Pond Creek. Floodplain storage compensation shall be provided 1.0 times the displaced storage capacity in the Floyds Fork watershed, with the exception of the Chenoweth Run watershed. The ratio may also be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25-foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the Kentucky Division of Water through its KPDES General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25-foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50-foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or "soft" approaches where possible. MSD's Design Manual outlines natural channel design requirements in Section 10.3.6.

The MS4 permit requires all developments with a disturbed area equal or greater than one acre, including projects less than one acre that are part of a larger common plan of development equal to or greater than one acre, to treat the first 0.6" of runoff. This can be accomplished by infiltrating or treating the stormwater using post-construction water quality practices, which are detailed in Chapter 18 of the Design Manual.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet or more of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids generated by the site. The design storm to be used is the 10-year, 24-hour SCS Type II storm event.

Table of Contents

LIST OF APPENDICES

MAPS

1.0 PLANNING METHODOLOGY

1.0 PLANNING METHODOLOGY

1.1 Introduction

The Watershed Master Plan (WMP) was developed for Louisville Metro by the Louisville and Jefferson County Metropolitan Sewer District (MSD). MSD assumed responsibility of the community's public stormwater system, along with the flood protection system, in 1986. The basis of this WMP was MSD's original Watershed Master Plan, which was created in 1988 as part of the Stormwater Drainage Master Plan, and subsequent updates. The purpose of this plan is to help effectively manage present and future regional stormwater drainage in Louisville Metro.

The WMP is intended to compile related reference and data documents. It is a process that MSD can utilize to affect present and future regional management of stormwater drainage. In doing so, stormwater drainage facilities (e.g. storm sewers, detention basins, and post-construction water quality practices) will be employed within a comprehensive planning context.

It should be emphasized that the WMP is not a flood study or a floodplain management program. The primary objective for the WMP is the promotion of stormwater drainage management practices in the context of a regional program; however, this plan was prepared in coordination with the floodplain management plan, which is part of the Louisville Metro Hazard Mitigation Plan. Furthermore, stormwater quality is addressed in more detail through the State of the Streams Report and applicable portions of the Integrated Overflow Abatement Plan (IOAP).

The WMP can be considered a precursor to the Stormwater Master Plan that was recommended in the Critical Repair and Reinvestment Plan, MSD's 20-year Facility Plan. The Stormwater Master Plan is scheduled to begin in fiscal year 2025 and will build on the WMP. With this timeline in mind, the initial Stormwater Master Plan pilot project was completed in fiscal year 2022 with the second to begin in fiscal year 2023. These pilot projects were initiated to establish the methodology for the plan and to determine priority areas. The goal of this program is to address the following:

- Work towards minimum level of service for everyone in the MSD drainage service area.
- Develop and maintain an up-to-date inventory of the stormwater infrastructure, including identified deficiencies.
- Prepare a process to develop ratings of stormwater infrastructure by comparing present conditions against established standards and required levels of service.
- Establish a methodology to review technical standards and design criteria for stormwater infrastructure in the MSD drainage service area, at least once every 10 years.
- Identify projects that conform to adopted design criteria and standards.
- Look for opportunities to integrate water quality practices into the planning of MSD projects to meet the objectives of the MS4 Program.

Downtown Louisville along the Ohio River

1.2 Watershed Study Area

1.2.1 General

The WMP includes all areas affecting surface water runoff in Jefferson County, Kentucky. Jefferson County is an approximately 375 square mile political subdivision within the much larger 203,900 square mile physiographic Ohio River Basin, which embraces parts of fourteen states. The large drainage system originates in the Allegheny Mountains, flows generally in a southwesterly direction converging with numerous tributaries, and eventually discharges into the Mississippi River. A little less than one-half (91,170 square miles) of the Ohio River Basin lies upstream of Jefferson County.

The Jefferson County area is drained by two major drainage systems: (1) the Ohio River and (2) the Salt River. The Ohio River receives discharges from Mill Creek, Beargrass Creek, Goose Creek, Harrods Creek, and the combined sewer system. Cedar Creek and Pennsylvania Run discharge into Floyds Fork, which in turn, discharges in the Salt River. The Salt River also receives discharge from Pond Creek near its confluence with the Ohio River.

In this report, eleven major watersheds are defined and are geographically shown in Figure 1.1. These watersheds are based on the drainage systems mentioned above. Table 1.1 provides a summary description of the general characteristics of each watershed. Each of these watersheds is discussed in detail in the following sections and throughout the plan.

1.2.2 Ohio River and Floodwall

Floodwall near 6th Street

A large portion of Jefferson County lies within the broad floodplain of the Ohio River; however, about 17,600 acres of this floodplain, including downtown Louisville, are protected by a 28.9 mile long flood protection system. The first phase of the system, which protects the area from Beargrass Creek to just south of Rubbertown, was completed by the U.S. Army Corps of Engineers (USACE) in 1957. A second phase was completed in the late 1980's. The second phase protects southwest Jefferson County, from Rubbertown to Pond Creek. The floodwall system is built to protect Jefferson County from floods equivalent to the historic flood event of 1937, with three feet of freeboard.

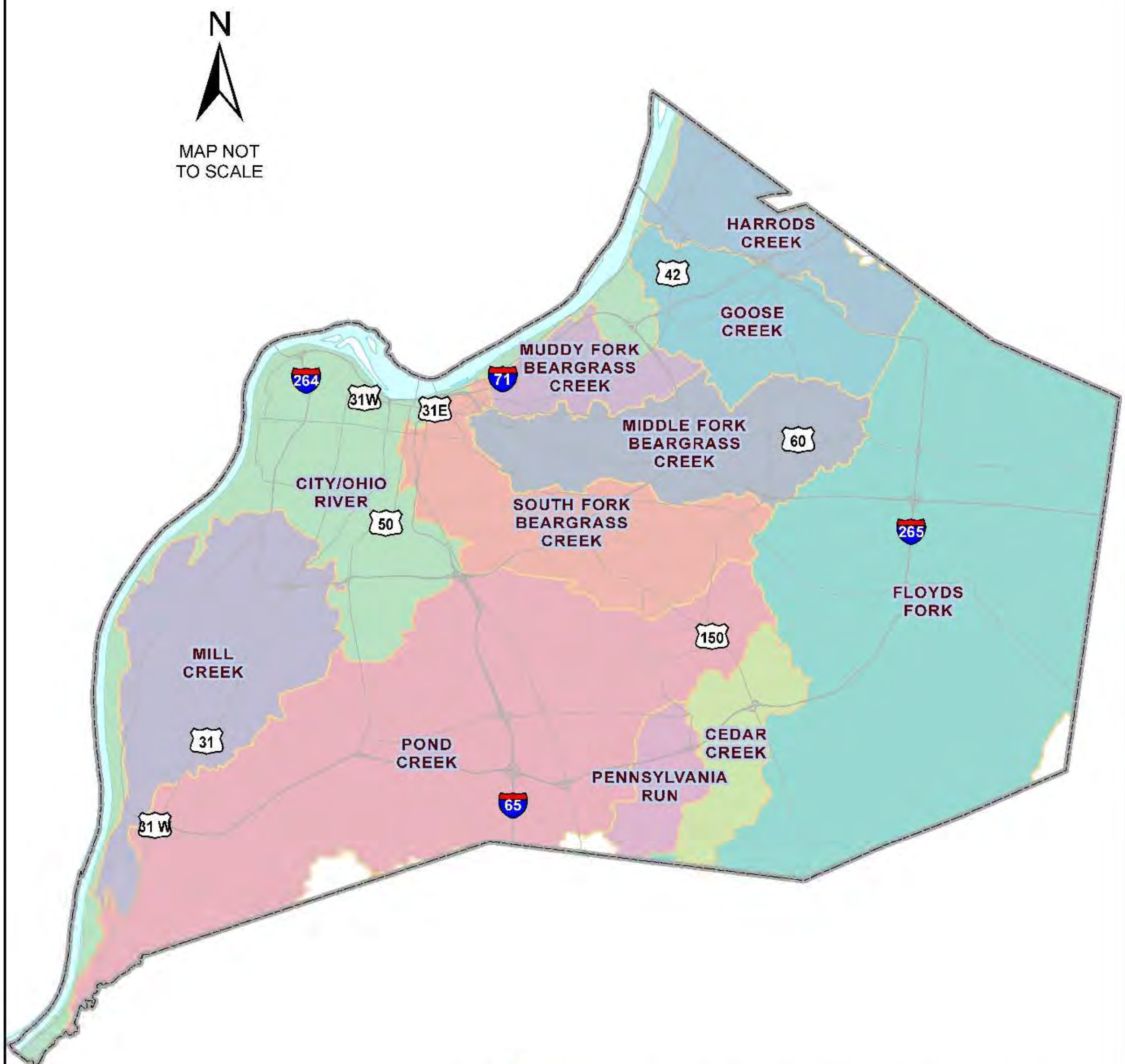
As indicated in Section 1.1, the WMP is intended to address management of stormwater drainage and not floodplain management. Floodplain management information can be found in the Louisville Metro Hazard Mitigation Plan.

1.2.3 Physiography

Jefferson County is located in the north central portion of Kentucky, on the south bank of the Ohio River, approximately 600 miles below its headwaters at Pittsburgh, Pennsylvania.

The entire county lies within the outer Blue Grass region of the Appalachian Plateau, a portion of which was once a vast plain extending from east of Lexington, Kentucky westward to Indiana. The Ohio River, with its attending streams, has eroded the plain and effectively reduced most of the surface in Jefferson County below its original elevation.

FIGURE 1.1 WATERSHED BOUNDARY MAP



LOJIC

msd
Safe, clean waterways

This map is a product of MSD GIS.

Table 1.1
Watershed Characteristics

Watershed	Drainage Area (sq mi)	Major Stream Systems	USGS Stream Gauges
Middle Fork Beargrass Creek	25.1	Middle Fork Weicher Creek	Middle Fork @ Old Cannons Ln Middle Fork @ Lexington Rd Middle Fork @ Browns Ln
Muddy Fork Beargrass Creek	8.8	Muddy Fork	Muddy Fork @ Mockingbird Valley Rd
South Fork Beargrass Creek	27.1	South Fork Buechel Branch	South Fork @ Trevilian Way South Fork @ River Rd South Fork @ E Breckinridge St Beargrass Creek @ Brownsboro Rd
Cedar Creek(1)	11.23	Cedar Creek	Cedar Creek @ Thixton Rd
Floyds Fork	103.9 (Jefferson Co) 284 (Total)	Floyds Fork Chenoweth Run Pope Lick	Floyds Fork @ Old Taylorsville Rd Floyds Fork @ Bardstown Rd Chenoweth Run @Ruckriegal Pkwy Chenoweth Run @ Gelhaus Ln
Goose Creek	18.6 (Jefferson Co) 30.2 (Total)	Goose Creek	Goose Creek @ Old Westport Rd Goose Creek @ US Hwy 42 Little Goose Creek @ US Hwy 42
Harrods Creek	15.3 (Jefferson Co) 92 (Total)	Harrods Creek Wolf Pen Branch South Fork Harrods South Fork Hite	N/A
Mill Creek(2)	34.2	Mill Creek Upper Mill Creek Big Run Cane Run Black Pond Creek	Mill Creek Cutoff @ Cane Run Rd Mill Creek @ Orell Rd
Ohio River/City	39.8 (Jefferson Co) 91,170 (Total at Jefferson Co)	Combined Sewer System	Ohio River @ Water Tower Ohio River @ McAlpine Locks Ohio River @ Louisville Ohio River @ Big Four Bridge Ohio River @ Kennedy Bridge Ohio River @ Kosmosdale
Pennsylvania Run(1)	7.0	Pennsylvania Run	Penn Run @ Mt Washington Rd
Pond Creek	89.3 (Jefferson Co) 126 (Total)	Pond Creek Northern Ditch Southern Ditch Fern Creek	Pond Creek @ W Manslick Rd Pond Creek @ Pendleton Rd Northern Ditch @ Preston Hwy Fern Creek @ Old Bardstown Rd Brier Creek @ Pendleton Rd

Notes:
(1) Outlets into Bullitt County to Floyds Fork Watershed.
(2) Studied in two parts in WMP. Upper Mill Creek is 19 square miles and Lower Mill Creek is 15 square miles.

Wide valleys, broad rolling uplands, and highlands with deep, steep-sided valleys and narrow ridge crests are common. Streambeds are of fairly uniform slope and side slopes are in a constant state of change as lateral erosion increases.

Elevations in Jefferson County vary from about 382 feet above sea level, which is the pool stage of the Ohio River below the McAlpine Lock and Dam, to in excess of 900 feet along the southern boundary. Selected elevations in Louisville are shown in Table 1.2.

Table 1.2
Elevations in Louisville

Location	Elevation (ft)
Courthouse	462
Iroquois Park	761
Louisville International Airport	475
Anchorage	720
Coral Ridge	490
Fern Creek	715
Jeffersontown	711
Kosmosdale	449
Middletown	721
Prospect	460
Valley Station	452

1.2.4 Topography

Four distinct topographic regions exist in Jefferson County as listed below and shown in Figure 1.2.

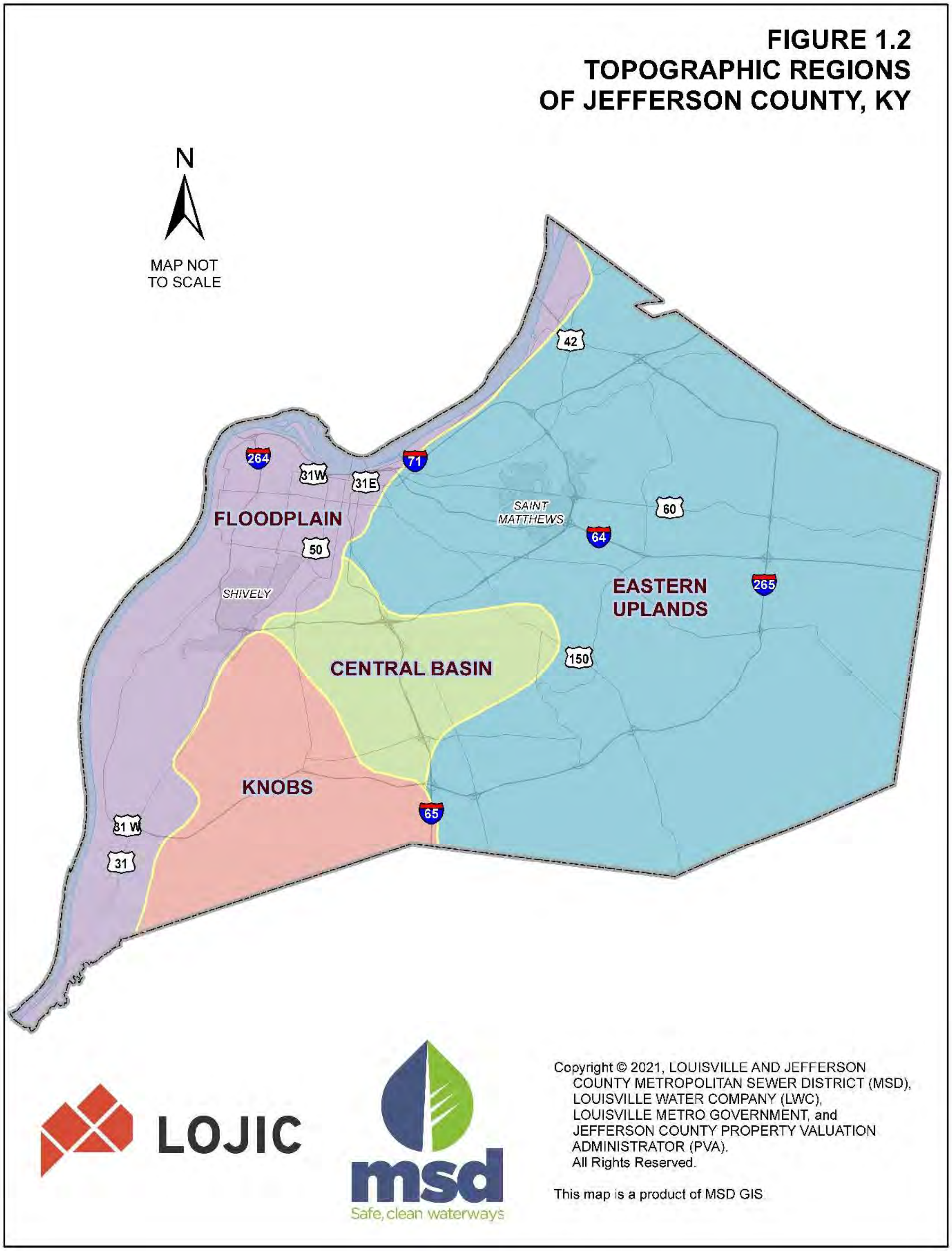
- Flood Plain
- Knobs
- Central Basin
- Eastern Uplands

Flood Plain Region as seen from Iroquois Park

Knobs Regions as seen from Iroquois Park

The "Flood Plain" is a strip of land bordering one-half to five miles wide along the Ohio River. The Flood Plain extends from the Salt River in the southwest, north to downtown Louisville, and continues northeast to the Oldham County line. The lowest elevations in the county are found in this region and generally range from 430 to 440, with occasional terraces to 460. The area is best characterized as flat to gently rolling and with very flat sloped stream beds. Mill Creek and the combined sewer system drain the majority of this region.

The "Knobs" region covers a triangular area in the southwestern portion of the county bounded approximately by Iroquois Park on the north, South Park Hills on this southeast, and the Southern Railroad on the southwest. The hills in this region have been highly dissected by stream erosion. Side slopes of 30% to 50% are common, and this region contains the highest elevations in the county, probably approaching the level of the original Appalachian Plateau. These steep sided hills rise 300 to 400 feet above their surroundings and numerous streams originate here. The majority of these streams drain to Pond Creek, which has eroded a trench, effectively bisecting this region from east to west. The west central portion of the county, bounded approximately by I-264 on the north, Shepherdsville Road on the east, and the "Knobs" region on the south



This map is a product of MSD GIS.

and west, is the “Central Basin.” This is a former slack-water region of shallow soils and nearly flat terrain with elevations ranging between 450 and 500. Various improvements to the Northern and Southern Ditch systems have helped alleviate the lack of natural drainage in the region.

The “Eastern Uplands” cover the remainder and largest portion of the county. This region is characterized by gently rolling to hilly plains to moderate to very steep valleys. Elevations range between 500 and 800. Goose Creek, Harrods Creek, Floyds Fork, and the Beargrass Creek system drain this region.

1.2.5 Geology

1.2.5.1 Historical Geology

The rocks that underlie Jefferson County were formed several hundred million years ago during the Paleozoic Era of Geologic Time. During this period, a vast area of what is now North America was under ancient seas. Sedimentary processes allowed deposition of layers of materials onto the sea floor and shoreline. Subsequently, these sediments underwent lithification and became limestones, dolomites, shales, and siltstones.

In general, limestone and dolomite are accumulations of calcium carbonate and/or magnesium carbonate precipitated from both seawater and the remains of organic sea life which extracted carbonates from the water. Shale is formed from fine clayey particles which are either transported from land by winds or washed into the sea by the streams and then deposited on the sea floor. Siltstone is generally formed from deposits which accumulate near shorelines, such as very fine grains of quartz.


Ohio River at Cox Park

Over the last 300 million years, gentle uplifting of the continental mass has raised these sedimentary rocks to their present elevation, producing fractures and undulations of varying magnitudes.

The Quaternary glacial outwash in the “Flood Plain” is much younger than the rock it overlays. This unique formation was deposited some 15 to 30 thousand years ago when the extreme southern edge of continental glaciers were just north of the Ohio River. Great masses of mud, sand, and gravel pushed by the ice were washed into a river bed much deeper and wider than now exists. As the glaciers receded northward, leaving behind deep unconsolidated sediments, normal drainage conditions were restored, and the river formed in approximately its present location.

1.2.5.2 General Stratigraphy

Stratigraphy is a branch of geologic study concerned with the form, arrangement, distribution, and mutual relationships of sedimentary rocks.

In Jefferson County, rock lies in nearly horizontal beds, or strata. Structurally, these beds range from a few feet to several hundred feet in thickness, and gently dip toward the southwest.

The oldest of these rocks, Ordovician, is found in the Floyds Fork area of the “Eastern Uplands.” They consist of randomly alternating layers of limestone, dolomite, and occasional thinly-bedded shales.

To the west, younger Silurian rocks outcrop in the Goose, Beargrass, and Fern Creek systems. They consist of limestone, dolomite, and occasional shale layers.

Progressing further west, and continuing into younger strata, a thin basal layer of limestone comprises the lower Devonian rock encountered near the Beargrass Creek system of the "Eastern Uplands." Upper Devonian rock is comprised of a thick layer of black shale, which underlies most of the Central Basin.

The youngest rocks in Jefferson County are Mississippian and are found in the "Knobs" region. They consist of a very thick basal clay shale layer, a middle layer of silty shale and interbedded siltstones, and an occasional thin upper layer of limestone.

1.2.5.3 Geologic Erosion

As the continental mass of North America rose in elevation, the down-cutting action of the running water increased its relentless attack on the land surface. The various sedimentary rock types have eroded at different rates and by different processes.

The most distinctive property of limestone, and to a somewhat lesser degree, dolomite, is solubility. In general, materials in these rocks chemically react with water to gradually dissolve, yielding sinkholes, solution channels, and caverns. Fractures in rock strata serve as conduits for this activity and greatly accelerate the process.

Shale is a structurally laminated sedimentary rock which exhibits high impermeability when unexposed to the atmosphere. Once exposed, however, rapid disintegration occurs owing to contact with moisture and temperature fluctuation. In fact, shale erodes much faster than other exposed sedimentary rocks, and rarely forms any prominent topographic features.

Siltstone, much like its larger grained-size sandstone counterpart, is a very erosion resistant material. Having a very even-granular, well-stratified structure, siltstone tends to stand out in relief against over- or underlying rocks and is well documented "ridge former."

1.2.5.4 Relationship of Erosion and Topography

The topographic regions of Jefferson County are a direct result of the selective erosional characteristics of its geologic structure, excluding the "Flood Plain" which is a product of deposition.

In the Mississippian rocks of the "Knobs" region, vast areas of the upper limestone have been totally removed by solutioning and gradual erosion. In the process, water has migrated downward into the softer shales and highly resistant siltstones. As the more easily eroded shales disintegrate, the siltstone becomes undercut, creating overhangs, which eventually fall as their weight overcomes their horizontal strength. This process has led to the formation of steep, rounded-top hills. An excellent example is observed in the road cuts along the Gene Synder Freeway just west of I-65.

Big Rock in Cherokee Park

The upper Devonian shale of the “Central Basin” displays the characteristic impermeability of horizontal, fissile shales. In a former geologic age, overlying rocks were eroded away and the shale’s surface was subsequently subjected to inundation during the Quaternary glacial period. An alluvial mantle, 0 to 50 feet thick and deposited onto the shale in the ponded lake bed, now protects it from the atmosphere. Groundwater is unable to penetrate the nearly horizontal strata and as a result, the local water table is high and many areas are marshy. The lower Devonian, Silurian, and Ordovician rocks which underlie the “Eastern Uplands” are being eroded in a combination of processes. Most notably, the solutioning of limestones and dolomites has deepened and widened stream valleys. Sinkholes and small caverns are common on plateaus and in cliffs of this region. These natural conduits carry surface waters into underlying rocks where chemical reactions enlarge solution channels. Eventually, much of this water finds its way back to surface streams in the form of springs. Where interbedded shales are exposed, the more resistant carbonates are undercut, leading to rock falls which widen valleys. An excellent example is the “Big Rock” locality in Cherokee Park.

1.2.5.5 Parent Material

Parent material influences the textural, chemical, and mineralogical properties of soils. In Jefferson County, parent material is extremely variable. About seventy-five percent of the county’s soils developed in residuum derived from the underlying, nearly horizontal beds of sedimentary rocks. The remaining twenty-five percent developed in local alluvium.

1.2.6 Soils

1.2.6.1 Factors of Formation

Soils are formed through the complex interaction of parent material, topography, climate, living organisms, and time. A change in any one of these factors affects the soil-forming process and the resultant soil characteristics. The importance of each factor differs from place to place, even within short distances However, in Jefferson County, parent material and topography, more than the other factors, account for differences among soils.

1.2.6.2 Topographic Factors

Topography in Jefferson County ranges from nearly level, to gently rolling, to very steep. The range of slopes is mostly from zero to twenty percent, although thirty to fifty percent is common in the “Knobs” region.

