

Kansas City, Missouri Water Services Department

Overflow Control Program

Conceptual Control Plan Draft

August 28, 2007



City Contract 770 – City Project 81001

Synopsis

Kansas City, Missouri is required to submit to the Missouri Department of Natural Resources and the U.S. Environmental Protection Agency by July, 2008 a Control Plan for decreasing the frequency and volume of overflows from its combined and separate sanitary sewer systems. The Control Plan will be structured to help minimize loss of life & injury and reduce property damage due to flooding, and improve water quality while maximizing economic, social, and environmental benefits. Achieving these goals and meeting regulatory requirements will require a watershed approach. Green Solutions, Stormwater Best Management Practices, and conventional source reduction techniques will all play significant and early roles in a structured yet adaptive program aimed to achieve these goals at an appropriate cost.

This Conceptual Control Plan was guided by informed community input and extensive technical analyses. The comprehensive Control Plan will be structured to: reduce the problem before we try to solve it; integrate structural controls and Green Solutions; address flood protection needs while reducing combined sewer overflows; engage the entire metropolitan community; and maximize use of the existing system.

Proposed strategies in the separate sanitary sewer system basins are to reduce inflow and infiltration where cost-effective; provide a combination of wet weather storage and treatment to address remaining wet weather flows; and accommodate population growth. Proposed strategies in the combined sewer system basins are structured to meet the community's goals and regulatory requirements while providing multiple benefits. A wide range of system-wide policy and management actions are also needed. A Watershed Management Plan for the entire Blue River basin addressing pollutants in stormwater runoff will be coupled with combined sewer overflow control to support appropriate recreational uses and attainable water quality standards. A period of 25 years or more will be needed to complete implementation of the Control Plan (subject to development of a suitable funding plan) and to maximize the benefits of Green Solutions in reducing the cost of conventional structural solutions. That time frame will be confirmed during completion of the Control Plan. The estimated capital cost for implementing all these overflow control strategies is \$2.4-\$3.0 billion.

The Control Plan is expected to result in a capture of approximately 75% of the wet weather flows in those combined sewer systems directly tributary to the Kansas and Missouri rivers, and approximately 83% in those combined sewer systems tributary to the Blue River, by employing a combination of conventional structural controls and Green Solutions and other source controls. Combined sewer overflow volumes in a typical year will be reduced from 6.1 billion gallons to 1.8 billion gallons.

The public education and participation process that has been conducted throughout development of the Control Plan will be continued. A draft of the proposed Control Plan will be submitted to the Council in April, 2008. A 30-day formal public comment period is required by regulation. The draft will be revised as necessary to respond to City Council and public comments and submitted to the regulatory agencies in July, 2008.