Topographic effects in areas of level terrain are such that large amounts of water can infiltrate the soil and percolate downward through it. Little or no soil is lost through geologic erosion, and there is a continuing accumulation of material. In rolling terrain, the rate of geologic erosion is slightly less than the rate of soil formation, and soils will form and mature. In steep terrain only small amounts of water can infiltrate and as a result, geologic erosion is rapid and soil material is removed as rapidly as it forms.

1.2.6.3 Relationship of Soils and Topographic Region

The General Soil Map contained in the NRCS Soil Survey of Jefferson County graphically represents the correlation between soil associations and topographic regions. Table 1.3 provides correlation between soil types and topographic regions in Jefferson County.

The NRCS Soil Survey also contains pertinent information regarding engineering properties of these soil associations. These include description, depth to rock, unified and AASHTO classifications, permeability, and depth to seasonal high water table.

The physical properties of the soils and rocks found in Jefferson County vary greatly depending upon location. Regarding surface water runoff, several implications and concerns arise.

- Lacustrine deposits and clay soils become plastic when wetted and are prone to slump and/or slide. In areas such as these, over steepened cuts should be avoided.
- Shale exposures are unstable, and once wetted, disintegrate very rapidly. Drainage ditches cutting through or into shale can be expected to undergo bank failure and channel siltation. The weight of large impoundments of water for detention purposes may induce stresses in shale which cause regional instability and, in areas of high relief, lead to landslide activity.
- Limestone and dolomite exposures are much more stable, but these rocks are susceptible to karstic-type weathering. The use of sinkholes as conduits for storm drainage should be avoided. Introduction of water accelerates the solutioning process, enlarges underground voids and leads to subsidence of overlying terrain.
- Springs within Devonian limestones and Silurian limestones and shales furnish much of the water for streams in the “Eastern Uplands” topographic region. For new channels or existing channel improvements, care must be taken to avoid accidentally sealing off existing springs, thereby, mitigating any unpredictable results due to the alteration of normal groundwater flows.

Table 1.3
Soil Type By Topographic Region

Region	Soil Association	Soil Type
Flood Plain	1	Wheeling-Weinbach-Huntington
Knobs	2 4	Memphis-Loring-Zanesville Westmoreland-Litz-Muskingham
Central Basin	3	Zipp-Robertsville
Eastern Uplands	5 6 7	Russellville-Crider-Dickson Crider-Corydon Beasley-Fairmont-Russellville

1.3 Model Methodology

As part of MSD’s most recent Risk Mapping Assessment, and Planning (Risk MAP) project, updated Flood Insurance Rate Map (FIRM) Panels and Flood Insurance Study (FIS) profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county.

Specific stream modeling details are described in further detail in the watershed chapters. Models have been developed for each of the 11 watersheds. In general, detailed modeling was accomplished using the USACE software, HEC-HMS and HEC-RAS or HEC-1 and HEC-2. The SCS Type II, 24-hour design storm was used. The 1 percent annual chance return interval was modeled for the existing and future conditions. In some cases, the 10, 2, and 0.2 percent chance events were also modeled. Appendix E contains a summary of studies included in the most current FIS.

1.3.1 Topographic Mapping

The WMP has been subdivided into 11 major watersheds. Each watershed was further subdivided for modeling purposes. The watersheds and subbasins were delineated using contour information, along with combined and separate storm sewer information, from the Louisville Jefferson County Information Consortium (LOJIC).

The number of subbasins into which a watershed is divided is primarily a function of the number of locations at which drainage discharges are desired. Since the locations of interest will vary throughout the life of the WMP, the number of subbasins may increase with time.

Close inspection of various components within each watershed revealed unique features and facilities which act as hydrologic breaks, or nodes (e.g. reservoir outlets, stream confluences, major bridges, culverts). Nodes define the logical locations of the outlet point of a subbasin. A particularly important feature which can serve as a node is a gauging station, since the data that it records can be used to calibrate hydrologic models.

1.3.2 Hydrologic Soil Groups

The SCS Curve Number method was used to determine surface runoff. This method requires a combination of soil and land use data. A necessary step in determining surface runoff through use of SCS methodology concerns the location of hydrologic soil groups by watershed. The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) has performed detailed studies of Jefferson County. The Soil Survey of Jefferson County was referenced to obtain soil information for this study. Part 630, Chapter 7 of the NRCS National Engineering Handbook describes the hydrologic soils groups pertinent to Jefferson County. This information is summarized in Table 1.4.

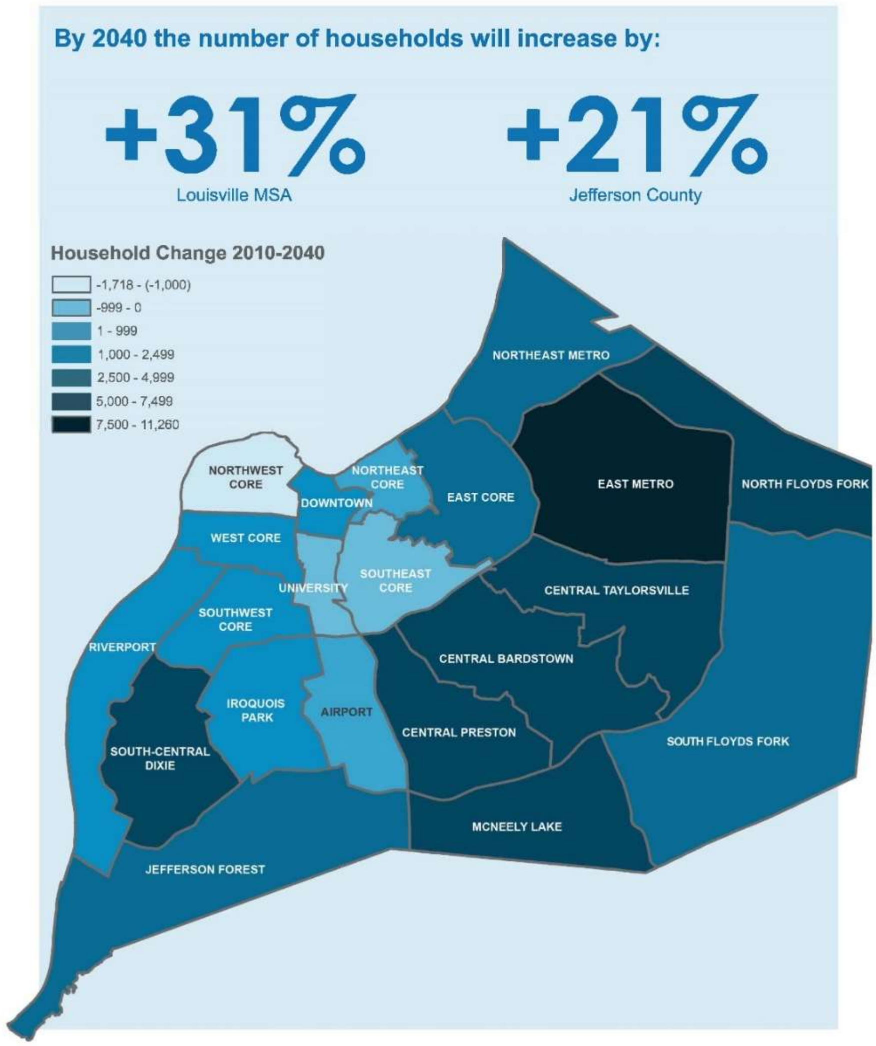
Table 1.4
Hydrologic Soil Groups

Soil Classification	Runoff Potential	Comments
A	Very Low	Soils have high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands and gravels. These soils have a high rate of water transmission.
B	Low	Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
C	Medium	Soils having low infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a low rate of water transmission.
D	High	Soils having very low infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soil with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material. These soils have a very low rate of water transmission.
Unclassified		Soil types will likely vary and must be checked by soil borings on a location by location basis.

Based on the NRCS survey, soil types fall into one of four NRCS categories. In the unsurveyed urban areas, soils were put into an unclassified group and were designated as "U", bringing the total number of categories to five. If a soil is assigned to a dual hydrologic group (such as B/C, B/D), the first letter is for drained areas and the second letter is for undrained areas.

1.3.3 Land Use

Jefferson County is expected to experience the largest growth of any county in Kentucky by 2040[1]. The Louisville Metro Comprehensive Plan demonstrates how this growth will affect the number of households in each watershed. For more information regarding development trends in each watershed, see the Louisville Metro Comprehensive Plan, Plan 2040[2]. Future land use conditions were based on fully developed conditions using the current zoning. Land use data was obtained using information from LOJIC for both existing and proposed land uses.



Note: Household Change 2010-2040. Reprinted from *Plan 2040: Comprehensive Plan for Louisville/Jefferson County* (p. 26), by Louisville Metro Government, 2019

1.4 Stormwater Management Policies

1.4.1 General Policies

[1] Ruther M, Sawyer T & Ehresman, S (2016) *Projections of Population and Households State of Kentucky, Kentucky Counties, and Area Development Districts 2015-2040* Kentucky State Data Center University of Louisville
[2] Louisville Metro Government (2019) *Plan 2040: Comprehensive Plan for Louisville/Jefferson County*

Through the WMP, MSD Design Manual, Louisville Metro Floodplain Management Ordinance, and Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance, a watershed-by-watershed approach to regional management of stormwater drainage is taken. Other permits, such as the Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities and the MS4 permit also affect the stormwater policies in Jefferson County.

New development in Jefferson County is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25 and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24 hour rainfall distribution is required to be used for the modeling. The MSD Design Manual currently uses Division of Water Resources Department for Natural Resources and Environmental Protection Engineering Memorandum No. 2 (4-30-71, rev 6-1-79) data; however, this will be updated to the NOAA Atlas-14 Precipitation-Frequency Atlas of the United States data with the MSD Design Manual update scheduled for fiscal year 2023. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

For new development in the combined sewer area, the post-developed 100-yr flows are restricted to the pre-developed 10-yr flows to help reduce the flows in the system during rain events. Engineers must design the new development's onsite stormwater system to meet this Design Manual requirement. Examples of this include building detention basins, oversizing onsite stormwater pipes, and using green solutions such as pervious pavement and rain gardens to reduce peak flows and overall runoff volumes.

Floodplain compensation is required throughout Jefferson County for any fill placed in the fully developed local regulatory floodplain as stated in the Louisville Metro Floodplain Management Ordinance. Floodplain compensation of 1.5 times the displaced storage capacity is required in the following watersheds: Beargrass Creek, Cedar Creek, Chenoweth Run, Goose Creek, Harrods Creek, Mill Creek, Ohio River, Pennsylvania Run, and Pond Creek. Floodplain storage compensation shall be provided 1.0 times the displaced storage capacity in the Floyds Fork watershed, with the exception of the Chenoweth Run watershed. The ratio may also be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative. A minimum buffer is also required by the KPDES General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

Chapter 4 Part 8 of the Louisville Metro Land Development code establishes minimum buffer areas along protected waterways, including: perennial and intermittent streams or rivers, wetlands, and other water bodies. The "Jefferson Protected Waterways" and "Jefferson Potential Wetlands (Hydric Soil)" LOJIC GIS mapping layers are used to identify these sensitive features during preliminary development planning. The delineation of wetland boundaries is established using Hydric Soils as a preliminary indicator of potential wetland areas and the need for further investigation. Development standards encourage areas of sensitive features to be preserved and dedicated as open space. Louisville-Jefferson County Metro Government receives credit through the National Flood Insurance Program's Community Rating System (CRS) for open space areas protecting natural floodplain function. Hydric Soils Map (HS-1) shows those areas identified as potential wetlands as they relate to preserved open space areas credited for CRS. Many residential subdivision projects within Jefferson County include the reservation of open space and/or woodland protection areas to further protect sensitive features such as wetlands, steep slopes and stream buffers.

Floodplain property acquisitions are another way MSD preserves open space in the floodplain. MSD routinely reaches out to homeowners who have suffered repetitive flooding to survey interest in participating in a buyout program. Buyouts are funded by both MSD and FEMA Hazard Mitigation Assistance Buyout Programs as funds become available. Floodplain grant buyouts are voluntary. Completed interest surveys from property owners are kept on file and referenced when determining which properties to include in grant applications. Funding is limited. Projects that are not approved because of limited funding are kept on file should funding become available in the future. Once submitted, grant approval by FEMA can take 12 months or longer. Following the purchase of a grant property, the structures are demolished and the property deed restricted. Future uses are limited to those which would provide open space. MSD uses many of these properties for reforestation and is pursuing community partnerships for other uses such as agriculture. Another long term goal for these areas could be the construction of a stormwater basin or similar mitigation method to aid in reducing the impact of smaller storm events where feasible.

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or “soft” approaches where possible. MSD’s Design Manual outlines natural channel design requirements in Section 10.3.6.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

A Site Disturbance Permit is required by the Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance for developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24 hour SCS Type II storm event.

1.4.2 Municipal Separate Storm Sewer System (MS4)

MSD, along with five co-permittees, has an MS4 permit (aka stormwater quality permit) through the Kentucky Division of Water (KDOW). The purpose of the MS4 program is to maintain and enhance water quality in Jefferson County. The purpose is also to protect and promote the public health, safety and welfare by preventing the introduction of harmful materials into the separate storm sewer system. The co-permittees in the permit are:

- City of Anchorage
- City of Jeffersontown
- City of Shively
- City of St. Matthews
- City of Louisville
- MSD

The MS4 permit program is the result of the 1987 amendments to the Clean Water Act (CWA), commonly referred to as the Water Quality Act of 1987. In these amendments, Congress mandated that the Environmental Protection Agency (EPA) address non-point source pollution in stormwater runoff. In essence, EPA defined urban stormwater (previously considered a non-point source) as a point source because there was a physical location (or point) of discharge. Congressional action required EPA to develop a program to permit the discharge of the stormwater from the MS4.

The Louisville MS4 Permit includes over 100 activities and is organized into several program elements including:

- Illicit Discharge Detection and Elimination
- Construction Site Runoff Controls (Erosion Prevention and Sediment Control)
- Post Construction Site Runoff Controls (Long-term Water Quality Control)
- Public Involvement and Outreach Programs
- Monitoring
- Reporting and Assessment

The MS4 program elements are accomplished by both the co-permittees and MSD. MSD has the sole responsibility for the following duties:

- Education and outreach to the general Louisville Metro area. MSD will lead selected specific elements including green infrastructure outreach and education efforts. MSD will provide opportunity for input from co-permittees;
- Investigation and enforcement upon potential illicit discharges through administration of applicable sections of the Wastewater and Stormwater Discharge Regulations;
- Hazardous material plans and inspections for qualifying industrial and commercial properties;
- Construction oversight including plan review, site inspection and administration of the Erosion Prevention and Sediment Control Ordinance;
- Post-Construction site stormwater runoff control measures verification and monitoring of required maintenance;
- Good housekeeping/pollution prevention operation and maintenance program including training to prevent or reduce polluted runoff from daily operations, including maintenance;
- Monitoring program and related laboratory analyses; and
- Annual compliance demonstration report preparation for MSD activities and collection of co-permittees portions.

Co-permittees of the MS4 permit have the sole responsibility for the following duties within their jurisdictional boundaries:

- Implement education and outreach at the applicable levels of neighborhood and local community that complement the education and outreach provided by MSD tailored to local waterbodies and pollutants of concern;
- Drainage system and outfall mapping;
- Drainage system operation and maintenance;
- Report and refer potential illicit discharges observations by municipal employees or other reports from residents to MSD for investigation and potential enforcement;
- Construction oversight in addition to that provided through Louisville MSD;
- Inspection, operation, maintenance and/or applicable certification that permanent (also known as post-construction) water quality devices, controls, and management practice are operating effectively;
- Road maintenance including snow and ice removal related stormwater management activities;
- Fleet and facility stormwater pollution prevention plans and their implementation; and
- Preparation and timely submittal of annual compliance demonstration report to MSD according to agreed upon formats and standards.

The SWQMP, which is a detailed business plan MSD and its co-permittees use as a tool to implement the MS4 permit, was submitted to KDOW in July 2017 and an annual review of the SWQMP is completed as part of the MS4 Annual Report submittal. The intended purposed of the SWQMP is to improve water quality in local streams, creeks, and waterways within Jefferson County. The expected water quality benefits include reductions in pollutants of concern and more closely meeting the Clean Water Act goals for water quality.

1.4.3 Integrated Overflow Abatement Plan (IOAP)/Green Infrastructure

MSD is currently under a consent decree by the U.S. Environmental Protection Agency and the Kentucky Environmental and Public Protection Cabinet to reduce sanitary and combined sewer overflows. An Integrated Overflow Abatement Plan (IOAP) has been prepared by MSD to address the consent decree. The IOAP is a long-term plan to control combined and separate sewer overflows in the community so MSD can meet all federal and state clean water regulations. The goal of the program is to improve water quality and protect the health of the citizens of Louisville Metro and these regulations must be met in order to avoid severe financial penalties. The original completion deadline was 2024 but due to changes to infrastructure condition risks, an extension to 2035 was granted. This extension will allow the addition of critical health and safety projects into the capital program while balancing financial restrictions. A list of Amended Consent Decree projects can be found in Appendix B.

Water quality improvements resulting from Consent Decree projects implementation so far include:

- Reduced basement backups through completion of nearly 18,000 plumbing modification projects
- Reduced CSO volumes to local waterways by 5 billion gallons per Typical Year
- Elimination of 72% projected sanitary sewer overflow volumes for a 2-year storm

Notable IOAP projects include:

- Asset Inventory - MSD has committed to investing $25 million per year in collection system and wastewater treatment asset management through 2035 as an Amended Consent Decree Requirement. This program will improve clean water services reliability, reduce failures, and benefit water quality by reducing inflow and infiltration sources. This program is documented in MSD's Strategic Asset Management Plan (SAMP), with facility- and system-specific strategies under development in a series of Tactical Asset Management Plans (TAMPs).

- Paddy's Run Flood Pumping Station – This project will construct a new flood pumping station with six new flood pumps providing an estimated pumping capacity of 1,900 MGD.

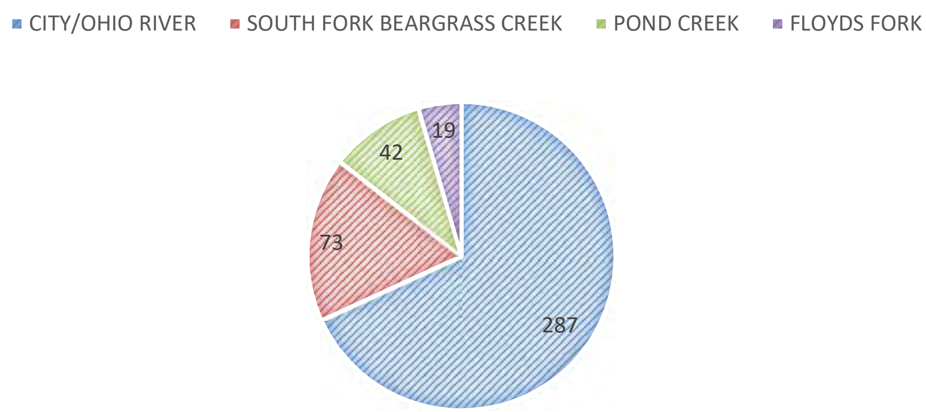
- Critical Interceptor Projects – These projects are required as part of the Amended Consent Decree and will be an approximately $70 million dollar investment:
    - Completed - Harrods Creek Force Main Repair, Nightingale Sewer Rehabilitation
    - Underway - I-64 and Grinstead Infrastructure Rehabilitation, Rudd Avenue Sewer Infrastructure Rehabilitation
    - Future - Prospect Phase II Area Sewers Rehabilitation, Western Outfall Infrastructure Rehabilitation

1.4.4 Floodplain Buyout Grant Prioritization

Where flooding occurs along the Ohio River, residents typically have 2 to 3 days notice to evacuate. However, elsewhere in Jefferson County, flash flooding is a greater risk due of the suddenness and unpredictability of localized flooding events. This leaves residents with little or no time to evacuate since roadways in these areas are also at risk of flooding. This creates risk to emergency personnel because boat rescues may be required. For these reasons, there are limited opportunities to reduce flood risk by elevating or floodproofing structures and MSD continues to pursue flooding risk mitigation through various FEMA Hazard Mitigation Assistance and MSD funded buyout programs.

Recently, MSD carried out a planning study to prioritize properties for future buyout programs that analyzed the Special Flood Hazard Area, Local Regulatory Floodplain and First Street Foundation Flood Factor data. Flood Factor data was included as it provides flood information at the property level for future climate scenarios as well as risks associated with pluvial flooding that would not be included in riverine flood zone mapping. Based on this study, homes anticipated to experience 2' or more of flooding during a 100-year flood event will be prioritized for future buyout grant applications. Figure 1.4 below shows the top 4 watersheds for potential residential floodplain buyout acquisitions.

FIGURE 1.4
POTENTIAL FLOOD BUYOUT PROPERTIES BY WATERSHED



1.4.5 American Rescue Plan Act of 2021 (ARPA) Funding

The American Rescue Plan Act of 2021 (ARPA) provided funding to support recovery from the 2020 COVID-19 pandemic. ARPA funds received by MSD were spent on flood protection items. MSD is working with small cities within Jefferson County who received ARPA funds to fast track selected DRI program projects.

1.5 Watershed Master Plans

1.5.1 General

The management of stormwater drainage is recommended to be on a watershed-by-watershed basis. Accomplishment of this approach shall be through the development of Watershed Master Plans. These plans document the hydrologic, physiographic, drainage characteristics, and planning tools pertinent to managing stormwater drainage in the watershed. Utilizing this information within the context of various policies, goals and objectives established for the WMP, specific “Action Plans” set forth recommended regional projects, special regulations for development, and requirements for further updating and upgrading the planning data and models.

Further information specifically regarding the floodplain of each watershed, including number of floodprone buildings, development trends, critical facilities located in the floodplain, natural and beneficial functions of the floodplain, and general flooding information can be found in the Louisville Metro Hazard Mitigation Plan.

1.5.2 Plan Contents

The individual watershed plans provide an overview for each of Louisville Metro's eleven sub-watersheds. Each subsection provides the following information:

- General description including watershed area, stream names, soils and land use
- Completed stormwater improvement projects such as regional detention basins, large and small scale drainage projects, and water quality practices
- Current hydrologic and hydraulic models available for the particular watershed
- Watershed specific requirements for new development such as 1.5:1 compensation for fill added to the floodplain or requiring post developed stormwater discharge rates to be less than pre-developed levels
- List of recommended stormwater improvement projects that correspond with the Critical Repair and Reinvestment Plan (CRRP) and the Integrated Overflow Abatement Plan (IOAP) planned through 2035

The intent of the WMP is to develop the means and methods to address management of stormwater drainage on a regionally consistent basis. The various planning tools and data in the Watershed Master Plans will be used by both MSD and the technical community. Therefore, the organization of this data was standardized to provide consistent means of cataloging and referencing the data. The following is the standardized outline for a Watershed Master Plan.

- **Watershed Study Area** – This section provides a general description of the watershed location, communities, and notable features. Topography, geology, soils, land use, and any regional basins or major channel improvement projects are also described in this section. This section also includes a description of any natural stormwater features located in the watershed that will be protected, such as parks, greenways, and conservation easements.
- **Modeling** – This section describes modeling that has been done for the watershed. Assumptions and calibrations for the models are described.
- **Action Plan** – This section provides recommended drainage improvement projects and regulatory control strategy for the watershed.

2.0 MIDDLE FORK BEARGRASS CREEK

2.0 MIDDLE FORK – BEARGRASS CREEK

2.1 Watershed Study Area

2.1.1 General


Middle Fork Beargrass Creek at Cherokee Park

The 25 square mile Middle Fork Beargrass Creek Watershed is located in the north central portion of Jefferson County. Its headwaters originate in Middletown and flow in a westerly direction through St. Matthews. The stream continues into the Highlands via Seneca and Cherokee Parks, to finally outlet into the South Fork Beargrass Creek just south of Main Street. The major streams in the Middle Fork Beargrass Creek Watershed are Middle Fork and Weicher Creek. An aerial map showing the Middle Fork Beargrass Creek Watershed is included as Map MLF-1. A drainage map showing the 17 subbasins for Middle Fork Beargrass Creek is included as Map MLF-2.

Communities lying in this watershed include the Highlands, Seneca Gardens, St. Regis Park, St. Matthews, Lyndon, Wildwood, Hurstbourne, Douglass Hills, and Middletown.

Notable landmarks include Cherokee Park, Seneca Park, Cave Hill Cemetery, the Southern Baptist Seminary, Bowman Field, Big Spring Country Club, Mall St. Matthews, Oxmoor Mall, and Hurstbourne Country Club.


Wetlands located along Middle Fork Beargrass Creek at Arthur K. Draut Park

Several parks are located along the Middle Fork of Beargrass Creek. These parks provide open space where flooding can occur without property damage and allow recreational use during drier periods. Cherokee Park and Seneca Park, which are owned by Louisville Metro, are located along Middle Fork Beargrass Creek in the Highlands area. The City of St. Matthews has three parks located along Middle Fork floodplain, St. Matthews Community Park, Brown Park and Arthur K. Draut Park. Arthur K. Draut Park also includes wetlands, which help improve water quality for the creek. In addition, conservation easements have been created by the Peterson-Dumesnil House located in Crescent Hill.

2.1.2 Topography

The entire Middle Fork Beargrass Creek Watershed is situated in the Eastern Uplands Topographic Region. Broad steep-sided valleys and flat to gently rolling plateaus dominate the terrain. Middle Fork Beargrass Creek has cut deeply into this terrain and flows through a well-entrenched channel; where near vertical cliffs are common.

Elevations range from about 425 feet, at the confluence with South Fork Beargrass Creek, to about 750 feet, in the Middletown area.

2.1.3 Geology

The major portion of this watershed is underlain by limestones of the lower Devonian and middle Silurian ages. A notable exception is the Lyndon/St. Matthews area, which is underlain by middle Devonian age shale. Middle Fork Beargrass Creek has eroded deep into these rocks, and in some instances, shales of middle Silurian age are exposed. The general dip of these rock beds, or strata, is toward the west at a little less than one foot in one-hundred feet. A northeast trending synclinal axis is observed, however, in the Lyndon/St. Matthews area. A northeast trending anticlinal axis is also observed in the Seneca Gardens/Seneca Park area. Limited karst activity is represented by some small sinkholes and springs, particularly in the Lyndon/ Oxmoor area and in the area of the Sinking Fork.

Middle Fork at Breckenridge Lane

2.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Middle Fork Beargrass Creek Watershed is mainly Group B and unclassified. The soil groups in the Middle Fork Watershed can be found on Map MLF-3.

2.1.5 Land Use

The land use in the Middle Fork Watershed is mostly residential and commercial, with many of the commercial properties located along Shelbyville Road and Hurstbourne Lane. Some agricultural land is also located in this watershed behind the Oxmoor Mall. A map of the existing land use is included as Map MLF-4.

2.1.6 Watershed Improvements

Watershed improvements in the Middle Fork Beargrass Creek watershed include:

- The Waterway Protection Tunnel project extension replaced the planned storage basin project near Lexington Rd and Grinstead Dr and linked it with a four-mile long, 20 ft diameter tunnel running from 11th and Rowan streets to Grinstead Drive and Lexington Road, The tunnel can store up to 55 million gallons of storm and waste water until sewer treatment capacity is available. The tunnel will prevent 439 million gallons of untreated water per Typical Year from entering Beargrass Creek and the Ohio River. Construction is underway and will be completed before the December 2022 Consent Decree deadline.

Waterway Protection Tunnel during construction

- MSD partnered with the Louisville Jefferson County Environmental Trust to complete a restoration project along the banks of a tributary to Middle Fork Beargrass Creek in a conservation easement along Grinstead Drive. The project installed native plants, trees and shrubs in an effort to reduce erosion and improve water quality of roadway drainage before it enters the stream.

- Metro Parks and the U.S. Army Corps of Engineers partnered in a planning effort entitled: “Beargrass Creek Trail Conceptual Shared Use Path and Ecological Restoration Plan.” The plan area extended along Beargrass Creek from its confluence with the Ohio River to the area of the Grinstead Drive/Lexington Road intersection.

- MSD and the U.S. Army Corp of Engineers worked together on the Three Forks of Beargrass Creek Ecosystem Restoration Feasibility Study that includes South, Middle, and Muddy forks of Beargrass Creek. The project investigated options to restore ecosystem structure, function and processes lost over time in the watershed. The study recommendations were completed in May 2022 with a signed Chief’s Report.

- A stream restoration in Cherokee park realigned the stream channel through a bridge and implemented methods to reduce erosion including: vane structures, pools, and toe wood and soil bioengineering techniques.

- Stream restoration at Brown Park - Realignment of Beargrass Creek in the City of St Matthews Brown Park. This work stabilized 1,050 linear feet the flow line and banks of the creek by installing bank protection, j hooks, riffles, brush layering and log vane structures.

- Stream restoration at the City of St Matthews Community Center Park restored sections of two intermittent stream channels totaling 2,600 linear feet by planting vegetation to prevent additional erosion of the stream bank.

- The Whipps Mill Basin, which is a regional flood storage basin that is situated in the upper portion of the Middle Fork Watershed, was built in 2000. The basin covers a 40-acre site and provides flood protection for hundreds of residents.

- The Woodlawn Park Basin is a regional basin located on an approximately 5-acre site in the central portion of the Middle Fork Watershed.

2.1.7 Local Basins

There are currently 79 local and two regional stormwater basins located in the Middle Fork Beargrass Creek watershed. These basins are shown on Drainage Map MLF-2.

2.1.8 Water Quality Best Management Practices

There are currently 5 bioswales, 1 green wet basin, 17 rain gardens and 36 water quality units in the Middle Fork Beargrass Creek watershed. These are shown on Drainage Map MLF-2.

Middle Fork at Brown Park

2.2 Modeling

The hydrologic analysis for Middle Fork Beargrass Creek was calculated using HEC-1 and HEC-HMS. Curve numbers, drainage area, and time of concentration were used to determine flows from each subbasin. Storage routings were added as needed and numerous trials were required in order to determine final discharge values. Using the discharge values from HEC-l or HEC-HMS, HEC -2 or HEC-RAS was used to create stream profiles. Cross sections and bridge elevations and geometry were field surveyed.

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Streams within this watershed were updated with this effort. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E. A Zones exist for Foxmoor Creek and more detailed modeling of this area will be performed as funding becomes available.

An updated study is currently underway for an approximately 8.7 mile reach along Middle Fork Beargrass Creek downstream of Sherburn Ln. The current models for this area are in HEC-1 and HEC-2 format. This update with convert these to the current HEC platforms and reflect the removal and addition of hydraulic strictures occurring since the original model was created.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Map MLF-5 shows the limits of each of these floodplains.

2.3 Action Plan

2.3.1 Watershed Requirements

New development in the Middle Fork Beargrass Creek Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24 hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

For new development in the combined sewer area, the post-developed 100-yr flows are restricted to the pre-developed 10-yr flows to help reduce the flows in the system during rain events. Engineers must design the new development's onsite stormwater system to meet this Design Manual requirement. Examples of this include building detention basins, oversizing onsite stormwater pipes, and using green solutions such as pervious pavement and rain gardens to reduce peak flows and overall runoff volumes.

Floodplain compensation is required in the Middle Fork Beargrass Creek Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. The ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or “soft” approaches where possible. MSD’s Design Manual outlines natural channel design requirements in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24 hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

2.3.2 Proposed Projects

Proposed projects in this watershed include the following:

- IOAP projects in this watershed include the Waterway Protection Tunnel and Upper Middle Fork Lift Station. More information regarding these projects can be found in Appendix A of this report.
    - The Waterway Protection Tunnel (construction underway) will be completed before December 2022 and will store a volume of up to 55 million gallons of combined sewer overflow every time it rains until sewer treatment capacity is available. This will prevent 439 million gallons of untreated water per Typical Year from entering Beargrass Creek and the Ohio River. In 2016 and again in 2018, this project consolidated former CSO storage basin solutions associated with the Ohio River and Beargrass Creek into a single underground storage solution. The Waterway Protection Tunnel is a four-mile long, 20 ft diameter tunnel running from 11th and Rowan streets to Grinstead Drive and Lexington Road.
    - Upper Middle Fork Lift Station – This project includes constructing 10,200 LF of 30" Force Main Diversion to Hikes Lane Interceptor from the existing UMFLS. A Middle Fork Relief Interceptor will be constructed between Oxmoor and Middle Fork at Breckenridge with a new pump station constructed at Duchmans Ln and Dupont Rd. The pipe downstream of manhole 15138 will be upsized to 18". This project will reduce combined sewer as well as sanitary sewer overflows to Middle Fork and South Fork of Beargrass Creek. Its IOAP completion deadline is December 31, 2030.

- A watershed plan for Middle Fork was completed using EPA’s 319(h) funding. This plan evaluated water quality within Middle Fork and identified potential projects for improvement. The watershed plan was approved by the EPA in March 2022 and MSD has begun working toward implementing the plan. These projects will be budgeted through MS4 program. A list of proposed projects can be found in Appendix D. The first project that has been submitted for funding using the 319(h) funding is a watershed coordinator for Middle Fork. The application for the watershed coordinator is currently under review.

- In an effort to reduce risks associated with flooding, flood level sensors and remote monitoring equipment will be placed on the high hazard dam located at Whipps Mill. The sensors and monitoring equipment are planned to be placed on the dam in FY23.

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated a program to address a wide variety of drainage issues requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- In addition to the DRI projects, the Critical Repair and Reinvestment Plan proposes the City of Hurstbourne Early Action Project, the Richlawn Early Action Project and the Woodlawn Park basin retrofit as projects in the Middle Fork watershed. Proposed Critical Repair and Reinvestment Projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

3.0 MUDDY FORK BEARGRASS CREEK

3.0 MUDDY FORK – BEARGRASS CREEK

3.1 Watershed Study Area

3.1.1 General

The eight square mile Muddy Fork Beargrass Creek Watershed is located in the north central portion of Jefferson County. Its headwaters originate in the Graymoor/Devondale area. The stream then flows northwesterly to I-71, turns to the southwest, and parallels I-71 to finally outlet into South Fork Creek Beargrass Creek just downstream of the Beargrass Creek pumping station. The only major creek running through this watershed is Muddy Fork Beargrass Creek. An aerial map showing the Muddy Fork Beargrass Creek Watershed is included as Map MF-1. A drainage map showing the seven subbasins for Muddy Fork Beargrass Creek is included as Map MF-2.

Communities lying in this watershed include Graymoor, Devondale, Crescent Hill, Rolling Fields, Mockingbird Valley, Indian Hills, and Windy Hills.


Muddy Fork at Mockingbird Valley Rd

Notable landmarks include the Veterans Administration (VA) Hospital and Crescent Hill Park.

3.1.2 Topography

The major portion of the Muddy Fork Watershed is situated in the Eastern Uplands Topographic Region. The remaining portion, which includes I-71 and land adjacent to the Ohio River, is in the Flood Plain.

Broad steep-sided valleys and gently rolling plateaus dominate the terrain in the Eastern Uplands Region. Muddy Fork has cut deeply into this terrain and flows though a well entrenched channel where near vertical cliffs are common.

A flat, low-lying terrain predominates in the floodplain. Stream channels of low gradient slopes tend to parallel the Ohio River.

Elevations range from about 420 feet, the pool stage of the Ohio River above the McAlpine Lock and Dam, to about 585 feet, in the Devondale area.

3.1.3 Geology

The portion of this watershed lying in the Eastern Uplands Topographic Region is predominately underlain by limestone of lower Devonian age. The major creeks, however, have eroded channels deeply into, and in many cases, through these rocks, exposing limestones, shales, and dolomites of middle Silurian age. The general dip of these rock beds, or strata, is toward the west at a little more than one-half foot in one-hundred feet. However, a northeast trending anticlinal axis is observed in the Brownsboro Village/Windy Hills area. Limited karst activity is represented by small sinkholes and springs.

The portion of this watershed lying in the Flood Plain Topographic Region is underlain by various alluvial deposits of Quaternary age. These deposits range in thickness from several feet to well over one hundred feet, and are comprised of complex layers of silts, sands, clays, and gravels. This region is a well-documented aquifer and groundwater is readily available.

3.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Muddy Fork Beargrass Creek Watershed is mainly B and C soils, with some soils in the unclassified soil group. The soil groups in the Muddy Fork Watershed can be found on Map MF-3.

Muddy Fork at Elmwood Avenue

3.1.5 Land Use

The majority of the land use in the Muddy Fork Watershed is residential. The existing land use in the Muddy Fork Watershed can be found on Map MF-4.

3.1.6 Watershed Improvements

No regional stormwater basins or major channel improvement projects are located in the Muddy Fork Watershed. This Clifton Heights combined sewer storage basin project was completed as part of the IOAP.

MSD and the U.S. Army Corp of Engineers worked together on the Three Forks of Beargrass Creek Ecosystem Restoration Feasibility Study which includes South, Middle, and Muddy forks of Beargrass Creek. The project investigated options to restore ecosystem structure, function and processes lost over time in the watershed.

The MSD Clifton Heights Combined Sewer Overflow (CSO) Basin was completed December 21, 2018. It will store up to 7 million gallons of wastewater and stormwater during rain events and gradually release it back into the sewer system when treatment capacity is available. The basin is mostly underground and invisible to the public. The hillside covering the part of the basin is an unmowed meadow. A mowed grassy flat area at the bottom of the hillside provides a place for the neighbors to enjoy the park-like setting. A wetlands area contains a mix of 25 diverse native meadow plant species providing pollinator habitat and erosion control.

3.1.7 Local Basins

There are currently 15 local stormwater basins and 1 regional stormwater basin located in the Muddy Fork Beargrass Creek watershed. These basins are shown on Drainage Map MF-2.

3.1.8 Water Quality Best Management Practices

There are currently two bioswales and six water quality units in the Muddy Fork Beargrass Creek watershed. These are shown on Drainage Map MF-2.

3.2 Modeling

Hydraulic analyses for the Muddy Fork Watershed were developed using HEC-RAS. Curve numbers, drainage area, and time of concentration were used to determine flows from each subbasin. Using the discharge values from HEC-HMS and HEC-RAS were used to create stream profiles. Cross sections and bridge elevations and geometry were field surveyed.

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Streams within this watershed, which were previously A zones, were updated to AE zones with this effort. More information on these studies can be found in Appendix E.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Map MLF-5 shows the limits of each of these floodplains.

3.3 Action Plan

3.3.1 Watershed Requirements

New development in the Muddy Fork Beargrass Creek Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24 hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

For new development in the combined sewer area, the post-developed 100-yr flows are restricted to the pre-developed 10-yr flows to help alleviate the flows in the system during rain events. Engineers must design the new development's onsite stormwater system to meet this Design Manual requirement. Examples of this include building detention basins, oversizing onsite stormwater pipes, and using green solutions such as pervious pavement and rain gardens to reduce peak flows and overall runoff volumes.

Floodplain compensation is required in the Muddy Fork Beargrass Creek Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. This ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or "soft" approaches where possible. MSD's Design Manual outlines natural channel design requirements in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an

EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24 hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

3.3.2 Proposed Projects

Proposed projects in this watershed include the following:

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

Other than the DRI program, the Critical Repair and Reinvestment Plan does not propose any projects for the Muddy Fork watershed. Future projects may be identified as a result of the Stormwater Master Plan.

4.0 SOUTH FORK BEARGRASS CREEK

4.0 SOUTH FORK – BEARGRASS CREEK

4.1 Watershed Study Area

4.1.1 General

The 27 square mile South Fork Beargrass Creek Watershed is located in the north central portion of Jefferson County. Its headwaters originate in Jeffersontown, flow in a westerly direction to Buechel, turn northwest into the Highlands, and finally, turn slightly northeast at the Louisville and Nashville Railroad and eventually outlet into the Ohio River near Towhead Island. At about mile 0.75 of South Fork, the Louisville Local Flood Protection Project (Floodwall) crosses the stream. A large pumping station is located at this point. In addition, from approximately mile 1.4 to mile 4.1, the stream is a large concrete channel with high vertical sidewalls. Major streams in this watershed include South Fork Beargrass Creek and Buechel Branch. An aerial map showing the South Fork Beargrass Creek Watershed is included as Map SF-1. A drainage map showing the 24 subbasins for South Fork Beargrass Creek is included as Map SF-2.

South Fork Beargrass Creek at Broadway

Communities lying in the watershed include Jeffersontown, Phoenix Hill, Germantown, Audubon Park, Strathmoor, Wellington, Buechel, Highgate Springs, Houston Acres, Forest Hills, Schnitzelburg, Smoketown, Shelby Park, Tyler Park and the Highlands.

Notable landmarks include the Beargrass Creek Pumping Station, Calvary Cemetery, the Louisville Zoo, Tyler Park, and Rest Haven Memorial Cemetery. Several parks are located within the floodplain of South Fork Beargrass Creek, including Joe Creason Park and the Beargrass Creek State Nature Preserve. Buechel Park is located along Buechel Branch, a tributary of South Fork Beargrass Creek. These parks provide open space where flooding can occur without property damage, as well as recreational uses during drier periods. Conservation easements have also been granted along South Fork Beargrass Creek near Poplar Level Road and Illinois Avenue by Audubon Hospital, Calvary Cemetery, Day Spring, and the St. Joseph Home for the Aged.

4.1.2 Topography

The major portion of the South Fork Beargrass Creek Watershed is situated in the Eastern Uplands Topographic Region. The remaining portion, which lies west of the Louisville and Nashville Railroad and adjacent to the Ohio River, is in the Flood Plain.

Broad steep-sided valleys and flat to gently rolling plateaus dominate the terrain in the Uplands Region. South Fork Beargrass Creek has cut deeply into this terrain and flows through a well-entrenched channel.

Beargrass Creek Flood Pumping Station

A very flat, low-lying terrain predominates in the Flood Plain. South Fork Beargrass Creek flows through an improved concrete channel in this region. Elevations range from about 420 feet, the pool stage of the Ohio River above McAlpine Lock and Dam, to about 690 feet, in the area north of Jeffersontown.

4.1.3 Geology

The portion of this watershed lying in the Eastern Uplands Topographic Region is predominately underlain by limestones of lower Devonian and middle Silurian age. The South Fork Beargrass Creek, which flows through a well developed alluvial channel, cuts deeply into those rocks but does not expose the older, middle Silurian shales and dolomites. The general dip of these rock beds, or strata, is toward the west at a little less than one foot in one hundred feet. A north trending synclinal axis is observed in the Buechel/Highgate Springs area. A northeast trending anticlinal axis is observed in the Camp Taylor/Strathmoor area. Limited karst activity is represented by some small sinkholes and springs.

Outlet of South Fork Beargrass Creek into the Ohio River

The portion of this watershed lying in the Flood Plain Topographic Region is predominately underlain by glacial outwash deposits of Quaternary age. These deposits vary in thickness from several feet to well over one hundred feet, and are comprised of complex layers of silts, sands, clays, and gravels. This region is a well-documented aquifer, and groundwater is readily available.

4.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the South Fork Beargrass Creek Watershed is mainly Group B and unclassified. The soils in the South Fork Beargrass Creek Watershed can be found on Map SF-3.

4.1.5 Land Use

The majority of the land use in the South Fork Watershed is residential, however many commercial properties are located in the downtown area and along major roads such as Bardstown Road, Poplar Level, and Hurstbourne Parkway. Some industrial properties also exist in the South Fork Watershed and are mostly located near the downtown area and the Newburg Road area south of the Watterson Expressway. Map SF-4 shows the land use in this watershed.

4.1.6 Watershed Improvements

Watershed improvements include:

- MSD and the U.S. Army Corp of Engineers worked together on the Three Forks of Beargrass Creek Ecosystem Restoration Feasibility Study, which includes South, Middle, and Muddy forks of Beargrass Creek. The project investigated options to restore ecosystem structure, function and processes lost over time in the watershed.

- The Logan Street CSO Basin at 935 Logan Street is completed and captures 11 combined sewer overflow points that previously discharged 15,400,000 gallons of a mixture of sewage and rainwater annually into the South Fork of Beargrass Creek.

- Nightingale Pump Station Replacement and CSO Storage Project was completed.

- MSD has also completed several green infrastructure projects in this watershed to improve water quality and reduce runoff including tree boxes and pervious pavers near CSO 130, which is in the Butchertown neighborhood.

- The South Fork Beargrass Creek Flood Protection project was initiated in 2001 and completed in 2010. The project was a joint project between the USACE and MSD and included the construction of eight regional basins, ranging in size from 9 acre-feet to 160 acre-feet of storage, throughout the South Fork Watershed. The project also included 2000 feet of channel improvement, 1900 feet of floodwall around an apartment complex, and environmental features, such as construction of pools and riffles in the channels and planting 9 acres of bottomland hardwoods. The purpose of the project was to help relieve flooding in the South Fork Watershed. The basins are located near Bashford Manor, Breckenridge Lane, Downing Way, Fountain Square, Hikes Lane, Gerald Court, Richland Ave, and Old Shepherdsville Road.

- The Dry Bed Reservoir, which is located in the upper portion of the South Fork Beargrass Creek Watershed. This basin was constructed in the 1980's to relieve flooding along South Fork.

- IOAP projects included:
  - Camp Taylor Sewer Replacement & Sewer Rehabilitation
  - Logan Street and Breckinridge Street Storage Basin –This project included a 16.6 MG underground covered storage basin to reduce overflows to 8 overflows per Typical Year
  - Nightingale Pump Station Replacement & Storage – Upgraded the Nightingale Pump Station (NGPS) to 33 MGD and added a 7.7 MG storage basin
  - Nightingale I&I Rehabilitation
  - Story Avenue and Spring Street Green Infrastructure –construction of a suite of green infrastructure practices in the CSO130 contributing drainage area to achieve 0.08 MG in overflow reduction and mitigate overflows to 8 overflows in a Typical Year.

4.1.7 Local Basins

There are currently 74 local and 11 regional stormwater basins located in the South Fork Beargrass Creek watershed. These basins are shown on Drainage Map SF-2.

4.1.8 Water Quality Best Management Practices

There are currently 12 bioswales, 2 green dry basins, 8 planter boxes, 16 rain gardens, 36 tree boxes and 51 water quality units in the South Fork Beargrass Creek watershed. These are shown on Drainage Map SF-2.

Bashford Manor Regional Basin

4.2 Modeling

A hydrologic analysis for South Fork Beargrass Creek was completed for the 2006 and 2021 FIS. HEC-HMS and HEC-1 were used to model the stream. LOJIC data was used to estimate model inputs, such as curve number, time of concentration, and soil groups. Water surface elevations were determined using HEC-RAS or HEC-2 and cross sections were obtained from field surveys. Bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Ineffective flow areas were included in areas with significantly reduced flow conveyance, such as inundated commercial/industrial areas, neighborhoods, and areas of floodplain storage. Roughness coefficients were determined based on field inspections and aerial photography.

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Streams within this watershed were updated with this effort. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E. A Zones exist for the Brooklawn Tributary. More detailed modeling of this area will be performed as funding becomes available.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Map SF-5 shows the limits of each of these floodplains.

4.3 Action Plan

4.3.1 Watershed Requirements

New development in the South Fork Beargrass Creek Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24 hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

For new development in the combined sewer area, the post-developed 100-yr flows are restricted to the pre-developed 10-yr flows to help reduce the flows in the system during rain events. Engineers must design the new development's onsite stormwater system to meet this Design Manual requirement. Examples of this include building detention basins, oversizing onsite stormwater pipes, and using green solutions such as pervious pavement and rain gardens to reduce peak flows and overall runoff volumes.

Floodplain compensation is required in the South Fork Beargrass Creek Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. This ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or "soft" approaches where possible. MSD's Design Manual outlines natural channel design requirements in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24 hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

4.3.2 Proposed Projects

Proposed projects in this watershed include the following:

- FEMA Hazard Mitigation Assistance Buyout Programs are on going in this area. Properties purchased through this grant program are required to be maintained as open space. Long-term uses for these areas could include the construction of a stormwater basin, floodplain storage creation, or similar mitigation method to aid in reducing the impact of smaller storm events. Other future uses could be for community park spaces such as the potential Hayfield-Dundee Pocket Park planned for acquired properties along Sutherland Drive and Calder Ct.

- Design drawings are being prepared for retrofit of the existing Kort Springs Basin to add water quality features including bioswales and rain gardens.

- The Congress for New Urbanism was held in Louisville in 2019 and generated four Legacy Projects with one of these being a plan for connecting the diverse neighborhoods along Beargrass Creek. This project would construct an accessible shared-use path system along South Fork Beargrass Creek extending from the Louisville Zoo to the Ohio River.

- In an effort to reduce risks associated with flooding, flood level sensors and remote monitoring equipment will be placed on the high hazard dam located at South Fork and the Willowbrook floodwall.