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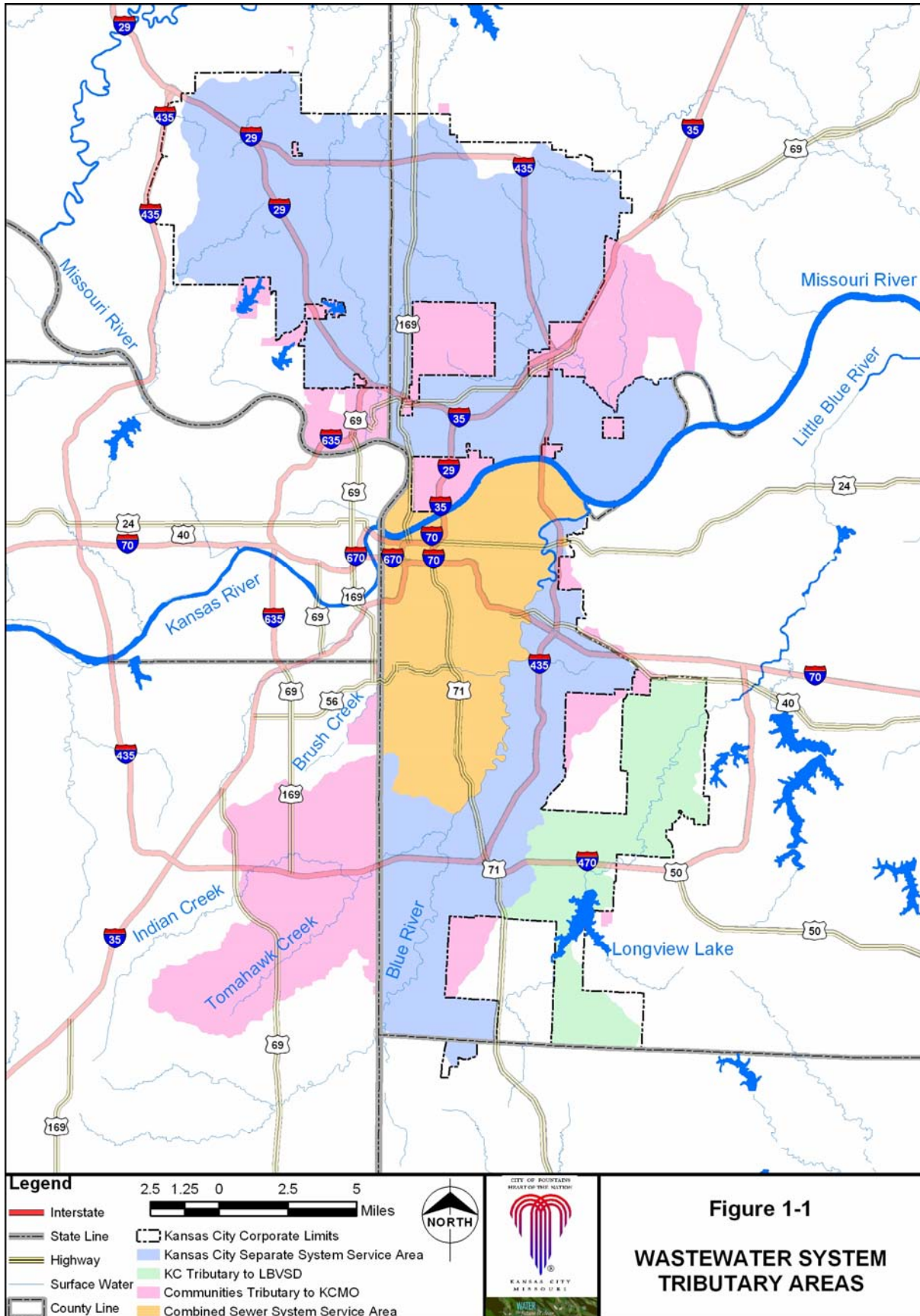
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1 BACKGROUND

This planning effort began in late 2002, with preparation of Work Plans that defined how the Overflow Control Program (Program) would be conducted. That Program's mission is to "*protect the public health and the environment, and meet regulations at an appropriate cost.*" In 2004, eight Basin Engineers (consultant firms tasked with the detailed analysis of individual basins), along with firms that provided flow metering, sampling, water quality analysis, and rainfall data were placed under contract. Most field work and data gathering was completed in 2005, with model analysis and alternative development proceeding in 2006. Development of standardized methodologies, reports, public participation, and agency coordination continued throughout the process. The Annual Reports submitted to the Missouri Department of Natural Resources by the Water Services Department provide excellent interim Program summaries. By mid-2007, the sewer improvement plan framework was being developed.

1.1 Existing System and Performance

The Kansas City WSD provides wastewater collection and treatment for approximately 650,000 people, located within the city and in 27 tributary or "satellite" communities. Figure 1-1 shows the entire area presently tributary to the Kansas City wastewater collection system (totaling approximately 406 square miles). Of that total area, roughly 307 square miles are within the corporate limits of Kansas City, with the balance in the satellite communities. The most significant satellite customer is the Johnson County, Kansas Wastewater District (population of nearly 57,000 served by the Kansas City system). Roughly 36 square miles within Kansas City drains to and is served by the Little Blue Valley Sewer District's collection and treatment system. Major streams in the area include the Missouri, Kansas, and Blue rivers; smaller streams of interest in development of the Control Plan include Brush Creek and Town Fork Creek. System performance was established based on metered sewer flow (over 2.5 million data sets recorded at 170 locations), measured rainfall (over 3.8 million radar rainfall records), and mathematical modeling of critical system components (all overflow structures and 2.6 million feet of sewer).



1.1.1 Combined Sewers (Basin Descriptions)

About 56 square miles* within Kansas City south of the Missouri River are served by combined sewers. That area is bounded by the Missouri/Kansas state line on the west, 85th Street on the south, the Blue River on the east, and the Missouri River on the north. For planning purposes, the area was subdivided into seven principal basins, as shown on Figure 1-2. Five of those basins (Gooseneck Creek, Lower Blue River, Town Fork Creek, Brush Creek, and Middle Blue River) are tributary to the Blue River Interceptor Sewer, which generally parallels the Blue River downstream (north) of Brush Creek and discharges to the Blue River Wastewater Treatment Plant (WWTP). A sixth basin (Northeast Industrial District, or NEID) is served by that same WWTP. The seventh principal combined sewer system basin (Turkey Creek/Central Industrial District (CID)) discharges to the Westside WWTP. Combined Sewer System basin characteristics are further defined in Table 1-1. In addition to those seven basins, the Charles B. Wheeler (Downtown) Airport is presently served by combined sewers, adding approximately 1.6 square miles to the total area of Kansas City, Missouri served by combined sewers. An additional small area of 37 acres (0.06 square miles) east of the Blue River (at Winner Road and Interstate 435) is also served by combined sewers.