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- The Critical Repair and Reinvestment Plan proposes nine new projects in the South Fork watershed. Seven of the projects are basin retrofits. These projects are located at the Breckinridge Lane basin, Downing Way basin, Fountain Square basin, Gerald Court basin, Hikes Lane basin, Old Shepherdsville Road basin, and Richland Avenue basin. These basin retrofits are included in the 5-year capital improvement plan budget. Proposed Critical Repair and Reinvestment Projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

5.0 CEDAR CREEK

5.0 CEDAR CREEK

5.1 Watershed Study Area

5.1.1 General

The 11 square mile Cedar Creek Watershed is located in south central Jefferson County and is bisected by the Gene Snyder Freeway. Its headwaters originate in the Fern Creek area. The stream flows in a southerly direction, passing into Bullitt County, and eventually discharges into Floyds Fork. For the purposes of this study, the Jefferson/Bullitt County line serves as the approximate southerly watershed boundary. Cedar Creek is the only major stream in this watershed. An aerial map showing the Cedar Creek Watershed is included as Map CC-1. A drainage map showing the six subbasins for Cedar Creek is included as Map CC-2.

Cedar Creek near Gene Snyder Freeway

Communities lying in this watershed include Fern Creek and Highview.

Notable landmarks include Beulah Church and Fern Creek High School.

5.1.2 Topography

The entire Cedar Creek Watershed is situated in the Eastern Uplands Topographic Region. Broad, fairly steep-sided valleys and narrow ridge crests dominate the terrain. Streams have cut deeply into this terrain and flow through the well-entrenched channels.

Elevations range from about 550 feet, at the Jefferson County/Bullitt County line, to about 740 feet, in the area north of Fern Creek.

5.1.3 Geology

The entire watershed is underlain by rocks of middle Silurian age. On higher ground, limestone is predominant. In the deeply cut stream channels, shales and dolomites are commonly exposed. The general dip of these rock beds, or strata, is toward the west at a little less than one foot in one hundred feet. Surficial features do not indicate karst activity, but springs are common on top of the Silurian shales.

5.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Cedar Creek Watershed is mainly from soil group C and the unclassified soil group. The soils in the Cedar Creek Watershed can be found on Map CC-3.

5.1.5 Land Use

The Cedar Creek Watershed is mainly residential, with large tracts of agricultural land use, especially in the eastern portion of the watershed. A map showing existing land use in the Cedar Creek Watershed is included as Map CC-4.

Bartley Drive Stream Buffer Restoration

5.1.6 Watershed Improvements

In 2016, MSD initiated the Bartley Stream Restoration Project. The project purchased and removed one home located in the floodplain. This riparian area was then restored to a natural stream buffer. Trees, shrubs and grasses were planted along the stream buffer to improve the stream health by adding shade and habitat along Cedar Creek.

5.1.7 Local Basins

There are currently 54 local stormwater basins located in the Cedar Creek watershed. These basins are shown on Drainage Map CC-2.

5.1.8 Water Quality Best Management Practices

There is currently 1 green dry basin, 1 green wet basin, 1 rain garden and 14 water quality units in the Cedar Creek watershed. These basins are shown on Drainage Map CC-2.

5.2 Modeling

Modeling for Cedar Creek was completed using HEC-HMS. LOJIC data was used to estimate model inputs, such as curve number, time of concentration, and soil groups. Water surface elevations were determined using HEC-RAS. Cross sections were obtained from field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Roughness coefficients were determined based on field inspections and aerial photography. No stream gauges existed in the Cedar Creek Watershed at the time of the study; therefore, the model was calibrated using the regression equations for Jefferson County presented in “Estimation of Peak-Discharge Frequency of Urban Streams in Jefferson County, Kentucky, U.S. Geological Survey, Water-Resources Investigations Report 97-4219.”

As part of MSD’s most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. More information on these studies can be found in Appendix E.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Map CC-5 shows the limits of each of these floodplains.

5.3 Action Plan

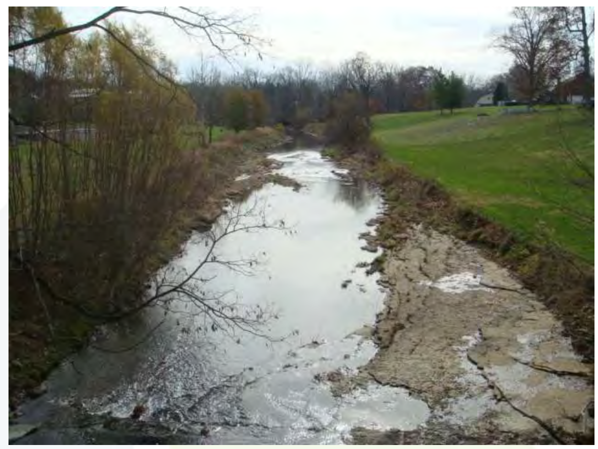
5.3.1 Watershed Requirements

New development in the Cedar Creek Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24 hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

Floodplain compensation is required in the Cedar Creek Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. This ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).


Cedar Creek at Thixton Lane

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams are should use natural or “soft” approaches where possible. MSD’s Design Manual outlines natural channel design requirements in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm used is the 10-year 24-hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

5.3.2 Proposed Projects

Proposed projects in this watershed include the following:

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- The Critical Repair and Reinvestment Plan proposes one new project in Cedar Creek, the Seatonville Early Action Project. Proposed Critical Repair and Reinvestment Projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

6.0 FLOYDS FORK

6.0 FLOYDS FORK

6.1 Watershed Study Area

6.1.1 General

The 460 square mile Floyds Fork Watershed is located in eastern Jefferson County, Henry, Oldham, Shelby, Spencer, and Bullitt Counties. Its headwaters originate in southwest Henry County, approximately 13 miles beyond the Jefferson County boundary line. Flow is generally southwest through Oldham, Shelby, and Jefferson Counties, and then into Bullitt county, where it outlets into the Salt River. The major streams in this watershed are Floyds Fork, Pope Lick, and Chenoweth Run. Aerial maps showing the Floyds Fork Watershed are included as Maps FFN-1 and FFS-1. Drainage maps showing the 16 subbasins for Floyds Fork are included as Maps FFN-2 and FFS-2.


Turkey Run a tributary to Floyds Fork at The Parklands of Floyds Fork

The watershed covers a six county area: Jefferson, Bullitt, Spencer, Oldham, Henry and Shelby. For the purpose of this report, only the 104 square mile portion of this watershed which lies in Jefferson County and drains parts of Jeffersontown, Middletown, and Anchorage is given detailed study.

Communities in the study area include parts of Jeffersontown, Middletown, Anchorage, Berrytown, Woodland Hills, Tucker Station, and Hopewell.

Notable landmarks include Fishermens Park, Chenoweth Park, parts of Bluegrass Industrial Park, Eastern High School, and Jeffersontown High School. The Parklands of Floyds Fork is an existing public park system surrounding and preserving open space along Floyds Fork. It includes 4,000 acres and contains 4 major parks: Beckley Creek Park, Pope Lick park, The Strand, Turkey Run Park and Broad Run Park. Conservation easements have also been provided in the Floyds Fork watershed near Deer Run Road and Pope Lick Road. Woodland Protection Areas in this watershed have been created for the Oakland Hills, Hills of Beckley Station and Overlook at Eastwood Subdivisions.

6.1.2 Topography

The entire 33 square mile study area is situated in the Eastern Uplands Topographic Region. Broad, steep-sided valleys and narrow ridge crests dominate the terrain. Major streams have cut deeply into this terrain and flow through well-entrenched channels, where near-vertical cliffs are common. Elevations range from about 490, in the area of the Seatonville Springs Country Club, to about 760 feet, in the area north of Anchorage.

6.1.3 Geology

The major portion of this study area is underlain by limestones, shales, and dolomites of middle Silurian age. Major creeks, however, have eroded channels deeply into, and in many cases, through these rocks. In these deep cuts, limestones, shales, and dolomites of upper Ordovician age are commonly exposed.


Fairmount Falls, a tributary to Floyds Fork

The general dip of these rock beds, or strata, is toward the west at a little less than one foot in one hundred feet. Surficial features do not indicate karst activity, but springs are common on top of the Silurian and Ordovician shales.

6.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Floyds Fork Watershed is from groups B, C, D, and the unclassified group. The soils in the Floyd Forks Watershed can be found on Maps FFN-3 and FFS-3.

6.1.5 Land Use

The majority of the land use in the Floyds Fork Watershed is residential and agricultural. In an effort to protect the natural environment surrounding Floyds Fork, Louisville Metro created the Floyds Fork Special District Development Review Overlay. Properties in this district are subject to additional development standards. The existing land use in the Floyds Fork Watershed can be found on Maps FFN-4 and FFS-4.

6.1.6 Watershed Improvements

21st Century Parks, along with the City of Louisville and Future Fund, acquired nearly 4,000 acres of land to create the Parklands of Floyds Fork. This public park system extends from Shelbyville Road to Bardstown Road along Floyds Fork and incorporates the existing Miles Park and Floyds Fork Park. The project restored and maintains the streamside tree buffer, added new wetlands, forest, meadow, and preserves the natural habitat of several endangered species.

6.1.7 Local Basins

There are currently 382 local stormwater basins located in the Floyds Fork watershed. These basins are shown on Drainage Map FF-2.

6.1.8 Water Quality Best Management Practices

There are currently 11 bioswales, 9 green dry basins, 6 green wet basins, 11 rain gardens and 153 water quality units in the Floyds Fork watershed. These are shown on Drainage Map FF-2.

6.2 Modeling

In the Floyds Fork Watershed, new hydrologic analyses were done using HEC-HMS software to calculate 10, 2, 1, and 0.2 percent chance flood events using the SCS Type II, 24-hour design storm distribution. Model inputs such as curve number, time of concentration, and soil groups were determined using information from LOJIC. Water surface elevations were determined using HEC-RAS. Cross sections were obtained from field surveys and all bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry for Brush Run Upper and Floyds Fork. Cross sections for Long Run Creek were obtained using topographic mapping from LOJIC with a contour interval of 2 feet. Bridges along Long Run Creek were hand measured, but not field surveyed. Roughness coefficients were determined based on field inspections and aerial photography. The majority of the land in the Floyds fork watershed ranges from low density to open land use.

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E. A Zones exist for the tributaries of Upper Brush Run, Chenoweth Run and an unnamed tributary of Floyds Fork. More detailed modeling of these areas will be performed as funding becomes available.

Long Run Creek at Eastwood-Fisherville Road

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Maps FFN-5 and FFS-5 show the limits of each of these floodplains.

6.3 Action Plan

6.3.1 Watershed Requirements

New development in the Floyds Fork Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24-hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

Waterfall on Big Run, a tributary of Floyds Fork

Floodplain compensation is required at a ratio of 1.5:1 in the Chenoweth Run Watershed and 1:1 in the remaining area of the Floyds Fork Watershed for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. This ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS

7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or “soft” approaches where possible. MSD’s Design Manual outlines natural channel design requirements in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24-hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

6.3.2 Proposed Projects

Proposed projects in this watershed include:

- A concept design has been prepared for the installation of a rain garden and creek access at the MSD Floyds Fork Water Quality Treatment Center. This installation will also include educational outreach signage.

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- The Critical Repair and Reinvestment Plan proposes two new projects in the Floyds Fork watershed, the Pope Lick Early Action Project and the drainage improvements to the viaduct at Taylorsville Road and Merioneth Drive. Proposed Critical Repair and Reinvestment Projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

7.0 GOOSE CREEK

7.0 GOOSE CREEK

7.1 Watershed Study Area

7.1.1 General

The 18 square mile Goose Creek Watershed is located in northeastern Jefferson County and is drained primarily by Goose Creek and Little Goose Creek. Goose Creek's headwaters originate in Anchorage, flow in a westerly direction to the area of Westport Middle School, then turn generally northwest, and finally outlet into the Ohio River at Six Mile Island. Little Goose Creek's headwaters originate in the Freys Hill area, flow northwesterly, and eventually discharge into Goose Creek about one-half mile from its outlet on the Ohio River. The major streams are Goose Creek and Little Goose Creek. An aerial map showing the Goose Creek Watershed is included as Map GC-1. A drainage map showing the eight subbasins for Goose Creek is included as Map GC-2.

Outlet of Goose Creek into the Ohio River

Communities situated in this watershed include Anchorage, Rolling Hills, Plantation, Old Brownsboro Place, Hills and Dales, Glenview Heights, Brownsboro Farm, and Green Spring.

Notable landmarks include Kentucky Country Day School, E.P. Tom Sawyer State Park, Owl Creek Country Club, Central State Hospital, Standard Country Club, and Ballard High School. Hounz Lane Park is located along Goose Creek and provides open space and wetland areas that will be preserved. E.P. "Tom" Sawyer State Park is another park located along Goose Creek that provides open space that will be preserved. Woodland Protection Areas have also been created for the Woodstone Subdivision along Goose Creek.

7.1.2 Topography

The major portion of the Goose Creek Watershed is situated in the Eastern Uplands Topographic Region. The remaining portion, which lies adjacent to the Ohio River, is in the Flood Plain.

Broad, fairly steep-sided valleys and gently rolling plateaus dominate the terrain in the Uplands Region. Both Goose and Little Goose Creek have cut deeply into this terrain and they flow through well entrenched, channels, where near vertical cliffs are common.

A flat, low-lying terrain predominates in the Flood Plain Region. Excluding Goose Creek, stream channels of low gradient slopes tend to parallel the Ohio River.

Elevations range from about 420 feet, the pool stage of the Ohio River at the McAlpine Lock and Dam, to about 760 feet, in the area north of Anchorage.

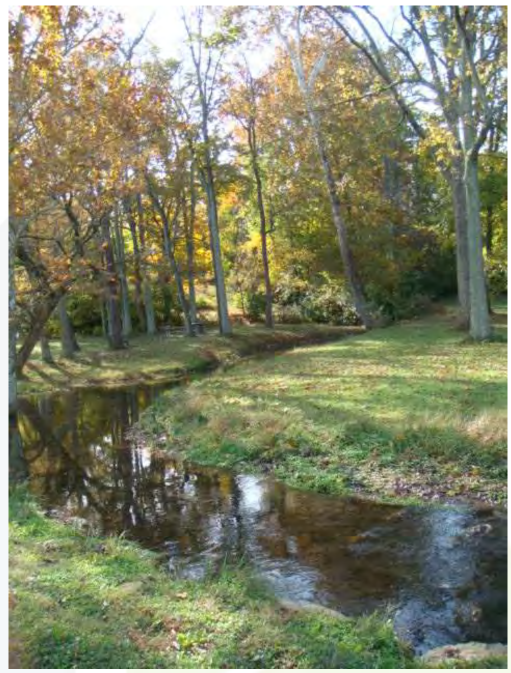
7.1.3 Geology

The portion of this watershed lying in the Eastern Uplands Topographic Region is predominantly underlain by limestones of lower Devonian and middle Silurian age. This major creek, however, has eroded channels deep into these rocks, exposing middle Silurian shales and dolomites. The general dip of these rock beds, or strata, is toward the west at a little more than one-half foot in one hundred feet. A northeast trending anticlinal axis is observed about 0.6 miles north of and parallel to County Road 1447. An east trending synclinal axis is observed in the area north of Anchorage. Limited karst activity is represented by some small sinkholes and springs.

The portion of this watershed lying in the Flood Plain Topographic Region is underlain by various alluvial deposits of Quaternary age. These deposits range in thickness from several feet to well over one hundred feet, and are comprised of complex layers of silts, sands, clays, and gravels. This region is a well-documented aquifer and groundwater is readily available.

7.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Goose Creek Watershed is mainly from soil group B and the unclassified group. The soils in the Goose Creek Watershed are shown on Map GC-3.



Goose Creek at Hounz Lane Park

7.1.5 Land Use

The majority of the land use in the Goose Creek Watershed is residential. The existing land use in the Goose Creek Watershed can be found on Map GC-4.

7.1.6 Watershed Improvements

There are no regional basins or major channel improvement projects located in the Goose Creek Watershed.

7.1.7 Local Basins

There are currently 71 local stormwater basins located in the Goose Creek watershed. These basins are shown on Drainage Map GC-2.

7.1.8 Water Quality Best Management Practices

There is currently 1 green wet basin and 19 water quality units in the Goose Creek watershed. These are shown on Drainage Map GC-2.

7.2 Modeling

Hydraulic analyses were completed for Goose Creek, Little Goose Creek for the 2006 and 2021 FIS. The modeling was performed with HEC-HMS using the SCS Type II, 24-hour rainfall distribution. Hydraulic parameters such as curve number, time of concentration, and soil groups were determined using information from LOJIC. Water surface elevations were determined using HEC-RAS. Cross sections were obtained from field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Roughness coefficients were determined based on field inspections and aerial photography.

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E. A Zones exist for Goose Creek and more detailed modeling of these areas will be performed as funding becomes available.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Map GC-5 shows the limits of each of these floodplains.

7.3 Action Plan

7.3.1 Watershed Requirements

New development in the Goose Creek Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24-hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

Floodplain compensation is required in the Goose Creek Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. The ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or “soft” approaches where possible. MSD’s Design Manual outlines natural channel design requirements in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24 hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

7.3.2 Proposed Projects

Proposed projects within this watershed include:

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- The Critical Repair and Reinvestment Plan proposes one new project in the Goose Creek watershed, the Ten Broeck Way Early Action Project. Proposed Critical Repair and Reinvestment Projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

8.0 HARRODS CREEK

8.0 HARRODS CREEK

8.1 Watershed Study Area

8.1.1 General

The 180 square mile Harrods Creek Watershed is located in northeastern Jefferson County, Oldham and Henry Counties. Its headwaters originate in the area east of LaGrange, Kentucky, approximately 17 miles beyond the Jefferson County border. The creek flows generally to the southwest, converging with South Fork Harrods Creek about one-half mile outside the Jefferson County line. From this point, the flow continues southwest through Jefferson County to an outlet on the Ohio River at Guthrie Beach. Major streams in this watershed include Harrods Creek, Wolf Pen Branch, South Fork Harrods Creek, and South Fork Hite Creek. An aerial map showing the Harrods Creek Watershed is included as Map HC-1. A drainage map showing the nine subbasins for Harrods Creek is included as Map HC-2.

Outlet of Harrods Creek into the Ohio River

For the purpose of this report, only the 15.3 square mile portion of this watershed in and adjacent to Jefferson County is given detailed study.

Communities in the study area include Fincastle, Ballardsville, Pewee Valley, Lake Louisvilla, Worthington, and Prospect.

Notable landmarks include the Ford Motor Company Kentucky Truck Plant and Hunting Creek Country Club.

8.1.2 Topography

The major portion of the 15.3 square mile study area is situated in the Eastern Uplands Topographic Region. The remaining portion, which lies adjacent to the Ohio River, is in the Flood Plain.

Broad steep-sided valleys and gently rolling plateaus dominate the terrain in the Uplands Region. Harrods Creek has cut deeply into this terrain and it flows through a well entrenched channel, where near-vertical cliffs are common.

A very flat, low-lying terrain predominates in the Flood Plain, excluding Harrods Creek, stream channels of low gradient slopes tend to parallel the Ohio River. Elevations range from about 420 feet, the pool stage of the Ohio River above the McAlpine Lock and Dam, to about 780 feet, in an area southwest of Pewee Valley.

8.1.3 Geology

The portion of this study area lying in the Eastern Uplands Topographic Region is predominantly underlain by limestones of the lower Devonian and middle Silurian ages. The major creeks, however, have eroded channels deeply into, and in some cases, though these rocks. In these deeper cuts, shales, dolomites, and limestones of middle and lower Silurian and upper Ordovician age are commonly exposed. The general dip of these rock beds, or strata, is toward the west at a little more than one-half foot in one hundred feet. Some limited karst activity is represented by small sinkholes and springs.

In the Harrods Creek channel, and in the study area portion, which lies in the Flood Plain Topographic Region, various alluvial deposits of the Quaternary age are encountered. These deposits range in thickness from several feet to well over one hundred feet. They are comprised of complex layers of silts, sands, clays, and gravels. This region is a well documented aquifer and groundwater is readily available.

8.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Harrods Creek Watershed is mainly from soil group B and the unclassified group. The soil groups in the Harrods Creek Watershed can be found on Map HC-3.

8.1.5 Land Use

The majority of the land use in the Harrods Creek Watershed is residential and agricultural. The existing land use in the Harrods Creek Watershed can be found on Map HC-4.

8.1.6 Watershed Improvements

No regional basins or major channel improvement projects are located in the Harrods Creek Watershed.

8.1.7 Local Basins

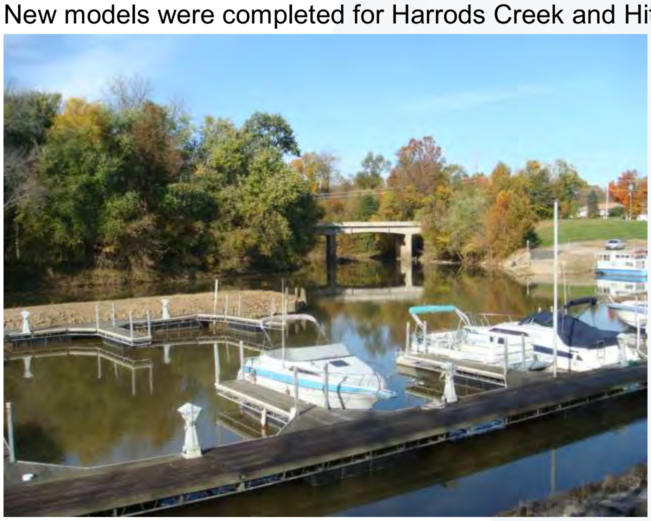
There are currently 100 local stormwater basins located in the Harrods Creek watershed. These basins are shown on Drainage Map HC-2.

8.1.8 Water Quality Best Management Practices

There is currently 1 bioswale, 4 green dry basins, 1 green wet basin, 7 rain gardens and 26 water quality units in the Harrods Creek watershed. These are shown on Drainage Map HC-2.

8.2 Modeling

New models were completed for Harrods Creek and Hite Creek using HEC-HMS for the 2006 and 2021 FIS. The standard SCS Type II, 24-hour design storm distribution was used to determine the 10, 2, 1, and 0.2 percent annual chance events. Hydraulic parameters such as curve number, time of concentration, and soil groups were determined using information from LOJIC. Water surface elevations were determined using HEC-RAS. Cross sections were obtained from field surveys. Bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Roughness coefficients were determined based on field inspections and aerial photography. Based on the modeling, Harrods Creek is controlled by backwater from the Ohio River for the entire length located in Jefferson County.



Harrods Creek upstream of US Hwy 42

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E. A Zones exist for the tributaries of Wolf Pen Branch and Hite Creek. More detailed modeling of these areas will be performed as funding becomes available.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Map HC-5 shows the limits of each of these floodplains.

8.3 Action Plan

8.3.1 Watershed Requirements

New development in the Harrods Creek Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24-hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

Floodplain compensation is required in the Harrods Creek Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. This ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or "soft" approaches where possible. MSD's Design Manual outlines this requirement in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24-hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

8.3.2 Proposed Projects

Proposed projects within this watershed include:

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- The Critical Repair and Reinvestment Plan proposes one new project in the Harrods Creek watershed, the Prospect Early Action Project. Proposed Critical Repair and Reinvestment projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

9.0 MILL CREEK

9.0 MILL CREEK

9.1 Watershed Study Area

9.1.1 General

Lower Mill Creek at Outlet to Ohio River

The 34 square mile Mill Creek Watershed is located in the western portion of Jefferson County. Due to the diversion of the upstream reaches of Mill Creek into a "cut-off" channel, this watershed is divided into two entirely separate sections. These are referred to as Upper Mill Creek and Lower Mill Creek. Major streams included in Upper Mill Creek include Big Run, Cane Run, and Mill Creek Cutoff. Major streams included in Lower Mill Creek include Mill Creek and Black Pond Creek. An aerial map showing the Mill Creek Watershed is included as Map MC-1. A drainage map showing the 16 subbasins for Mill Creek is included as Map MC-2.

The 19 square mile Upper Mill Creek's headwaters originate in the area of Manslick Road and I-264. From here, they flow in a westerly direction to the western side of Shively, where several tributaries including Cane Run, Boxwood Ditch, Lynnview Ditch, and Big Run join the flow. From this point, the flow direction is to the northwest, via the cutoff channel. The stream outlets into the Ohio River just south of Riverside Gardens. A flood pumping station is located in the Riverside Gardens area near the stream outlet. This flood pumping station is part of the flood levee system that protects Jefferson County from Ohio River flooding.

Communities lying in the Upper Mill Creek section include Shively, Heatherfield, Hunters Trace, Parkwood, St. Denis, and Riverside Gardens.

Notable landmarks include Louisville Gas & Electric's Mill Creek Power Station, Western High School, Doss High School, Shively Park, Dixie Manor, and a part of Iroquois Park. Sun Valley Park is located on Mill Creek near Lower River Road. This park provides preserved open space along Mill Creek.

The 15 square mile Lower Mill Creek's headwaters originate in the area of Lower Hunters Trace and Terry Road. From here, the flow is generally to the south, paralleling the Ohio River. Several tributaries, including Black Pond Creek and Valley Creek, join this flow in the Valley Downs area. The stream eventually outlets into the Ohio River west of Valley Village. A flood pumping station is located 0.75 miles upstream of the mouth of Lower Mill Creek. This flood pumping station is part of the flood levee system that protects Jefferson County from Ohio River flooding.

Communities lying in the Lower Mill Creek section include Valley Village, Meadow Lawn, Valley Downs, parts of Valley Station and Pleasure Ridge Park, Sylvania, Greenwood, and Waverly Hills.

Notable landmarks include Sun Valley Community Park, Valley High School, Waverly Park, and the Louisville and Jefferson County Riverport Authority.

9.1.2 Topography

The major portion of the Mill Creek Watershed is situated in the Flood Plain Topographic Region. The remaining portion, which lies east of the Illinois Central Railroad, lies in the Knobs.

A very flat, low-lying terrain predominates in the Flood Plain. Stream channels with low gradient slopes tend to parallel the Ohio River. Terraces of ten to twenty feet in height are common.

Lower Mill Creek at Bethany Lane

Steep-sided, round-topped hills dominate the terrain in the Knobs. Stream channels are deeply cut into these hills and commonly have high gradient slopes.

Elevations range from about 382 feet, the pool stage of the Ohio River below the McAlpine Lock and Dam, to about 760 feet, at the top of the Iroquois Park hill.

9.1.3 Geology

The portion of this watershed lying in the Flood Plain Topographic Region is predominantly underlain by glacial outwash deposits of the Quaternary age. These deposits vary in thickness from several feet to well over one hundred feet, and are comprised of complex layers of silts, sands, clays, and gravels. This region is a well documented aquifer and groundwater is readily available.

The portion of this watershed lying in the Knobs topographic region is predominantly underlain by a hilly complex of Mississippian age siltstones and shales, whose lower flanks are covered by zero to thirty feet of an alluvial deposit of Quaternary age loess and eloian sand. The general dip of the rock beds, or strata, in this hilly area is toward the west at a little less than one foot in one hundred feet. Karst activity is not associated with this region. It should be noted, however, that Mississippian shales become plastic when wetted and even moderate slopes are prone to slump and/or slide.

9.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Mill Creek Watershed is principally from soil groups B, C, and the unclassified group. The soil groups in the Mill Creek Watershed can be found on Map MC-3.

9.1.5 Land Use

The majority of the land use in the Mill Creek Watershed is residential, with commercial areas located along Dixie Highway and a combination of commercial and industrial uses near the river. The existing land use in Mill Creek can be found on Map MC-4.

9.1.6 Watershed Improvements

The Wheeler Basin is a regional basin located in the Mill Creek Watershed. The basin was constructed to relieve flooding from the combined sewer system. MSD and the USACE completed a study of the Upper Mill Creek Basin. The study identified one potential project to remove a portion of the old Ohio River levee that is no longer in service.

Two other regional basins, Gagel Ave and Stallings Ave, are currently under study to determine if basin outlet modifications or the installation of water quality best management practices can reduce downstream flooding for smaller storms.

Several MSD funded property acquisitions have occurred in this area to address localized repetitive flooding issues.

9.1.7 Local Basins

There are currently 71 local stormwater basins and 3 regional stormwater basin located in the Mill Creek watershed. These basins are shown on Drainage Map MC-2.

9.1.8 Water Quality Best Management Practices

There are currently 3 bioswales, 2 green dry basins, 5 green wet basins, 6 rain gardens and 32 water quality units in the Mill Creek watershed. These are shown on Drainage Map MC-2.

9.2 Modeling

Hydraulic analyses for Mill Creek were completed using HEC-HMS. Curve numbers, drainage area, and time of concentration were used to determine flows from each subbasin. Storage routings were added as needed and numerous trials were required in order to determine final discharge values. Using the discharge values from the HEC-HMS models, HEC-RAS was used to create stream profiles for each stream. Cross sections and bridge elevations and geometry were field surveyed.

Mill Creek Cutoff near outlet to Ohio River

Along the floodwall, areas that are inundated by backwater during pumping operations were purchased by the County and/or put into flowage easements to protect the areas from future development.

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E. A Zones exist for the tributaries of Big Run Creek, Black Pond Creek, Cane Run, Iroquois Heights Branch, Ponder Creek, Upper Mill Creek and Valley Creek. An updated study for Black Pond Creek is planned for Fiscal Year 2023 and more detailed modeling of other areas will be performed as funding becomes available.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Map MC-5 shows the limits of each of these floodplains.

9.3 Action Plan

9.3.1 Watershed Requirements

New development in the Mill Creek Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24-hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

Floodplain compensation is required in the Mill Creek Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. The ratio may be increased on a site-specific basis as determined by MSD.

Louisville Loop Bridge over Mill Creek Cutoff

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should use natural or “soft” approaches where possible. MSD’s Design Manual outlines this requirement in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24 hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

9.3.2 Proposed Projects

Proposed projects within this watershed include:

- EPA 319(h) funding has been approved to create a watershed plan for Mill Creek. This plan will identify potential projects that will address non-point source pollution within the watershed.

- A grant application has been submitted to FEMA for review for Big Run to prepare a flood mitigation study to determine potential projects to reduce flooding impacts from Big Run.

- A study is underway to determine the limits of the local regulatory floodplain in the area of Oak Valley Drive. This drainage area is located along an unnamed tributary of Big Run Creek and is known to have historical flooding issues. This study will identify potential projects to alleviate this localized flooding.

- Drive In Branch, a tributary of Big Run, is currently being studied to investigate potential benefits of improvements to existing storage basins and channels in mitigating localized flooding. Alternatives being evaluated in the study are expansion of storage basin volumes, incorporation of green management practices and channel restoration.

- The Kentucky Department of Fish & Wildlife is assisting in funding a study for the restoration of approximately 8 miles of the stream and will participate in construction once plans are approved. The Nature Conservancy donated funds to study routes for potential trail systems that could follow this section of the stream corridor and tie into other amenities such as the Louisville Loop.

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- The Critical Repair and Reinvestment Plan proposes one new project in the Mill Creek watershed, the Valley Creek Early Action Project. Proposed Critical Repair and Reinvestment projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

10.0 OHIO RIVER/CITY

10.0 OHIO RIVER/CITY

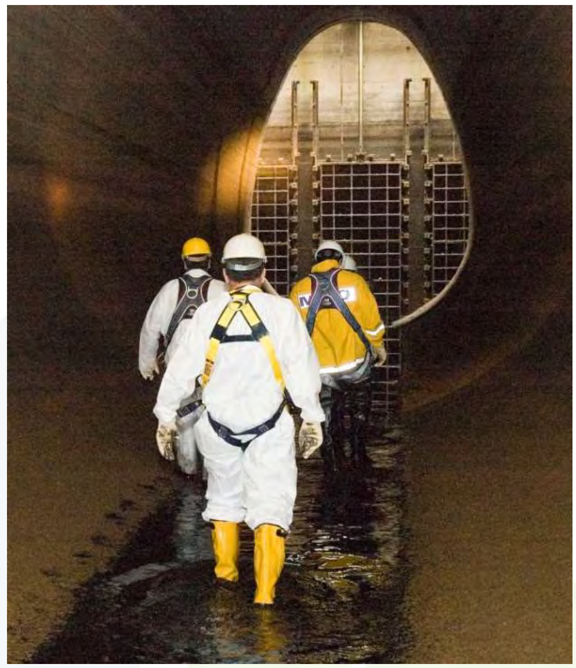
10.1 Watershed Study Area

10.1.1 General

The Ohio River/City Watershed is drained by a complex system of combined sewers. No open channels of any magnitude exist. An aerial map showing the Ohio River/City drainage area is shown on Maps CORE-1 and CORW-1 on the following page. A drainage map showing the six subbasins for the Ohio River/City Watershed is included as Maps CORE-2 and CORW-2.

Communities situated in this watershed include downtown Louisville, Kenwood, Southern Heights, Beechmont, Highland Park, Oakdale, Wilder Park, Parkland, South Parkland, Shawnee, and Portland.

Notable landmarks include portions of Iroquois Park, the Kentucky Fair and Exposition Center, the University of Louisville, Churchill Downs, Kentucky International Convention Center, City Hall, Shawnee Park, and Chickasaw Park. Many parks are located along the Ohio River and provide preserved open space along the Ohio River floodplain. These parks include Eva Bandman Park, Capertown Swamp, Chickasaw Park, Carrie Gaulbert Cox Park, Hays Kennedy Park, Kulmer Reserve, Lannan Park, Portland Wharf Park, Riverside Farnsley-Moorman Landing, Riverview Park, Thurman Hutchins Park, Twin Park, and Waterfront Park.



Combined Sewer System at the Southwestern Outfall

10.1.2 Topography

The major portion of the Ohio River/City Watershed is located in the Flood Plain Topographic Region. The remaining portion lies in the Central Basin. A very flat, low-lying terrain predominates both the Flood Plain and Central Basin Regions.

Elevations range from about 382 feet, the pool stage of the Ohio River below the McAlpine Lock and Dam, to about 586 feet in Glenview.

10.1.3 Geology

The portion lying in the Flood Plain Topographic Region is predominately underlain by glacial outwash deposits of Quaternary age. These deposits vary in thickness from several feet to well over one hundred feet, and are comprised of complex layers of silts, sands, clays, and gravels. This region is a well documented aquifer and groundwater is readily available.
The portion of this watershed lying in the Central Basin Topographic Region is predominately underlain by alluvial lacustrine deposits of Quaternary age. These deposits vary in thickness from zero to fifty feet, and are comprised of layers of silts, sands, clays, and gravels.

10.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Ohio River/City Watershed is mainly unclassified. The soils in the Ohio River/City Watershed are shown on Maps CORE-3 and CORW-3.

10.1.5 Land Use

The land use in the Ohio River/City Watershed is mainly a mix of residential, commercial, and industrial land use. The existing land use in the Ohio River/City Watershed is shown on Maps CORE-4 and CORW-4.

10.1.6 Watershed Improvements

No open channels of any magnitude exist in this watershed; however, several watershed improvements have been made in this area, including:

- The Waterway Protection Tunnel (construction underway) will be completed before December 2022 and store a volume of up to 55 million gallons of combined sewer overflow every time it rains until sewer treatment capacity is available. This will prevent 439 million gallons of untreated water per Typical Year from entering Beargrass Creek and the Ohio River. In 2016 and again in 2018, this project consolidated former CSO storage basin solutions associated with the Ohio River and Beargrass Creek into a single underground storage solution. The Waterway Protection Tunnel is a four-mile long, 20 ft diameter tunnel running from 11th and Rowan streets to Grinstead Drive and Lexington Road.

- Several large scale underground infiltration basins have been constructed to capture and treat stormwater from impervious surfaces, including infiltration basins at the University of Louisville, Churchill Downs, and the Norton Healthcare Sports & Learning Center.

- Two regional basins located in the Ohio River/City Watershed have been constructed to reduce combined sewer overflows. These basins are Executive Inn Basin and Brady Lake.

- Several pump station modification projects have been completed along the Ohio River such as the 34th Street, 4th Street, 27th Street, 17th Street, and the Shawnee Flood Pump Station to reduce combined sewer overflows and improve water quality.

- Other combined sewer projects that have been completed in this watershed to improve water quality and reduce combined sewer overflows include:
    - Southern Outfall In-line Storage at 43rd St (SOR1) – completed Nov 30, 2018. In-line storage using an actuated gate or inflatable dam in the Southern Outfall (11.4 MG) linked to Real Time Control near the end of 43rd Street and the existing Whayne Supply property. Project reduced overflows to 8 overflows per Typical Year.
    - Bells Lane Wet Weather Treatment Facility – completed September 25, 2017. This project included a 50 MGD High Rate Treatment Facility, a 25 MGD Equalization Basin, an upgrade of the Southwestern Pump Station to 160 MGD, and modifications to RTC setpoints at SWOR1 and SWOR2 to increase inline storage.
    - Broadway Interceptor Infrastructure Rehabilitation – rehabilitation of this large diameter sewer was completed June 30, 2021.
    - Central Relief Drain CSO In-line Storage, Green Infrastructure & Distributed Storage – completed December 20, 2018. Modified weir elevations to maximize in-line storage and distributed storage within the CSO drainage areas to reach 8 overflows in a Typical Year level of control.

- CS0190 Green Infrastructure – Water quality practices in CSO190 with an investment of nearly 6.5 million dollars, treating 96 acres of impervious surface. Green infrastructure implemented through this project reduced overflows to 8 overflows per Typical Year.
- Morris Forman WQTC Headworks – completed December 17, 2018. The Morris Forman WQTC Headworks replaced the existing 1/2" bar screen with 3/8" bar screens at the East and West Headworks Facility, allowing it to more reliably remove solids and floatables. The grit removal systems at each headworks was also replaced, and the aeration systems were replaced at the West Headworks. Flow control structures were modified to more precisely control flow to the East and West Headworks.
- Portland Storage Basin – completed August 30, 2019. This project includes a 6.7 MG underground covered concrete storage basin, with 1.8 MG of in-line storage from CSO019 to reduce overflows to 8 overflows Typical Year. The facility required a 6.37 MGD pump station to return the stored flow back to the interceptor.
- Southwestern Parkway Storage Basin – completed March 29, 2019. This project included a 20 MG underground covered concrete basin and in-line storage in the Western Outfall and the Northwest Interceptor for an additional 6.3 MG using adjustable gates to reduce overflows to eight overflows per Typical Year.
- Churchill Downs Parking Lot Improvements – Churchill Downs is located in close proximity to two of MSD's largest combined trunk sewers each having a large combined sewer overflow. Churchill Downs and MSD partnered to design and construct three oversized underground infiltration basins on the Churchill Downs property. These basins mitigate the impact of the existing impervious parking lot area. The basins have a combined 4-million-gallon storage capacity, capture more than 73 million gallons of water annually and will prevent about 15 million gallons of sewer overflow each year.
- University of Louisville Green Infrastructure – The University of Louisville worked with Louisville MSD to install various green infrastructure projects to keep stormwater runoff out of the combined sewer system. Projects include pervious pavement, a green roof, and infiltration basins. These projects divert about 72 million gallons of stormwater from the combined sewer system annually.
- Lynn Family Soccer Stadium - With construction of this project, stormwater from this area, which previously entered the combined sewer system, was separated and redirected to the Ohio River.

10.1.7 Local Basins

There are currently 41 local and 3 regional stormwater basins located in the Ohio River/City watershed. These basins are shown on Drainage Maps CORE-2 and CORW-2.

10.1.8 Water Quality Best Management Practices

There are currently 13 bioswales, 1 green dry basin, 1 green wet basin, 39 rain gardens, 45 tree boxes and 81 water quality units in the Ohio River/City watershed. These are shown on Drainage Maps CORE-2 and CORW-2.

10.2 Modeling

Modeling of the Ohio River was completed using HEC-HMS or Discharge Frequency Curve and HEC-RAS. The area behind the floodwall is drained through the combined sewer system. No open channels of any magnitude exist within this watershed; however, many low areas are prone to flooding due to surcharging of the combined sewer system. Modeling has been completed for the combined sewer system to predict the response of the system to various rain events. This model was created using the EPA's XP-SWMM program and was calibrated using observed data during various storm conditions. The pipe network used was based on the best available data, which included as-built drawings, construction drawings, and CSO inventory records. Floodprone areas have also been delineated in the combined sewer area based on the 1% annual chance flood.

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E.

Floodplain limits for the Ohio River for the 1 percent annual chance flood were calculated for existing conditions. The limits of the FEMA floodplain and Local Regulatory Floodplain are identical along the Ohio River. Maps CORE-5 and CORW-5 show the limits of each of these floodplains.

10.3 Action Plan

10.3.1 Watershed Requirements

New development in the combined sewer area is restricted to detaining the post-developed 100-yr flows to the pre-developed 10-year flows in order to help alleviate the flows in the combined sewer system during rain events. Examples of mitigation techniques include building detention basins, oversizing onsite stormwater pipes, and using green solutions such as pervious pavement and rain gardens to reduce peak flows and overall runoff volumes.


Ohio River near Mill Creek outlet

Floodplain compensation is required in the Ohio River/City Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. This ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should to use natural or "soft" approaches where possible. MSD's Design Manual outlines this requirement in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24-hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Green infrastructure must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

10.3.2 Proposed Projects

Proposed projects in this watershed include:

- Paddy’s Run Flood Pumping Station will be replaced with a new facility to increase the pumping capacity of this location. This project will serve to protect 63,000 residents from combined sewer flooding by increasing the pumping capacity to 1,900 MGD, designed for the projected 2035 10-year, 24-hour rainfall event. Built in 1953, it is beyond its useful life and in need of full replacement to prevent catastrophic risks to disadvantaged communities within the inundation area. This pump station also serves as the effluent pump station for the Bells Lane Wet Weather Treatment Facility, preventing combined system overflows and sewer backups. This project was recommended by the CRRP and the Amended Consent Decree deadline for completion is December 31, 2026.

- Green infrastructure projects in this watershed include the installation of an infiltration trench at the Brown-Forman facility and planning for a project to be located at 28th St and Broadway.

- FEMA Floodplain Acquisition Grants and MSD Buyouts are on-going in this area. Previous projects acquired through these programs include the Maple Street project and riverfront areas along the Ohio River. Additional grant applications in this watershed are currently under review at FEMA.

- The River Rd reconstruction project is a partnership between Louisville Metro Government and the Kentucky Transportation Cabinet (KYTC) to widen River Road from two lanes to four lanes from Beargrass Creek to Zorn Avenue. This project includes proposed sidewalks, bicycle lanes, a multi-use path, and a traffic signal at River Road and Edith Road. Portions of the roadway will be elevated above the 10 yr floodplain to increase access to properties along River Road during smaller, more frequent floods. Utility relocations and water quality improvements will be included with the project. The final design phase is complete and construction is expected to begin in 2022.

- The Western Flood Pump Station project proposes to increase capacity of the pump station and increase the volume of the surge basin to reduce roadway and structure flooding in this area.

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- The 20-year Critical Repair and Reinvestment Plan proposes 29 new projects in the Ohio River watershed The purpose of the projects is to improve drainage at 29 viaducts located throughout this watershed. These viaducts are routinely submerged during storm events which cause roadway flooding. Proposed Critical Repair and Reinvestment Projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

11.0 PENNSYLVANIA RUN

11.0 Pennsylvania Run

11.1 Watershed Study Area

11.1.1 General

The 7 square mile Pennsylvania Run Watershed is located in south central Jefferson County. Its headwaters originate in the Highview area, and the stream flows in a southerly direction, passing into Bullitt County, and eventually discharging into Cedar Creek. For the purpose of this study, the Jefferson County/Bullitt County border serves as the approximate southerly watershed boundary. Pennsylvania Run is the only major stream in this watershed. An aerial map showing the Pennsylvania Run Watershed is included as Map PR-1. A drainage map showing the three subbasins for Pennsylvania Run is included as Map PR-2.

McNeely Lake

Highview is the only community in the Pennsylvania Run Watershed.

Notable landmarks include McNeely Lake and McNeely Lake Park. McNeely Lake Park is located along Pennsylvania Run and provides preserved open space in the floodplain. Woodland Protection Areas have also been created for the Woods of Penn Run Subdivision along Penn Run.

11.1.2 Topography

The entire Pennsylvania Run Watershed is situated in the Eastern Uplands Topographic Region. Broad, fairly steep-sided valleys and narrow ridge crests dominate the terrain. Streams have cut deeply into this terrain and flow through well-entrenched channels.

Elevations vary from about 515 feet at the Jefferson County/Bullitt County line, to about 685 feet in the Highview area.

11.1.3 Geology

The major portion of this watershed is underlain by limestone of middle Silurian age. Pennsylvania Run has eroded deeply into, and in some cases through this limestone. Middle Silurian age shales and dolomites are commonly exposed in the valley walls. The general dip of these rocks is toward the west at a little less than one foot in one hundred feet. Surficial features do not indicate karst activity, but springs are common on top of the exposed shale.

11.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soil groups used to classify soils in this study. The soil composition in the Pennsylvania Run Watershed is mainly from soil groups B and C and the unclassified soil group. The soil groups in the Pennsylvania Run Watershed can be found on Map PR-3.

11.1.5 Land Use

The majority of the land use in the Pennsylvania Run Watershed is residential. Much of the watershed is undeveloped and is anticipated to continue developing as residential uses. The existing land use map in the Pennsylvania Run Watershed can be found on Map PR-4.

Pennsylvania Run at Mount Washington Road

11.1.6 Watershed Improvements

No regional basins or major channel improvement projects are located in the Pennsylvania Run Watershed; however, the largest lake in Jefferson County, McNeely Lake is located within this watershed.

11.1.7 Local Basins

There are currently 32 local stormwater control basins located in the Pennsylvania Run watershed. These basins are shown on Drainage Map PR-2.

11.1.8 Water Quality Best Management Practices

There is currently 1 green wet basin and 18 water quality units in the Pennsylvania Run watershed. These are shown on Drainage Map PR-2.

11.2 Modeling

Hydrologic modeling was completed for Pennsylvania Run for the 2006 and 2021 FIS. HEC-HMS was used for the modeling. Hydraulic parameters such as curve number, time of concentration, and soil groups were developed using data from LOJIC. Several storage routings were included in the model, including McNeely Lake. Water surface elevations were determined using HEC-RAS. Cross sections were obtained from field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Roughness coefficients were determined based on field inspections and aerial photography.

Pennsylvania Run at McNeely Lake Dam

As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Streams within this watershed were updated with this effort. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E. A Zones exist for Pennsylvania Run and the tributaries of

Anita Branch, Durbin Branch, Loworn Creek and Pholmann Branch. More detailed modeling of these areas will be performed as funding becomes available.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Map PR-5 shows the limits of each of these floodplains.

11.3 Action Plan

11.3.1 Watershed Requirements

New development in the Pennsylvania Run Watershed is required to detain proposed stormwater discharge rates to predeveloped conditions for the 2, 10, 25, and 100 year storm events through the MSD Design Manual. The NRCS Type II, 24-hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

Floodplain compensation is required in the Pennsylvania Run Watershed at a ratio of 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Louisville Metro Floodplain Management Ordinance. The ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams should to use natural or “soft” approaches where possible. MSD’s Design Manual outlines this requirement in Section 10.3.6.

The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24 hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

11.3.2 Proposed Projects

Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

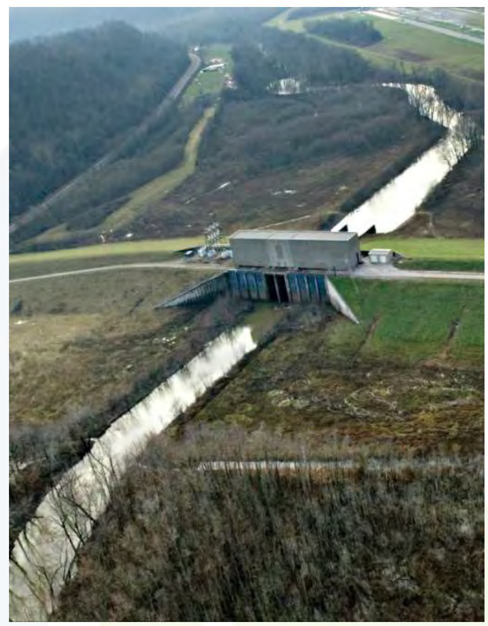
12.0 POND CREEK

12.0 POND CREEK

12.1 Watershed Study Area

12.1.1 General

The 94 square mile Pond Creek Watershed is located in south central and southwest Jefferson County. It is primarily drained by a series of natural and improved channels called Fern Creek, Northern Ditch, Southern Ditch, and Pond Creek. The headwaters of Fern Creek originate in the west side of Jeffersontown and flow southwest to Shepherdsville Road. At this point, the flow turns to the west and the improved channel is called Northern Ditch. This westerly flow continues into the vicinity of the Louisville and Nashville Railroad's Osborn Yard, where it turns southwest and finally outlets into Southern Ditch at the Outer Loop. The flow in Southern Ditch, an improved channel, originates in the Smyrna area and moves west, generally paralleling the Outer Loop. From this point, Southern Ditch flows to the west about three-quarters of a mile, then turns to the southwest and flows about one mile to Manslick Road. Downstream from Manslick Road, the natural channel is called Pond Creek. It flows in a generally southwesterly direction to its eventual outlet into the Salt River. Numerous tributaries enter these four main channels, including Fishpool Creek, Mud Creek, Wilson Creek, Bee Lick Creek, Greasy Ditch, Duck Spring Branch, Salt Block Creek, Slate Run, Bearcamp Run, Crane Run, Brier Run, and Weaver Run. Aerial maps showing the Pond Creek Watershed are included as Maps PCW-1, PCC-1, and PCE-1. Drainage maps showing the 38 subbasins for Pond Creek are included as Maps PCW-2, PCC-2, and PCE-2.



Pond Creek Flood Pumping Station

Communities situated in this watershed include parts of Jeffersontown, Fern Creek, Highview, Newburg, Smyrna, Okolona, Lynnview, Auburndale, Fairdale, Prairie Village, Medora, Orell, and part of Valley Station.

Notable landmarks include the Louisville International Airport, General Electric's Appliance Park, Jefferson Mall, part of Iroquois Park, Komosdale Cement Plant, and much of the Jefferson County Memorial Forest. Roberson Run Park is located along Roberson Run, a tributary of Pond Creek, and provides preserved open space along that tributary. A conservation easement has been created near the Outer Loop by the Trinity High School Foundation to protect existing wetlands in the Pond Creek watershed. Three floodplain compensation/wetlands mitigation banks are also located in this watershed. In addition, a Woodland Protection Area has been established in the Brookhurst Subdivision.

12.1.2 Topography

The Pond Creek Watershed is unique, in that it encompasses parts of all four of Jefferson County's Topographic Regions. Fern Creek is in the Eastern Uplands. Northern and Southern Ditch are in the Central Basin. Pond Creek has eroded a trench through the knobs and drains a portion of the Flood Plain.

In the Eastern Uplands Topographic Region, broad steep-sided valleys and gently rolling plateaus dominate the terrain. Major streams have cut deeply into this terrain and they flow through well-entrenched channels.

In the Central Basin Topographic Region, an extremely flat, low-lying terrain predominates. This was formerly a swampy area. The major streams have been greatly improved and flow in well entrenched, though very low gradient slope, channels.

In the Knobs Topographic Region, steep-sided, round-topped hills dominate the terrain. Stream channels are deeply cut into these hills and commonly have high gradient slopes.

Pond Creek

In the Flood Plain Topographic Region, a very flat, low-lying terrain predominates. Stream channels of low gradient slopes tend to parallel the Ohio River, and terraces of ten to twenty feet in height are common.

Elevations range from about 382, the pool stage of the Ohio River below the McAlpine Lock and Dam, to in excess of 900 feet, along the county's southern boundary.

12.1.3 Geology

The portion of this watershed lying in the Eastern Uplands Topographic Region is predominately underlain by limestones of lower Devonian and middle Silurian age. At the boundary with the Central Basin, an occasional exposure of middle Devonian age shale is observed. Only in a few stream beds are middle Silurian age shales exposed. The general dip of theses rock beds, or strata, is toward the west at about one and one half feet in one hundred feet. Near the boundary of the Central Basin, the general dip approached two and one half feet in one hundred feet.

The portion of this watershed lying in the Central Basin Topographic Region is predominately underlain by alluvial lacustrine deposits of Quaternary age. These deposits vary in thickness from zero to fifty feet, and are comprised of complex layers of silts, sands, clays, and gravels.

The portion of this watershed lying in the Knobs Topographic Region is predominately underlain by a hilly complex of Mississippian age siltstones and shales, whose lower flanks are covered by zero to thirty feet of alluvial deposits of Quaternary age loess, eolian sand, and terrace materials. The general dip of the rock beds, or strata, in this hilly area is toward the west at a little less than one foot in one hundred feet. Karst activity is not associated with this region. It should be noted, however, that Mississippian shales become plastic when wetted and even moderate slopes are prone to slump and/or slide.

Vulcan Regional Basin

The portion of this watershed lying in the Flood Plain Topographic Region is predominately underlain by glacial outwash deposits of Quaternary age. These deposits vary in thickness from several feet to well over one hundred feet, and are comprised of complex layers of silts, sands, clays, and gravels. This region is a well documented aquifer and groundwater is readily available.

12.1.4 Soils

Section 2.2.2 of the WMP explains in detail the five soils groups used to classify soils in this study. The soil composition in the Pond Creek Watershed is mainly soil groups B and C and the unclassified soil group. The soils in the Pond Creek Watershed are shown on Maps PCW-3, PCC-3, and PCE-3.

Northern Ditch at Preston Hwy

12.1.5 Land Use

The majority of the land use in the Pond Creek Watershed is residential. The existing land use in the Pond Creek Watershed is shown on Maps PCW-4, PCC-4, and PCE-4.

12.1.6 Watershed Improvements

Watershed improvements in Pond Creek include:

- The first regional basin built by MSD was the Roberson Run Basin. It was built in the early 1990s and is relatively small. Although the impacts on flooding are minimal by today's standards, the basin is a multiuse facility with the incorporation of walking paths around the basin that link adjoining residential areas.
- In 1998, MSD, Jefferson County Government, and the USACE began the construction phase of the Pond Creek Flood Prevention Project. The project utilizes large basins for flood storage and channel improvements to remove an estimated 2,000 buildings from the danger of most floods. In addition, the project incorporated Greenways principles that provide pedestrian access to Pond Creek. Walking and biking paths help connect neighborhoods and introduce area residents to ever improving water quality along Pond Creek. A description of each phase of the project is listed below.

  - Phase I: The Okolona Wetlands Restoration Site is an environmental restoration of 15 acres of wetlands located in a sludge lagoon near the Okolona Wastewater Treatment Plant. The restoration process included draining the area of sludge and replanting native vegetation.

  - Phase II: The Vulcan Detention Basin included constructing a dam on Fishpool Creek, installing a low-flow pipe, and constructing an overflow structure into the basin. The basin was designed to fill during a 24-hour storm event and drain over a period of approximately eight days. This basin became operational in September 1999. The capacity of the detention basin is 450 acre-feet. A diversion dam was constructed across the creek and an 18'' pipe was placed through the dam to maintain base flows.

  - Phase III: The Melco Detention Basin behind the Ford Motor Plant was completed in 2001. It expanded an existing 15-acre borrow pit to 80 acres, which increased the storage capacity to 1,500 acre-feet.

  - Phase IV: This phase included channel modifications to Northern Ditch between Preston Highway and the Melco Basin inlet. It also included widening one bank of Northern Ditch for a distance of almost 1.5 miles, replacing culverts and installing riffle structures and pools in the stream to improve aquatic habitat.

- o Phase V: Channel modifications to Pond Creek and the placement of a multipurpose recreation trail alongside the creek have been completed. This phase included widening one bank of Pond Creek for a distance of 2.4 miles, replacing culverts and installing riffle structures and pools in the stream to improve aquatic habitat.

- MSD has also worked with a private company to create a floodplain and runoff compensation bank located in the Pond Creek Watershed. This compensation bank was funded though private development. It consists of three basins. Pond 1 is located near I-65 and the Outer Loop and is 80 ac-ft. Pond 2 is located near Wilson Creek and the Gene Snyder Freeway and is 26.5 ac-ft. Pond 3 located at National Turnpike and Southern Ditch and is 234 ac-ft. These ponds also function as wetland mitigation banks.

- MSD completed a regional flood control basin on Northern Ditch near its confluence with Southern Ditch called the Aluma Basin. The basin construction was completed in 2012.

12.1.7 Local Basins

There are currently 233 local and 4 regional stormwater basins located in the Pond Creek watershed. These basins are shown on Drainage Maps PCW-2, PCC-2, and PCE-2.

12.1.8 Water Quality Best Management Practices

There are currently 10 bioswales, 6 green dry basins, 12 green wet basins, 9 rain gardens and 101 water quality units in the Pond Creek watershed. These basins are shown on Drainage Maps PCW-2, PCC-2, and PCE-2.

12.2 Modeling

Hydrologic analyses was completed for the Pond Creek Watershed in the 2006 and 2021 FIS using HEC-HMS software to develop the models and determine the 10, 2, 1, and 0.2 percent annual chance events using the standard SCS Type II 24 hour design storm distribution. Hydrologic parameters, such as curve number, time of concentration, and soil groups, were developed using information from LOJIC. An unsteady state HEC-RAS model was created to determine water surface elevations. Cross sections were obtained from field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Roughness coefficients were determined based on field inspections and aerial photography. Ineffective flow areas were included in areas where restrictive fence lines and large or dense development exists.

Renaissance Basin, a sidesaddle basin along Southern Ditch constructed by private development

Along the floodwall, areas that are inundated by backwater during pumping operations were purchased by the County and/or put into flowage easements to protect the areas from future development. As part of MSD's most recent Risk MAP project, updated FIRM Panels and FIS profiles were adopted in February of 2021. Prior to the effective date of the 2021 flood maps, MSD incorporated the updated flood models into the Local Regulatory Floodplain. These changes were adopted in 2019. These updates modernized many flood studies and created limited detail flood models for most A zones in the county. Models for streams within this watershed were updated with this effort and more information on these studies can be found in Appendix E. A Zones exist for the tributaries of Blue Spring Ditch, Cooper Chapel Branch, Guardian Creek, Little Bee Lick, Mud Creek, Slate Run, Southern Ditch and Wilson Creek. An updated study for Little Bee Lick is planned for Fiscal Year 2023 and more detailed modeling of other areas will be performed as funding becomes available.

Floodplain limits for the 1 percent annual chance flood were calculated for existing conditions and future, fully developed conditions. Existing conditions are labeled as the FEMA floodplain and future conditions are labeled as the Local Regulatory Floodplain. Maps PCW-5, PCC-5, and PCE-5 show the limits of each of these floodplains.

12.3 Action Plan

12.3.1 Watershed Requirements

Wetlands along Wet Woods Creek constructed by Waste Management

The Pond Creek Watershed has significant flooding and drainage problems. A large portion of the watershed is very flat and not well drained. Due to this fact, the increased runoff volumes are generally more critical than the rate of discharge. Increases in runoff volume due to development in the Pond Creek Watershed must be mitigated at a ratio of 1.5:1 as required in the MSD Design Manual. The ratio may be increased on a site-specific basis as determined by MSD. Per the MSD Design Manual, all detention basins are required to limit the post-developed 2, 10, 25, and 100 year flows to the pre-developed peak discharge rates through the MSD Design Manual. The NRCS Type II, 24-hour rainfall distribution is required to be used for the modeling. In areas where adequate downstream facilities exist, especially in the lower portion of a watershed where peak flows from the new development will occur substantially prior to the overall peak of the stream, on a case-by-case basis, MSD allows increased runoff to be compensated using a regional facility fee. This regional facility fee is used to construct regional basins.

Floodplain compensation is also required in the Pond Creek watershed at a ratio 1.5:1 for any fill placed in the fully developed local regulatory floodplain as required in the Design Manual. The ratio may be increased on a site-specific basis as determined by MSD.

As stated in the Louisville Metro Floodplain Management Ordinance, a natural 25 foot buffer on each side of the stream bank must be preserved on all perennial and intermittent streams as defined by the USGS 7.5 minute topographic maps. In addition, perennial and intermittent streams may not be relocated, channelized, or stripped, with the exception of public projects such as road crossings, utilities, and detention basins that have no other viable alternative.

A minimum buffer is also required by the KDOW through its Kentucky Pollutant Discharge Elimination System (KPDES) General Permit For Stormwater Discharges Associated With Construction Activities (KYR10). A minimum 25 foot buffer is required for discharges to waters categorized as High Quality or Impaired Water (Non-construction related impairment). A minimum 50 foot buffer is required for discharges to waters categorized as Impaired Waters (Sediment impaired, but no TMDL).

In order to promote enhanced water quality and aquatic habitat, natural channel design techniques are the preferred method for the design of streams. Channel improvement projects in perennial streams

should use natural or “soft” approaches where possible. MSD’s Design Manual outlines this requirement in Section 10.3.6.
The Louisville/Jefferson County Erosion Prevention and Sediment Control Ordinance requires developments with 2000 square feet of disturbance and developments within 50 feet of a sensitive feature as defined by the ordinance to obtain a Site Disturbance Permit. The Site Disturbance Permit requires an EPSC plan to be developed which achieves 80% design removal of total suspended solids that are generated by the site. The design storm to be used is the 10-year 24 hour SCS Type II storm event.

Water quality and post-construction requirements are listed in Article 6 of the Wastewater Discharge Regulations. Water quality practices must be designed to manage the required water quality volume rain event of 0.6” of runoff and must manage at least 90% of the site’s disturbed area. This volume is to be infiltrated, treated, or otherwise managed for new development projects that disturb at least one acre or are part of a greater common development that disturbs at least one acre.

12.3.2 Proposed Projects

Proposed projects in this watershed include:

- Preliminary approval has been given for a grant to evaluate the Northern Ditch watershed for mitigation opportunities. A location near West Indian Trail has been identified for a potential regional detention basin and would be included in this study. This basin would create additional storage volume for the Pond Creek Watershed during major flooding events.

- In an effort to reduce risks associated with flooding, flood level sensors and remote monitoring equipment will be placed on the high hazard dam located at Roberson Run.

- FEMA Hazard Mitigation Assistance Buyout Programs are ongoing in this area. MSD’s long-term use for these areas could be the construction of a stormwater basin or similar mitigation method to aid in reducing the impact of smaller storm events where feasible. A study is currently underway to determine the feasibility and effectiveness of using floodplain buyout grant acquired properties at two locations in this watershed to construct floodplain compensation basins to manage stormwater to reduce the impact of flooding. This study would also evaluate the inclusion of water quality best management practices in future basins.

- The existing Roberson Run flood control basin is currently being evaluated to determine retrofit opportunities for water quality mitigation measures as well as potential reductions to downstream flooding.

- A 26.3 acre site abutting Guardian Creek has been dedicated as a deed restricted wetland by a private developer. Through a public-private partnership, this area is planned for a future nature preserve.

- The Lynnview Stormwater System Rehabilitation Project will address the failing stormwater system in the City of Lynnview, addressing issues with the pipe system as well as 23 catch basins.

- Small scale drainage projects are taken care of through the program Project DRI. Beginning in 2003, MSD initiated an aggressive program to address a wide variety of drainage issues that are requested by customers. This program, dubbed Project DRI (Drainage Response Initiative), assigned experienced project managers, contractors, and inspectors to address drainage problems on a "grade-to-drain" basis. Efforts under this program address problems ranging from structural flooding to alleviating minor standing water problems. Available funds are distributed across the service area based on relative levels of customer concerns and estimated costs of repairs within geographic areas. The DRI projects list can be found in the Appendix C of this report.

- The Critical Repair and Reinvestment Plan proposes three new projects in the Pond Creek watershed, the Whispering Hills Early Action Project, the Auburndale Early Action Project, and the Newburg Early Action Project. Proposed Critical Repair and Reinvestment Projects can be found in Appendix A. At this time, Critical Repair and Reinvestment projects are on hold due to budget constraints but will move forward as soon as funding becomes available.

Appendix A

Critical Repair and Reinvestment Plan
Project List

Appendix A: Critical Repair and Reinvestment Plan Project List	
Drainage	**Cost**
X_0105 RICHLAWN EARLY ACTION PROJECT	$350,000.00
X_0121 VIA09 6TH & HILL ST VIADUCT FLOOD RELIEF	$796,800.00
X_0145 VIA16 3RD & EASTERN PKY VIADUCT FLOOD RELIEF	$2,982,400.00
X_0146 VIA17 4TH STREET & INDUSTRY RD VIADUCT FLOOD RELIEF	$5,882,400.00
X_0147 VIA32 3RD & WINKLER VIADUCT FLOOD RELIEF	$5,582,400.00
DRI (DRAINAGE RESPONSE INITIATIVE)	$16,200,000.00
Stormwater Quality (MS4)	**Cost**
H14070 FY18 USGS STREAM MONITORING	$225,000.00
H14075 FY18 ENV'L DATA COLLECTION MS4 & IOAP	$1,000,000.00
H14080 FY18 WATER QUALITY MODELING MS4 &KPC	$37,500.00
H14100 FY18 MS4 PROGRAM	$1,000,000.00
H16038 FY19 MS4 PROGRAM	$1,000,000.00
H16043 FY19 USGS STREAM MONITORING	$225,000.00
H16044 FY19 WATER QUALITY MODELING - NONPOINT &	$37,500.00
H16049 FY20 ENV'L DATA COLLECTION-MS4 &IOAP	$500,000.00
H16055 FY20 MS4 PROGRAM	$1,000,000.00
H16059 FY20 USGS STREAM MONITORING	$225,000.00
H16061 FY20 WATER QUALITY MODELING - NONPOINT &	$37,500.00
H17016 FY21 MS4 PROGRAM	$1,000,000.00
H17018 FY21 ENV'L DATA COLLECTION-MS4 &IOAP	$500,000.00
H17023 FY21 USGS STREAM MONITORING	$225,000.00
X_0067 MS4 PROGRAM	$2,000,000.00
X_0071 USGS STREAM MONITORING	$180,000.00
X_0072 WTR QUALITY MODEL'G-NONPOINT & POINT FOR MS4 & KPDES DISCHARGES	$250,000.00
X_0106 GERALD COURT BASIN RETROFIT	$13,600.00
X_0107 DOWNING WAY BASIN RETROFIT	$24,000.00
X_0108 WOODLAWN PARK BASIN RETROFIT	$29,000.00
X_0109 HIKES LANE BASIN RETROFIT	$42,000.00
X_0110 RICHLAND AVE BASIN RETROFIT	$43,000.00
X_0111 BRECKENRIDGE LANE BASIN RETROFIT	$45,000.00
X_0112 FOUNTAIN SQUARE BASIN RETROFIT	$46,000.00
X_0113 OLD SHEPHERDSVILLE RD BASIN RETROFIT	$51,200.00

Appendix B

Amended Consent Decree
Additional Projects

Appendix B: Amended Consent Decree Additional Projects				
Project Name and IOAP ID	**Project Description**	**2021 Technology**	**2021 Estimated Cost**	**2021 Schedule Completion Date**
Morris Forman WQTC New Biosolids Facility *L_OR_MF_A*	Construct new thermal hydrolysis treatment process to be used in tandem with a combination of repurposed and new systems components.	Thermal Hydrolysis Process (THP)	$197,800,000	12/31/2030
Paddy's Run Pump Station Capacity Improvements *L_OR_MF_B*	Construction of a new 5,250, sq foot Pump Station rated at 1,900 MGD to replace the existing outdated facility.	New Pump Station	$115,000,000	12/31/2026
Buechel Trunk Sewer Rehabilitation *C_SF_MF_B*	Rehabilitation of approximately 20,500 feet of 12-inch to 30-inch sewers.	Sewer Lining & Point Repair	$3,000,000	12/31/2026
Harrods Creek Force Main Repair *C_HC_HC_A*	Repair of 3,200 feet of 18-inch to 30-inch force main.	Sewer Lining & Point Repair	$8,400,000	12/31/2026
Prospect Phase II Area Sewers Rehabilitation *C_HC_HC_B*	Rehabilitation of approximately 2,000 feet of 6-inch to 15-inch sewers.	Sewer Lining & Point Repair	$3,000,000	12/31/2026
Broadway Interceptor Infrastructure Rehabilitation *C_OR_MF_A*	Rehabilitation of approximately 5,4000 feet of 84-inch to 96-inch sewers.	Sewer Lining & Point Repair	$10,000,000	12/31/2026
I-64 and Grinstead Infrastructure Rehabilitation C_MI_MF_A	Rehabilitation of approximately 13,700 feet of 8-inch to 123-inch sewers.	Sewer Lining & Point Repair	$16,000,000	12/31/2026
Large Diameter Sewer Rehabilitation *C_OR_MF_B*	Program including the inspection, pre-design services, design work to the 60% design level and construction phase professional services.	Sewer Lining & Point Repair	$8,300,000	12/31/2026
Rudd Ave Sewer Infrastructure Rehabilitation *C_OR_MF_C*	Rehabilitation of approximately 4,020 feet of 120-inch to 138-inch sewers,	Sewer Lining & Point Repair	$2,300,000	12/31/2026
Western Outfall Infrastructure Rehabilitation C*_OR_MF_D*	Rehabilitation of approximately 18,350 feet of 108-inch to 141-inch sewers.	Sewer Lining & Point Repair	$16,000,000	12/31/2026
Nightingale Sewer Rehabilitation *C_SF_MF_A*	Rehabilitation of approximately 49,500 feet of 6-inch to 18-inch sewers.	Sewer Lining & Point Repair	$3,000,000	12/31/2026
Strategic Asset Management Plan (SAMP) *C_DW_DW_A*	Submittal of a draft plan outlining how MSD will prioritize and perform asset management.	Report	N/A	06/30/2021
Asset Management Program FY21 – FY25 *C_DW_DW_B*	Improvements to existing WQTC, Pump Station, Flood Pump Station, sewers, and related assets serving the wastewater system.	Various	$125,000,000	12/31/2025
Asset Management Program FY26 – FY30 *C_DW_DW_C*		Various	$125,000,000	12/31/2030
Asset Management Program FY31 – FY35 *C_DW_DW_D*		Various	$125,000,000	12/31/2035

Appendix C

Project DRI Project List

Appendix C: Project DRI Project List

Completed DRI Projects		
Budget ID	**Project Name**	**Watershed**
C16097	5103 Red Oak Lane DIP	Pond Creek
C16105	1400 Bernham Lane DIP	Ohio River
C16106	1221 W Main Street DIP	Ohio River
C16107	617 S 43rd Street	Ohio River
C16108	3235 Larkwood Ave DIP	Ohio River
C16113	214 Bramton Road DIP	Middle Fork Beargrass Creek
C16117	317 Bramton Road DIP	Middle Fork Beargrass Creek
C16133	3908 Glen Oak Drive DIP	South Fork Beargrass Creek
C16137	Greenhurst Drive DIP	South Fork Beargrass Creek
C16145	8309 Grandel Forest Way DIP	Mill Creek
C16156	10200 Mitchell Hill Road DIP	Pond Creek
C16162	6626 Bethany Lane DIP	Mill Creek
C16163	13400 Blakely Lane DIP	Pond Creek
C16171	4338 Sadie Lane DIP	Mill Creek
C16174	6624 Deep Cove Court DIP	Harrods Creek
C16178	7300 Shadwell Lane DIP	Harrods Creek
C16183	11210 Vista Greens Drive DIP	Goose Creek
C16187	10701 High grove Place DIP	Middle Fork Beargrass Creek
C16190	2304 Janlyn Road DIP	South Fork Beargrass Creek
C16198	Steep Ridge Court DIP	Floyds Fork
C16200	5906 Chenoweth Run Road DIP	Floyds Fork
C16202	Summer Glen Way DIP	Floyds Fork
C16210	7209 Gerber Ave DIP	Pond Creek
C16214	7708 Hall Farm Drive DIP	Floyds Fork
C16221	8004 Red Bud Hill Drive DIP	Pennsylvania Run
C16232	9703 Saturn Drive DIP	Pond Creek
C16233	7005 Shepherdsville Road DIP	Pond Creek
C16240	9903 Silverwood Lane DIP	Pond Creek
C16248	4008 Blossomwood Drive DIP	Middle Fork Beargrass Creek
C16252	3911 Springhill Road DIP	Middle Fork Beargrass Creek
C16254	3506 Deibel Way DIP	South Fork Beargrass Creek
C16110	1600 Thornberry Ave DIP	Ohio River
C16116	7004 Norbourne Ave DIP	Middle Fork Beargrass Creek
C16126	4026 Leland Road DIP	Muddy Fork Beargrass Creek
C16134	257 Eldorado Ave DIP	South Fork Beargrass Creek
C16158	7613 Yorktown Road DIP	Pond Creek
C16159	1002 Andle Court DIP	Pond Creek
C16165	13512 Kinross Blvd DIP	Mill Creek
C16173	1400 Clara Ave DIP	Ohio River
C16189	2208 Cherian Drive DIP	South Fork Beargrass Creek
C16196	10611 Kinross Court DIP	Middle Fork Beargrass Creek
C16199	4606 Dove Lake Court DIP	Floyds Fork
C16208	4802 Kingfisher Way DIP	Pond Creek
C16209	5350 Rollingwood Trail DIP	Pond Creek
C16211	301 E Esplanade Ave DIP	Ohio River
C16217	8011 Watterson Trail DIP	South Fork Beargrass Creek
C16219	9016 Sagebrush Court DIP	Cedar Creek
C16223	5305 Haventree Place DIP	Pond Creek
C16230	1583 Raydale Drive DIP	Pond Creek
C16236	10314 Blue Lick Road DIP	Pond Creek
C16237	4003 Sirate Lane DIP	Pond Creek
C16247	7405 Ridan Way DIP	Mill Creek
C16250	4016 Norbourne Blvd DIP	Middle Fork Beargrass Creek
C16251	3601 Rosemont Court DIP	South Fork Beargrass Creek

Proposed DRI Projects		
Budget ID	Project Name	Watershed
C16089	2534 Veronica Drive DIP	Mill Creek
C16091	6705 Elmwood Ave DIP	Muddy Fork Beargrass Creek
C16092	6462 Ladd Ave DIP	Mill Creek
C16099	3507 Susanna Drive DIP	Pond Creek
C16115	1606 Girard Ave DIP	Muddy Fork Beargrass Creek
C16127	2926 Riedling Drive DIP	Muddy Fork Beargrass Creek
C16136	1608 Whippoorwill Road DIP	South Fork Beargrass Creek
C16139	12203 Taylorsville Road DIP	Floyds Fork
C16141	8226 St Andrews Church Road DIP	Mill Creek
C16147	6806 Hill Peak Court	Mill Creek
C16149	6816 Manslick Road DIP	Mill Creek
C16153	953 Sissone Drive DIP	Pond Creek
C16167	9111 Aristides Drive DIP	Mill Creek
C16170	1410 Rhonda Way DIP	Mill Creek
C16197	326 Tucker Station Road DIP	Floyds Fork
C16204	6402 S 3rd Street DIP	Ohio River
C16207	6405 Kenjoy Drive DIP	Ohio River
C16216	7008 Fontendleau Way DIP	Cedar Creek
C16218	8313 Millington Court DIP	Pennsylvania Run
C16222	10200 Morrison Road DIP	Pond Creek
C16228	3500 Forman Lane DIP	Pond Creek
C16231	4016 Pinecroft Drive DIP	Pond Creek
C16235	3615 Susan Lane DIP	Pond Creek
C16241	4211 Tamm Court DIP	Pond Creek
C16242	7309 Paiute Road DIP	Pond Creek
C16245	Joe Don Court DIP	Pond Creek
C16253	6005 Alvarado Way DIP	South Fork Beargrass Creek
C16093	3029 Bridwell Drive DIP	Mill Creek
C16094	4520 Winnrose Way DIP	Ohio River
C16095	6600 Maravian Drive DIP	Mill Creek
C16098	4928 Kilgore Court DIP	Pond Creek
C16101	Bonita Court DIP	Pond Creek
C16102	212 Spring Garden Drive DIP	South Fork Beargrass Creek
C16103	2123 Ratcliffe Ave DIP	Ohio River
C16118	Alicent Road DIP	Muddy Fork Beargrass Creek
C16129	50 Pauline Road DIP	Muddy Fork Beargrass Creek
C16131	3004 Poplar Level Road DIP	South Fork Beargrass Creek
C16138	Bristol Oaks Court DIP	Pond Creek
C16148	1918 Farrington Drive DIP	Mill Creek
C16150	6115 Julie Kays Way DIP	Mill Creek
C16151	1724 Kurz Way DIP	Mill Creek
C16154	1101 Tallow Lane DIP	Pond Creek
C16157	10721 Charlene Drive DIP	Pond Creek
C16166	11517 Deering Road DIP	Pond Creek
C16168	13316 Girvan Ave DIP	Pond Creek
C16172	1559 Walter Ave DIP	Mill Creek
C16179	107 Gunpowder Court DIP	Harrods Creek
C16180	Harrods View Circle DIP	Harrods Creek
C16182	10214 Meadow Glen Way Phase 2	Goose Creek
C16188	8301 Doncaster Way DIP	Goose Creek
C16193	1908 Myddleton Drive DIP	Middle Fork Beargrass Creek
C16224	6801 Cliffside Court DIP	Pond Creek
C16225	5312 Chasewood Place DIP	Pond Creek
C16234	8003 Linda Road DIP	Pond Creek
C16244	9009 Annlou Drive DIP	Mill Creek
C16246	4707 Flushing Way DIP	Pond Creek
C16255	2855 Nepperhan Drive DIP	South Fork Beargrass Creek

Appendix D

Middle Fork Beargrass Creek
319 Project List

Appendix D: Middle Fork Beargrass Creek 319 Project List

BMP No.	BMP Description/Action Item	BMP Type/Pollutant Addressed	Additional Priority Goals and Objectives	Priority Action Items	Potential Responsible Party	Load Reduction*	Priority	Technical Assistance	Costs	Funding Mechanisms	Short Term 0-5 Years	Medium Term 5-10 Years	Long Term 10+ Years
1	Establish a Watershed Coordinator to implement watershed plan BMPs	General Watershed Health	Improve Water Quality	1. Apply for grant funding 2. Hire coordinator 3. Prioritize non-structural BMPs based on watershed needs and strengths	MSD	Not calculable	High	N/A	Estimated $75,000/year	319(h)	X		
2	Add watershed plan documents to project partner's websites	General Watershed Health	Involve Community Members	1. Upload watershed plan, watershed maps, and BMP plan to partner's website	MSD, KWA, BCA	Not calculable	Medium	N/A	Staff time	N/A	X		
3	Regulation, ordinance, and benchmark review and assessment: Review and assess local regulations and policies, as well as local ordinances that have the potential to impact water quality	General Watershed Health	Improve Water Quality	1. Evaluate existing regulations, ordinances, and benchmarks to understand potential water quality impacts 2. Develop recommendations for improvements/changes to regulations, ordinances, and benchmarks	MSD	Dependent on ordinance revisions	High	MSD, Project Partners	Staff time	MSD	X		
4	Create additional outreach for existing stream buffer requirements in Floodplain Ordinance	General Watershed Health	Improve Water Quality	1. Establish an outreach program to educate homeowners about the benefits of stream buffers	MSD, Property owners	Not calculable	High	MSD	Staff time	MSD, 319(h)	X		
5	Adopt-a-storm drain program to promote nonpoint source awareness in the watershed	General Watershed Health	Involve Community Members	1. Utilize Watershed Coordinator to identify willing partners to develop and promote program 2. Leverage partnerships to develop an adopt-a-storm drain program 3. Prioritize potential subwatersheds for program	MSD, Anchorage, St Matthews, Jeffersontown	Not calculable	Medium	MSD, Middle Fork Community Partners, Engineering Firms	Varies	MSD, Local, 319(h)	X		
6	Utilize public art and art education programs and activities to create energy around public awareness and activism to improve water quality	General Watershed Health	Involve Community Members	1. Leverage partnerships and relationship with Metro and other cities in the watershed 2. Citizen Lead Programs fostering arts and sciences with a water quality focus	MSD, Local environmental/ non-profit organizations, JCPS, Private Schools	Not calculable	Medium	MSD, Middle Fork Community Partners, Engineering Firms	Volunteer-donated costs	Art grants - External Agency Fund (Louisville Metro), MSD, 319(h), Environmental Education Grants	X		
7	Promote existing stormwater credit program	General Watershed Health	Involve Community Members	1. Distribute materials and promote existing stormwater credit program	MSD	Dependent on practice	High	MSD	$5,000-$25,000 per campaign	MSD	X		
8	Promote nonpoint source awareness in the watershed through education and outreach to schools	General Watershed Health	Involve Community Members	1. Partner with schools to develop curriculum for non-point source pollution and water quality 2. Present developed curriculum	KWA, JCSWCD, MSD, Parks, SRWW, Cities, JCPS, Private Schools, Home Schools	Not calculable	Medium	JCSWCD, JCPS, Curriculum Developers	$500 - $5,000 per curriculum	MSD, 319(h), Environmental Education Grants	X	X	

Appendix D: Middle Fork Beargrass Creek 319 Project List

BMP No.	BMP Description/Action Item	BMP Type/Pollutant Addressed	Additional Priority Goals and Objectives	Priority Action Items	Potential Responsible Party	Load Reduction*	Priority	Technical Assistance	Costs	Funding Mechanisms	Short Term 0-5 Years	Medium Term 5-10 Years	Long Term 10+ Years
9	Outreach with Community Master Gardener and Community Gardener Groups to promote watershed health	General Watershed Health	Involve Community Members	1. Coordinate with Community Master Gardener and Community Gardener Groups to educate on watershed health and priorities.	JCSWCD, MSD	Not calculable	Medium	Master Gardeners	Volunteer and staff time	N/A	X	X	
10	Ongoing watershed planning and evaluation	General Watershed Health	Continuous Improvement	1. On a five year cycle the watershed plan will be reviewed and evaluated by steering committee 2. On a five year cycle action items specific to watershed needs and priorities will be developed 3. A complete update of the watershed plan will be completed when significant changes are identified	MSD, Watershed Coordinator, Steering Committee	Not calculable	High	KWA, BCA, Partners	$10,000-$50,000 per update	MSD, local	X	X	
11	Continue to implement the downspout disconnection program within the combined sewer system	General Watershed Health	Involve Community Members	1. Promote downspout disconnection program and explore ideas for similar programs	MSD, Property Owners	Dependent on project	High	MSD	$100/down-spout plus staff time	MSD	X	X	
12	Protect streams with conservation easements	General Watershed Health	Improve Water Quality	1. Identify areas where conservation easements are feasible	MSD, Jefferson County Environmental Trust	Dependent on project	Medium	MSD , Jefferson County Environmental Trust	Varies	Jefferson County Environmental Trust		X	
13	Implement a trash removal program focused on determining sources of trash in watershed	General Watershed Health	Improve Water Quality	1. Identify appropriate partner to conduct study 2. Develop program to catch trash that would otherwise end up in the waterways 3. Implement study to analyze trash collected in this process--then target the source 4. Develop multimedia outreach to address the key trash items found	Kentucky Waterways Alliance, Beargrass Creek Alliance, MSD, Metro Parks Landowner	Unknown	Medium	MSD, Universities, EPA	Varies	USACE, MSD, 319(h), 2-year EPA Grant		X	
14	Implement a car wash campaign to reduce pollution in waterways	General Watershed Health	Improve Water Quality	1. Education and outreach to general public	MSD, Cities	Unknown	Low	MSD	$5,000-$25,000 per campaign	MSD, Cities, 319(h)		X	
15	Continue implementation of chlorinated pools outreach program	Specific Conductance	Improve Water Quality	1. Review existing materials and promote and distribute	MSD, Board of Health, Cities	Unknown	Medium	MSD	Staff time	MSD, Cities, 319(h)	X		
16	Implement a salt management strategy with education and outreach component	Specific Conductance	Determine Current Conditions	1. Study other salt management strategies 2. Study salt usage and users in watershed 3. Draft materials	MSD, Louisville Metro, KYTC, Cities	Unknown	Medium	MSD, KYTC, Local Engineering Firms	Varies	Louisville Metro Public Works, MSD, Cities, 319(h)		X	

Appendix D: Middle Fork Beargrass Creek 319 Project List

BMP No.	BMP Description/Action Item	BMP Type/Pollutant Addressed	Additional Priority Goals and Objectives	Priority Action Items	Potential Responsible Party	Load Reduction*	Priority	Technical Assistance	Costs	Funding Mechanisms	Short Term 0-5 Years	Medium Term 5-10 Years	Long Term 10+ Years
17	Street sweeping and catch basin cleaning	Sediment and Specific Conductance	Improve Water Quality	1. Work with cities in the watershed with street sweeping practices to understand frequency and perform cost benefit analysis for more frequent sweeping	MSD, Cities	Unknown	Low	KYTC	Varies	Louisville Metro Public Works, Cities	X		
18	Install green infrastructure, such as tree boxes, rain gardens, infiltration trenches	Sediment and Specific Conductance	Improve Water Quality	1. Identify potential project locations 2. Evaluate and design BMPs 3. Install BMPs	MSD, Louisville Metro, KYTC, Cities	Dependent on project	Medium	MSD, KYTC, Local Engineering Firms	Varies	MSD, Cities, 319(h)		X	
19	Increase education for EPSC	Sediment	Improve Water Quality	1. Expand education programs for EPSC	MSD	Not calculable	High	MSD, Engineering Firms	Staff time	MSD	X		
20	Encourage private land owners to establish and widen riparian buffers to stabilize banks with native trees and bushes	Sediment and Nutrients	Improve Water Quality	1. Provide grants or incentives for waterway bank stabilization	KWA, BCA, MSD, Property owners	Not calculable	High	MSD, Tree Nurseries, NRCS, Extension Office	$5,000 - $1,000,000 per project	USACE, MSD, 319(h), NRCS	X		
21	Design and install structural BMPs along the north side of Linn Station Road in Jeffersontown	Sediment and Nutrients	Improve Water Quality, Roadway Safety, Linear Flooding Impacts	1. Evaluate and design structural BMPs that address the drainage upstream of the degraded area 2. Install structural BMPs to capture and treat stormwater to address water quality and flooding concerns	Jeffersontown	Dependent on project	Medium	Engineering firms, MSD	Dependent on project	319(h), Jeffersontown	X	X	
22	Design and install structural BMPs along Valley View Road within the City of Anchorage	Sediment and Nutrients	Improve Water Quality, Roadway Safety, and Reduce Flooding	1. Evaluate and design structural BMPs that address the drainage upstream of the degraded area 2. Install structural BMPs to capture and treat stormwater to address water quality and flooding concerns	Anchorage	Dependent on project	Medium	Engineering Firms, MSD	Dependent on project	319(h), Anchorage	X	X	
23	Design and install structural BMPs along Woodland Drive	Sediment and Nutrients	Improve Water Quality, Roadway Safety, Linear Flooding Impacts	1. Evaluate and design structural BMPs that address the drainage upstream of the degraded area 2. Install structural BMPs to capture and treat stormwater to address water quality and flooding concerns	Anchorage	Dependent on project	Medium	Engineering Firms, MSD	Dependent on project	319(h), Anchorage	X	X	
24	Retrofit of detention basin at Osage Road and Cold Springs Road	Sediment and Nutrients	Improve Water Quality and Reduce Flooding	1. Evaluate and design a retrofit of the existing basin to current design standards to address the drainage upstream of the basin 2. Retrofit detention basin to a green basin to address water quality and volume control	Anchorage	Dependent on project	Medium	Engineering Firms, MSD	Dependent on project	319(h), Anchorage	X	X	

Appendix D: Middle Fork Beargrass Creek 319 Project List

BMP No.	BMP Description/Action Item	BMP Type/Pollutant Addressed	Additional Priority Goals and Objectives	Priority Action Items	Potential Responsible Party	Load Reduction*	Priority	Technical Assistance	Costs	Funding Mechanisms	Short Term 0-5 Years	Medium Term 5-10 Years	Long Term 10+ Years
25	Design and implement structural BMPs along Bluegrass Parkway in Jeffersontown	Sediment and Nutrients	Improve Water Quality and Reduce Flooding	1. Evaluate and design structural BMP to address sediment and water quality impacts due to flooding along Bluegrass Parkway 2. Install structural BMPs to address water quality and flooding concerns	Jeffersontown	Dependent on project evaluation	Medium	Engineering Firms, MSD	Dependent on project	319(h), Jeffersontown	X	X	
26	Design and install structural BMPs at Blairwood Apartments	Sediment and Nutrients	Improve Water Quality, Increase Volume Storage, and Reduce Flooding	1. Evaluate and design structural BMPs that address the drainage upstream of site. Low lying area could potentially be used to create storage on site. 2. Install structural BMPs to capture and treat stormwater to address water quality and flooding concerns.	Hurstbourne, Landowner	Dependent of project	Medium	MSD, Engineering Firms	Dependent on project	319(h), Hurstbourne, MSD	X	X	
27	Retrofit impervious surfaces where feasible to utilize pervious pavers to decrease peak flows and associated pollutants	Sediment	Improve Water Quality	1. Identify locations and/or for potential pervious pavement projects 2. Install pervious pavers with long term maintenance agreements identifying responsible parties with an MOA	MSD and Watershed Partners	Dependent on Project	Medium	MSD, Engineering Firms	$10,000-$500,000 +/- per project	USACE, MSD, 319(h), Research funds		X	
28	Characterize subwatershed's erosion potential instream	Sediment and Nutrients	Determine Current Conditions	1. Determine nonpoint source pollution load potential 2. Select subwatersheds for further characterization 3. Utilize current methods and strategies to calculate load reduction potential within the system 4. Evaluate background and conduct a benchmarking study to specifically address instream sediment loading concerns	MSD, Cities, Metro Parks	Dependent of Project	Medium	Parks, KWA, BCA, NRCS, USACE, Extension Office, JCSWCD	$20,000 to $250,000 +/- per subwatershed	USACE, MSD, 319(h), Research funds		X	
29	Install infiltrative overbank streamside features (diversion/detention/ponding)	Sediment and Nutrients	Improve Water Quality	1. Identify priority areas to apply practice 2. Install overbank streamside features	MSD	Dependent on project	High	MSD, Engineering Firms	Dependent on project	USACE, MSD, 319(h)		X	

Appendix D: Middle Fork Beargrass Creek 319 Project List

BMP No.	BMP Description/Action Item	BMP Type/Pollutant Addressed	Additional Priority Goals and Objectives	Priority Action Items	Potential Responsible Party	Load Reduction*	Priority	Technical Assistance	Costs	Funding Mechanisms	Short Term 0-5 Years	Medium Term 5-10 Years	Long Term 10+ Years
30	Implement stream restoration projects to prevent soil erosion and restore natural channel function	Sediment and Nutrients	Improve Water Quality	1. Identify potential project locations and/or partners 2. Evaluate and design a stream restoration project utilizing natural channel design 3. Construct stream restoration project	Conservation Landowners, MSD and Cities	0.02 lb./ft/yr. TN, 2.55 lb./ft/yr. TSS	High	KWA, BCA, NRCS, Extension Office	$25,000-$1,000,000 +/- per project	USACE, MSD, 319(h) , NRCS		X	
31	Evaluate and improve channels within the Hurstbourne Country Club property	Sediment and Nutrients	Improve Water Quality and Reduce Flooding	1. Evaluate existing channels 2. Use natural channel design to reduce sediment and erosion impacts while removing impervious and 3. Install structural BMPs according to evaluation and design with natural channel approach	Hurstbourne, Hurstbourne Country Club, MSD	Dependent on project	Medium	MSD, Engineering Firms	Dependent on project	319(h), Hurstbourne, Hurstbourne Country, Club, MSD		X	X
32	Create Stormwater Detention Features (regional, subregional, &/or pockets) to reduce peak flows and filter nutrients	Sediment and Nutrients	Improve Water Quality	1. Identify locations and partners for detention features 2. Design detention features 3. Construct detention features	MSD, Cities, Property Owners	~20% TN, ~60% TSS	Medium	MSD, Engineering Firms	$25,000 - $1,000,000+/- per project	MSD, Cities, 319(h)		X	X
33	Evaluate subwatersheds for the existing and potential constructed wetlands and enhance/construct wetlands	Sediment and Nutrients	Improve Water Quality	1. Identify locations of existing and potential wetlands and partners 2. Design constructed wetlands 3. Construct new wetlands and/or improve existing wetlands	MSD, Cities, Property Owners	25-55% TN, ~60% TSS	Medium	MSD, Engineering Firms	Low cost for location identification	MSD, Cities, 319(h)		X	X
34	Conduct tree planting events	Nutrients	Involve Community Members, Improve Water Quality	1. Identify potential locations for tree planting 2. Coordinate with community members on the location and planting plan 3. Plant trees and assign maintenance responsibilities	MSD, Property owners, Schools, KYTC	Not calculable	Medium	MSD, Louisville Metro	$5,000-$25,000 per campaign	MSD, Cities, 319(h), Trees Louisville, Louisville Grows	X		
35	Implement nutrient management program	Nutrients	Improve Water Quality	1. Establish partners for program 2. Determine target audience for program (e.g. golf courses, home owners, HOAs, commercial properties, etc.) 3. Implement program	MSD, SWCD	Dependent on practices	Medium	MSD, SWCD, Engineering Firms	$10,000-$25,000 per campaign	MSD, 319(h)	X		
36	Characterize subwatershed's bacteria load potential	Bacteria	Determine Current Conditions	1. Prioritize subwatersheds with high bacteria data 2. Correlate E. coli and fecal coliform data specific to MFBGC watershed 3. Identify projects and partners that reduce bacteria within prioritized subwatersheds	MSD	Unknown	High	MSD, Health Department	$50,000 to $250,000	MSD, 319(h)	X		

Appendix D: Middle Fork Beargrass Creek 319 Project List

BMP No.	BMP Description/Action Item	BMP Type/Pollutant Addressed	Additional Priority Goals and Objectives	Priority Action Items	Potential Responsible Party	Load Reduction*	Priority	Technical Assistance	Costs	Funding Mechanisms	Short Term 0-5 Years	Medium Term 5-10 Years	Long Term 10+ Years
37	Conduct a "Pick up after your dog" campaign	Bacteria	Improve Water Quality	1. Partner with dog parks, parks, and cities 2. Create outreach campaign	MSD, Cities, Dog Parks	Unknown	Medium	MSD	$5,000-$25,000 per project	MSD, Cities, 319(h)	X		
38	Implement geese-control program	Bacteria	Improve Water Quality	1. Review geese population in watershed to determine extent of problem and establish specific control practices, including do not feed campaigns, anti-roost controls, etc.	MSD, KWA, BCA, Local Communities	Unknown	Medium	MSD, Kentucky Department of Fish and Wildlife	$10,000-$25,000 per campaign	MSD, Cities, 319 (h)	X		
39	Implement septic system outreach program such as EPA Septic SMART targeting areas with septic systems	Bacteria	Improve Water Quality	1. Identify areas with septic systems in the watershed 2. Work with landowners regarding maintenance 3. Work with local communities regarding transition to sewers 4. Education and outreach regarding septic systems	MSD, Health Department, Cities	Unknown	High	MSD, Health Department	$5,000-$25,000 per campaign, Varies for sewer projects	MSD, Cities, 319(h)	X	X	
40	Install pet waste stations, including bags and disposal	Bacteria	Improve Water Quality	1. Identify location for pet waste stations 2. Locate stations in parks and neighborhoods in watershed	Dog Parks, Metro Parks, City Parks	Unknown	Medium	MSD	$3,000 to $15,000 per station and annual maintenance costs	MSD, Cities, 319(h)		X	
41	Implement inflow and infiltration sanitary sewer projects and other IOAP Projects	Bacteria and Nutrients	Improve Water Quality	1. Construct projects in 2021 IOAP Modification including Middle Fork Relief Interceptor and Pump Station 2. Construct rehabilitation projects identified in 20-year Comprehensive Facility Plan 3. Identify other potential interceptor projects in the watershed	MSD	Unknown	Medium	MSD, Local Engineers	Based on project (See 2021 IOAP and 20-Year Comp. Fac. Plan)	MSD			X

Appendix E

Summary of Contracted Studies Included in FIS Report

Appendix E: Summary of Contracted Studies Included in FIS Report

Watershed	Subwatershed or Stream Name	Downstream Limit	Upstream Limit	Length (mi)	Work Completed Date	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Return Interval (*Partially available)	FIS Report Dated	Contractor
Middle Fork Beargrass Creek	Country Club Branch	At confluence with Hurstbourne Creek	Approximately 500 feet upstream of Rugby Place	0.59	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Foxmoore Creek	At confluence with Hurstbourne Creek	Approximately 3,100 feet upstream of Hurstbourne Creek	0.58	Unknown	Unknown	Unknown	1%	12/5/2006	Unknown
	Hurstbourne Creek	At confluence with Middle Fork Beargrass Creek	Just downstream of Hurstbourne Pkwy.	2.96	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Linn Station Fork	At confluence with Country Club Branch	Approximately 575 feet upstream of Linn Station Road	0.5	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Middle Fork Beargrass Creek	Just upstream of Hobbs Station Road	At Bellewood Road	0.56	2016	HEC-HMS 2009	HEC-RAS 2010	1%	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Middle Fork Beargrass Creek	Approximately 250 feet upstream of Sherburn Lane	Just upstream of Hobbs Station Road	4.81	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Middle Fork Beargrass Creek	At confluence with South Fork Beargrass Creek	Approximately 250 feet upstream of Sherburn Lane	8.73	1976	HEC-1	HEC-2	10%, 2%, 1%, 0.2%	2/2/1994	USACE, Louisville District
	Middletown Branch	480 feet upstream of Dorsey Lane	Approximately 950 feet upstream of Brookside Drive	0.69	2016	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Middletown Branch	At confluence with Middle Fork Beargrass Creek	480 feet upstream of Dorsey Lane	1.17	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Sinking Fork	At confluence with Middle Fork Beargrass Creek	At Chiswick Court	0.68	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Weicher Creek	At confluence with Middle Fork Beargrass Creek	Approximately 3,700 feet upstream of Limehouse Ln.	3.12	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
Muddy Fork Beargrass Creek	Crescent Hill Creek	At confluence with Muddy Fork Beargrass Creek	Just downstream of Brownsboro Road	1.56	2016	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Muddy Fork	At confluence with Beargrass Creek	Approximately 1,750 feet upstream of South Foeburn Lane	7.17	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
South Fork Beargrass Creek	Avoca Creek	At confluence with South Fork Beargrass Creek	Approximately 475 feet downstream of S Hurstbourne Parkway	0.67	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Beals Branch	At confluence with Middle Fork Beargrass Creek	Just downstream of Cressbrook Drive	1.37	2019	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Beargrass Creek / South Fork Beargrass Creek	At confluence with Ohio River	Just downstream of Taylorsville Rd.	14.06	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Skees Engineering, Inc.
	Buechel Branch	At confluence with Buechel Terrace Creek	Approximately 1,390 feet upstream of Granvil Drive	1.31	2016	HEC-HMS 2010	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Buechel Branch	Approximately 110 feet downstream of Buechel Bank Road	At confluence with Buechel Terrace Creek	0.24	2017	N/A	HEC-RAS 2010	1%	12/5/2006	AECOM
	Buechel Branch	At confluence with South Fork Beargrass Creek	Approximately 110 feet downstream of Buechel Bank Road	1.66	1990	HEC-1	HEC-2	1%	2/2/1994	United States Army Corps of Engineers (USACE)
	Buechel Terrace Creek	At confluence with Buechel Branch	Approximately 1,200 feet upstream Nachand Lane	2.09	2016	HEC-HMS 2010	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc

Appendix E: Summary of Contracted Studies Included in FIS Report										
Watershed	Subwatershed or Stream Name	Downstream Limit	Upstream Limit	Length (mi)	Work Completed Date	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Return Interval (*Partially available)	FIS Report Dated	Contractor
South Fork Beargrass Creek	Camp Taylor Ditch	At confluence with South Fork Beargrass Creek	Approximately 500 feet upstream of Cardinal Drive	1.06	2016	HEC-HMS 2010	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Brooklawn Tributary	At confluence with South Fork Beargrass Creek	Just upstream of Shannon Drive	1.32	1976	HEC-1	HEC-2	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/2/1994	United States Army Corps of Engineers (USACE)
	Nachand Ditch	At confluence with Buechel Branch	Approximately 850 feet upstream of Orchard Lake Drive	0.79	2016	HEC-HMS 2010	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Cedar Creek	Cedar Creek	Jefferson County Boundary	Just downstream of Hudson Ln.	7.9	Unknown	Unknown	Unknown	1%	12/5/2006	Unknown
	Hawkins Rill	At confluence with Cedar Creek	Approximately 250 feet upstream of Shaffer Road	1.77	Unknown	Unknown	Unknown	1%	12/5/2006	Unknown
	Little Cedar Creek	At confluence with Cedar Creek	Approximately 500 feet upstream of Renate	2.95	-9999	Unknown	Unknown	1%	12/5/2006	Unknown
Floyds Fork	Back Run	At confluence with Broad Run	Approximately 1,800 feet upstream of confluence with Lisa Run	5.04	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Big Run	At confluence with Floyds Fork	Approximately 650 feet upstream of Seatonville Road	3.42	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Blackacre Creek	At confluence with Chenoweth Run I	Approximately 0.56 miles upstream of Landherr Drive	1.26	2016	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Big Run Tributary 1	At confluence with Big Run	Approximately 1,585 feet upstream of confluence with Big Run	0.3	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Big Run Tributary 2	At confluence with Big Run	Approximately 1,450 feet upstream of Seatonville Road	0.51	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Bradbe Creek	At confluence with Cane Run	Approximately 1,760 feet upstream of Bradbe Road	0.78	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Broad Run	At confluence with Floyds Fork	Approximately 1.05 miles upstream of Broad Run Road	2.88	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Brush Run Lower	At confluence with Floyds Fork	Approximately 1,685 feet upstream of Brush Run Road	2.94	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Brush Run Middle	At confluence with Floyds Fork	Jefferson County Boundary	2.56	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Brush Run Upper	At confluence with Floyds Fork	Approximately 1,900 feet upstream of Polo Fields Lane	2.72	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Cane Run	At confluence with Floyds Fork	Approximately 775 feet upstream of Chapman Road	4.85	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Chenoweth Run I	At confluence with Floyds Fork	Approximately 1,580 feet upstream of I-64	8.18	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Chenoweth Run II (Upper)	At confluence with Floyds Fork	Approximately 1,500 feet upstream of St. Clair Dr.	4.21	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Chenoweth Run II (Upper) Tributary A	At confluence with Chenoweth Run II (Upper)	Approximately 375 feet upstream of Eastpoint Parkway	1.05	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc

Appendix E: Summary of Contracted Studies Included in FIS Report

Watershed	Subwatershed or Stream Name	Downstream Limit	Upstream Limit	Length (mi)	Work Completed Date	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Return Interval (*Partially available)	FIS Report Dated	Contractor
Floyds Fork	Commerce Creek	At confluence with Pope Lick	At confluence with Mahoney Branch and Papa Johns Creek	0.62	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Dunbar Branch	At confluence with Cane Run	Approximately 3,000 feet upstream of Taylorsville Lake Road	1.05	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Floyds Fork	At Jefferson County southern corporate limit (Bullitt County)	At Jefferson County northeast corporate limit (Oldham/Shelby County)	33	2003	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	USACE, Louisville District
Floyds Fork	Jenkins Creek	At confluence with Brush Run Lower	Approximately 1.34 miles upstream of Brush Run Road	1.34	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Kuriger Creek	At confluence with Back Run	Approximately 0.78 miles upstream of confluence with Back Run	0.78	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Lang Run	At confluence with Long Run Creek	Approximately 0.52 miles upstream of the confluence with Long Run	0.52	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Lisa Run	At confluence with Back Run	Approximately 0.67 miles upstream of confluence with Back Run	0.67	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Long Run Creek	At confluence with Floyds Fork	At Jefferson County line	6.86	2004	HEC-HMS 2003	HEC-RAS 2003	0.01	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
Floyds Fork	Mahoney Branch	At confluence with Commerce Creek	Approximately 650 feet upstream of Tucker Station Road	0.56	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Old Mans Run	At confluence with Floyds Fork	Jefferson County Boundary	1.65	2016	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Papa Johns Creek	At confluence with Commerce Creek	Approximately 550 feet upstream of Tucker Station Rd.	0.4	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Plum Creek	At confluence with Cane Run	Approximately 445 feet upstream of Cedar Oak Trail	1.39	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Pope Lick Tributary	At confluence with Pope Lick	Approximately 475 feet upstream of Tucker Station Road	0.74	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Floyds Fork	Pope Lick	Approximately 400 feet downstream of Ledges Road	Approximately 1,255 feet upstream of Wooded Falls Road	5.39	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Pope Lick	Approximately 300 feet downstream of N Pope Lick Road	Approximately 400 feet downstream of Ledges Road		2007	HEC-HMS 2003	HEC-RAS 2004	1%	2/26/2021	Land Design & Development Inc.
Floyds Fork	Pope Lick	At confluence with Floyds Fork	Approximately 300 feet downstream of N Pope Lick Road	5.39	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Rehl Creek	At confluence with Pope Lick	Approximately 2,500 feet upstream of I-265 South	0.95	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Shakes Run	At confluence with Long Run	Jefferson County Boundary	2.92	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Sheckels Run	At confluence with Cane Run	Approximately 1.57 miles upstream of Bradbe Road	1.89	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Floyds Fork	Shinks Branch	At confluence with Chenoweth Run I	Approximately 2,600 feet upstream of Old Heady Road	2.14	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc

Appendix E: Summary of Contracted Studies Included in FIS Report

Watershed	Subwatershed or Stream Name	Downstream Limit	Upstream Limit	Length (mi)	Work Completed Date	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Return Interval (*Partially available)	FIS Report Dated	Contractor
Floyds Fork	Simpsonville Run	At confluence with Long Run	Jefferson County Boundary	0.66	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	South Long Run	At confluence with Long Run	Jefferson County Boundary	2.26	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Tater Run	At confluence with Long Run Creek	Jefferson County Boundary	0.54	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Unnamed Tributary to Pope Lick	At confluence with Pope Lick	Approximately 300 feet upstream of Upton Woods Way	0.1	2013	HEC-HMS 2003	HEC-RAS 2008	1%	12/5/2006	Land Design & Development Inc.
	Vettiner Creek	At confluence with Chenoweth Run I	Approximately 3,500 feet upstream of confluence with Chenoweth Run I	0.65	2016	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Woodmont Branch	At confluence with Klemenz Creek	Approximately 330 feet downstream of Old Henry Road	0.57	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Goose Creek	Brownsboro Ditch	At confluence with Little Goose Creek	Approximately 200 feet upstream of Ten Broeck Way	0.05	2002	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Tetra Tech, Inc.
	Goose Creek	At Lakeland Road	Approximately 1,200 feet upstream of Osage Road	1.8	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Goose Creek	Approximately 1,260 feet above confluence with Goose Creek Tributary	At Lakeland Road	4.92	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Goose Creek	Approximately 1,000 feet downstream of Westport Road	Approximately 1,260 feet above confluence with Goose Creek Tributary	0.8	2009	HEC-HMS 2008	HEC-RAS 2008	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Goose Creek	Backwater of the Ohio River	Approximately 1,000 feet downstream of Westport Road	4.99	2016	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Goose Creek Tributary	At confluence with Goose Creek	Just upstream of Ormsby Lane	0.46	2009	HEC-HMS 2008	HEC-RAS 2008	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	LeFores Branch	At confluence with Goose Creek	Approximately 1,000 feet upstream of the confluence with Goose Creek	0.21	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Lilac Run	At confluence with Little Goose Creek	Approximately 1,800 feet downstream of Wynbrooke Cir.	0.43	2002	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Tetra Tech, Inc.
	Little Goose Creek	Approximately 300 feet upstream of Westport Road	Approximately 1,175 feet upstream of Indian Lake Drive	1.02	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Little Goose Creek	Approximately 500 feet downstream of I-71	Approximately 300 feet upstream of Westport Road	3.69	2002	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Tetra Tech, Inc.
	Little Goose Creek	At confluence with Goose Creek	Approximately 500 downstream of I-71	4.78	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	TBD	Amec Foster Wheeler Environment and Infrastructure, Inc
	Rolling Hills Branch	Approximately 200 feet upstream of Goose Creek Road	Just downstream of Westport Road	0.71	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Rolling Hills Branch	At confluence with Little Goose Creek	Approximately 200 feet upstream of Goose Creek Road	0.3	2002	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Tetra Tech, Inc.
	Springhurst Creek	At confluence with Little Goose Creek	Approximately 350 feet upstream of Ten Broeck Way	0.11	2002	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Tetra Tech, Inc.

Appendix E: Summary of Contracted Studies Included in FIS Report										
Watershed	Subwatershed or Stream Name	Downstream Limit	Upstream Limit	Length (mi)	Work Completed Date	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Return Interval (*Partially available)	FIS Report Dated	Contractor
Goose Creek	Thornhill Creek	Just upstream of Seminary Dr.	Approximately 0.3 miles upstream of Chadford Way	0.49	2000	HEC-1	HEC-RAS 1998	1%	12/5/2006	Ogden Environmental and Energy Services
Goose Creek	Thornhill Creek	Approximately 100 feet downstream of I-71	Just upstream of Seminary Dr.	0.39	2010	HEC-HMS 2008	HEC- RAS 2008	1%	2/26/2021	LOMR 10-04-0314P
Harrods Creek	Harrods Creek	At confluence with Ohio River	At Jefferson County northeast corporate limit (Oldham County)	5.76	2002	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	USACE, Louisville District
Harrods Creek	Hite Creek	At Oldham County/Jefferson County line	Approximately 800 feet upstream of Collins Ln.	4.6	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
Harrods Creek	Hunting Branch	At confluence with Hunting Creek	Just downstream of Hunting Creek Country Club pond	0.49	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Harrods Creek	Hunting Creek	At confluence with Harrods Creek	Jefferson County Boundary	2.72	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2%	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Harrods Creek	Wallace Creek	At confluence with Harrods Creek	Jefferson County Boundary	2.91	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Harrods Creek	Wolf Pen Branch	At confluence with Harrods Creek	Approximately 740 feet upstream of I-71	2.02	2006	HEC-HMS 2006	HEC-RAS 2010	1%	2/26/2021	Metropolitan Sewer District
Mill Creek	Big Run Creek/Diversion	At confluence with Mill Creek Cutoff	300 feet upstream of Mount Calvary Road	4.52	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	Big Run Ditch	At confluence with Upper Mill Creek	Approximately 1,300 feet upstream of Lower Hunters Trace	1.51	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	Black Pond Creek	At confluence with Mill Creek	Just upstream of Bagbe Way	4.05	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	Boxwood Ditch	At confluence with Cane Run Ditch	Just downstream of S Crums Ln.	1.4	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	Cane Run Ditch	At confluence with Mill Creek Cutoff	Approximately 1.08 miles upstream of Balamor Drive	2.11	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	City Park Ditch East	At confluence with Upper Mill Creek	Approximately 1.55 miles upstream of confluence with Upper Mill Creek	1.59	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	City Park Ditch West	At confluence with Upper Mill Creek	Approximately 1,050 feet upstream of Hillview Ave.	0.99	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	East Branch Boxwood Ditch	At confluence with Boxwood Ditch	Approximately 1,700 feet upstream of Crums Lane	1.15	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	TBD	Stantec Consulting Services
Mill Creek	Heatherfield Ditch	At confluence with Upper Mill Creek	Just downstream of Peasleee Rd	1.94	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	Lower Garrison Ditch	At confluence with Mill Creek Cutoff	Approximately 2,100 feet upstream of confluence with Mill Creek Cutoff	0.4	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	Lynnview Ditch	At confluence with Upper Mill Creek	Approximately 1,000 feet upstream of Wayne Road	2.17	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Mill Creek	Mill Creek	At confluence with Ohio River	Approximately 2,450 feet upstream of Terry Road	9.75	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services

Appendix E: Summary of Contracted Studies Included in FIS Report

Watershed	Subwatershed or Stream Name	Downstream Limit	Upstream Limit	Length (mi)	Work Completed Date	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Return Interval (*Partially available)	FIS Report Dated	Contractor
Mill Creek	Mill Creek Cutoff/Upper Mill Creek	At confluence with Longview Creek	Approximately 1940 feet upstream of I-71 North	0.88	2016	HEC-HMS 2013	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Mill Creek Cutoff/Upper Mill Creek	At confluence with Cane Run Ditch	Approximately 700 feet upstream of Manslick Rd.	2.74	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Ponder Creek	At confluence with Valley Creek	Just upstream of Paralee Lane	1.81	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Stephan Ditch	At confluence with Valley Creek	Approximately 160 feet upstream of Paramount Drive	1.7	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Upper Garrison Ditch	At confluence with Lower Mill Creek	At confluence with Mill Creek	0.86	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Valley Creek	At confluence with Mill Creek	Approximately 2,340 feet upstream of Lila Avenue	3.47	2006	HEC-HMS 2003	HEC-RAS 2004	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
Ohio River	Locust Grove Creek	At confluence with Longview Creek	Approximately 1940 feet upstream of I-71 North	0.88	2016	HEC-HMS 2013	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Longview Creek	At confluence with Pennsylvania Run	At Cedar Creek Road	1.18	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	MSD and the University of Louisville
	Ohio River	Just downstream of County Boundary	Just upstream of County Boundary	36.81	2005	Discharge Frequency Curves	HEC-RAS 2005	10%, 2%, 1%, 0.2%	2/26/2021	United States Army Corps of Engineers (USACE)
	Paddy Run	At confluence with Ohio River	Approximately 0.90 miles upstream of confluence with Ohio River	0.76	2016	HEC-HMS 2013	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Winding Creek	At confluence with Longview Creek	Approximately 575 feet upstream of Woodside Road	0.29	2016	HEC-HMS 2013	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
Pennsylvania Run	Anita Branch	At confluence with Lovvorn Creek	Approximately 350 feet upstream of Cooper Chapel Road	0.42	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	MSD and the University of Louisville
	Drews Fork	At confluence with Pennsylvania Run	Approximately 500 feet upstream of Gene Snyder Freeway (I-265)	0.26	2000	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	MSD and the University of Louisville
	Durbin Branch	At confluence with Pennsylvania Run	Approximately 200 feet upstream of Beulah Church Road	1.58	2000	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	MSD and the University of Louisville
	Gene Snyder Tributary	At confluence with Pennsylvania Run	Approximately 500 feet upstream of Gene Snyder Freeway (I-265)	0.26	2000	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	MSD and the University of Louisville
Pennsylvania Run	Lovvorn Creek	At confluence with Pennsylvania Run	Approximately 200 feet upstream of Beulah Church Road	1.58	2000	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	MSD and the University of Louisville
	Pennsylvania Run	At Jefferson County southern corporate limit (Bullitt County)	At McNeely Lake Dam		2010	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2%	2/26/2021	Stantec Consulting Services
	Pennsylvania Run	At McNeely Lake Dam	Approximately 60 feet upstream of Stickler Rd.	4.82	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	MSD and the University of Louisville
	Pohlmann Branch	At confluence with Pennsylvania Run	Approximately 300 feet upstream of Beulah Church Road	1.41	2000	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	MSD and the University of Louisville

Appendix E: Summary of Contracted Studies Included in FIS Report										
Watershed	Subwatershed or Stream Name	Downstream Limit	Upstream Limit	Length (mi)	Work Completed Date	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Return Interval (*Partially available)	FIS Report Dated	Contractor
Pond Creek	Bearcamp Run	At confluence with Pond Creek	Approximately 120 feet upstream of Mitchell Hill Rd.	1.97	2009	HEC-HMS 2009	HEC-RAS 2005	10%, 2%, 1%, 0.2% 1% Future Developed Condition*	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Bee Lick Creek	At confluence with Northern Ditch	Approximately 1,500 feet upstream of Jefferson Blvd.	2	2004	HEC-HMS 2003	HEC-RAS 2003	1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Bee Lick Creek	At confluence with Pond Creek	Approximately 1.2 miles upstream of Jefferson County Boundary	6.09	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Blue Springs Ditch	At confluence with Floyds Fork	Approximately 775 feet upstream of Chapman Road	4.85	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Brier Creek	At confluence with Fishpool Creek	Approximately 1,250 feet upstream of River Trail Dr.	1.4	1990	HEC-1	HEC-2	10%, 2%, 1%, 0.2% 1% Future Developed Condition*	2/2/1994	USACE, Louisville District
	Cooper Chapel Branch	At confluence with Fern Creek	Approximatekly 3,000 feet upstream of Cross Creek Blvd.	1.45	2016	HEC-HMS 2009	HEC-RAS 2010	1%	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Crane Run	At confluence with Pond Creek	Approximately 1.15 miles upstream of Saw Mill Road	4.34	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Crane Run	Just downstream of Fegenbush Lane	Approximately 600 feet upstream of Mansfield Estates Drive	4.22	2017	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Stantec Consulting Services
	Downs Branch	At confluence with Northern Ditch	Just downstream of Fegenbush Lane	1.44	1990	HEC-1	HEC-2	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/2/1994	USACE, Louisville District
	Fern Creek	At confluence with Fishpool Creek	Just upstream of Shepherdsville Road	1.32	1990	HEC-1	HEC-2	1%	2/2/1994	USACE, Louisville District
	Fern Creek	At confluence with Southern Ditch	Approximately 300 feet downstream of Cooper Chapel Road	5.21	2004	HEC-HMS 2003	HEC-RAS 2003	10%*, 2%*, 1%, 0.2%* 1% Future Developed Condition*	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Filson Fork	At confluence with Northern Ditch	Just upstream of Poplar Level Road	2.46	1990	HEC-1	HEC-2	1%	2/2/1994	USACE, Louisville District
	Fishpool Creek	At confluence with Pond Creek	Confluence with Salt Block Creek	1.01	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Guardian Creek	At confluence with Wilson Creek	Approximately 350 feet upstream of Charlene Drive	2.25	1990	HEC-1	HEC-2	1%	2/2/1994	USACE, Louisville District
	Hollyhock Ditch	At confluence with Fishpool Creek	Approximately 0.28 miles upstream of Glen Rose Road	1.22	1990	HEC-1	HEC-2	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/2/1994	USACE, Louisville District
	Little Bee Lick Creek	At confluence with Ohio River	Approximately 2,450 feet upstream of Terry Road	9.75	2006	HEC-HMS 2003	HEC-RAS 2004	1%	2/26/2021	Stantec Consulting Services
	Manslick Branch	At confluence with Ohio River	At confluence with Cane Run Ditch	2.63	2006	HEC-HMS 2003	HEC-RAS 2004	1%	2/26/2021	Stantec Consulting Services
	Mud Creek	At confluence with Southern Ditch	Approximately 1,350 feet upstream of Blue Lick Road	2.91	1990	HEC-1	HEC-2	1%	2/2/1994	USACE, Louisville District
	Northern Ditch	At confluence with Pond Creek and Southern Ditch	At confluence with Fern Creek	7.1	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Picadilly Run	At confluence with Fern Creek	Approximately 1,925 feet upstream of Hudson Creek Dr.	1.73	2016	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc

Appendix E: Summary of Contracted Studies Included in FIS Report										
Watershed	Subwatershed or Stream Name	Downstream Limit	Upstream Limit	Length (mi)	Work Completed Date	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Return Interval (*Partially available)	FIS Report Dated	Contractor
Pond Creek	Pond Creek	At Jefferson County line	At confluence with Northern Ditch and Southern Ditch	16.79	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Poter Branch	At confluence with Snider Branch	Approximately 2,00 feet upstream of Gilmore Lane	1.13	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Rangeland Run	At confluence with Spring Ditch Backwater	At Shepherdsville Road	1.24	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Reardon Hollow Ditch	At confluence with Crane Run	Just below Saw Mill Rd.	0.72	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Roberson Run	Just downstream of Shepherdsville Road	Approximately 1,400 feet downstream of East Manslick Road	0.74	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Roberson Run	At confluence with Southern Ditch	Just downstream of Shepherdsville Road	1.26	1990	HEC-1	HEC-2	10%, 2%, 1%, 0.2%	2/2/1994	United States Army Corps of Engineers (USACE)
	Roney Ditch	Approximately 430 feet upstream of Zib Lane	Approximately 2,550 feet upstream of Donna Boulevard	1.21	2016	Unknown	Unknown	1%	12/5/2006	LOMR 15-04-6547P; LOMR 16-04-3003X
	Salt Block Creek	At confluence with Bee Lick Creek	Approximately 400 feet upstream of Lonesome Hollow Road	2.57	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Schuff Branch	At confluence with Snider Branch	Just downstream of Poplar Level Road	0.62	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Slate Run	At confluence with Pond Creek	Just upstream of St. Anthony Church Road	1.37	1990	HEC-1	HEC-2	1%	2/2/1994	USACE, Louisville District
	Snider Branch	At confluence with Guardian Ditch	At confluence with Schuff Branch	0.96	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Southern Ditch	At confluence with Pond Creek and Northern Ditch	Approximately 600 feet upstream of Michael Ray Drive	7	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Treeline Ditch	At confluence with Bee Lick Creek	Approximately 1,900 feet upstream of New Cut Rd.	0.41	2009	HEC-HMS 2009	HEC-RAS 2005	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Walnut Hill Branch	At confluence with Fern Creek	Approximately 540 feetupstream of Pavilion Way	1.42	2016	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Watterson Trail Creek	At confluence with Fern Creek	At Gonewind Drive	0.82	2016	HEC-HMS 2009	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Wet Woods Creek	Just downstream of I-65	At Preston Highway	1.2	1990	HEC-1	HEC-2	1%	2/2/1994	USACE, Louisville District
	Wet Woods Creek	At confluence with Southern Ditch	Just downstream of I-65	2.24	2004	N/A	HEC-RAS 2003	1%	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)
	Wheelers Run	At confluence with Back Run	Jefferson County Boundary	1.6	2016	HEC-HMS 2003	HEC-RAS 2010	10%, 2%, 1%, 0.2% 1% Future Developed Condition	2/26/2021	Amec Foster Wheeler Environment and Infrastructure, Inc
	Wilson Creek	At confluence with Southern Ditch	At Bullitt County/Jefferson County line	5.49	2004	HEC-HMS 2003	HEC-RAS 2003	10%, 2%, 1%, 0.2% 1% Future Developed Condition	12/5/2006	Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM)

Safe, clean waterways

700 West Liberty Street
Louisville, KY 40203-1911
LouisvilleMSD.org
24/7 Customer Relations
502.540.6000