**Table 1-1
Combined Sewer System Basin Data**

Basin	Basin Area(acres)	Basin Population (Note 1)	Existing Combined Sewer System*		
			Total Length (ft)*	Diversion Structures*	Number of Outfalls*
MISSOURI RIVER BASINS					
Downtown Airport	1,000	N/A	73,000	3	1
Turkey Creek/CID	5,440	58,300	944,300	5	4
Northeast Industrial District (NEID)	4,700	19,700	377,000	8	9
Subtotal, Missouri River Basins	11,140	78,000	1,394,300	16	14
BLUE RIVER BASINS					
Gooseneck Creek	3,800	28,600	614,000	19	2
Lower Blue River	4,420	22,500	590,400	25	18
Blue Summit (Diversion Structure 205)	37	1,120	10,000	1	1
Town Fork Creek	3,400	92,000	559,000	24	21
Brush Creek	7,820		1,316,700	44	24
Middle Blue River	5,770	29,500	645,600	33	16
Subtotal, Blue River Basins	25,247	173,720	3,735,700	146	82
CITY-WIDE TOTALS	36,387	251,720	5,130,000	162	96

Notes: (1) 2005 population. In industrial areas, includes one-quarter of industrial employees.

* Combined sewer system designation is subject to refinement as the final detailed analysis of the system is performed and improvement projects are implemented.

Using computer models based on the sewer flow meter and rainfall data, current combined sewer system performance (Table 1-2) was established. A set of 8 design rainfall events was developed to characterize Kansas City rainfall for a typical year. In a typical year, Kansas City experiences 78 rainfall events. Of that total, 36 events have a depth equal to or exceeding 0.28"; 18 equal or exceed 0.52"; 12 equal or exceed 0.86"; 6 equal or exceed 1.40"; 4 equal or exceed 1.80"; 3 equal or exceed 2.00"; 2 equal or exceed 2.40"; and one rainfall event equals or exceeds a depth of 2.90". The response of the Combined Sewer System to those design rainfall events was modeled, and the results aggregated to estimate the overall volume of Combined Sewer Overflows in a typical year. A total annual rainfall of 36.85" is reflected in that analysis, closely approximating the long-term average annual rainfall of 36.5" in Kansas City.

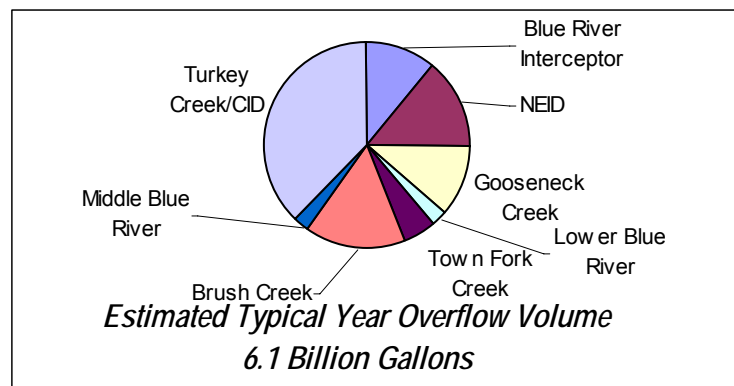
**Table 1-2
Combined Sewer System Performance in Typical Year**

Basin	Typical Year Wet Weather Flow (billion gallons)	Estimated Overflow Volume (billion gallons)	Capture of Wet Weather Flow (%)
MISSOURI RIVER BASINS			
Downtown Airport (Note 1)			
Turkey Creek /Central Industrial District	2.67	2.32	13%
Northeast Industrial District	1.19	0.89	25%
Subtotal, Missouri River Basins	3.86	3.20	17%
BLUE RIVER BASINS			
Gooseneck Creek	1.02	0.68	34%
Lower Blue River	0.62	0.16	74%
Town Fork Creek	0.88	0.30	66%
Brush Creek	1.83	0.95	48%
Middle Blue River	0.62	0.14	77%
Subtotal, Blue River Basins	4.97	2.23	55%
Blue River Interceptor (Note 2)	2.96	0.68	77%
CITY-WIDE TOTALS	11.8	6.1	48%

Notes:

- (1) Data not available
- (2) Wet Weather flows from sources other than listed Combined Sewer System basins

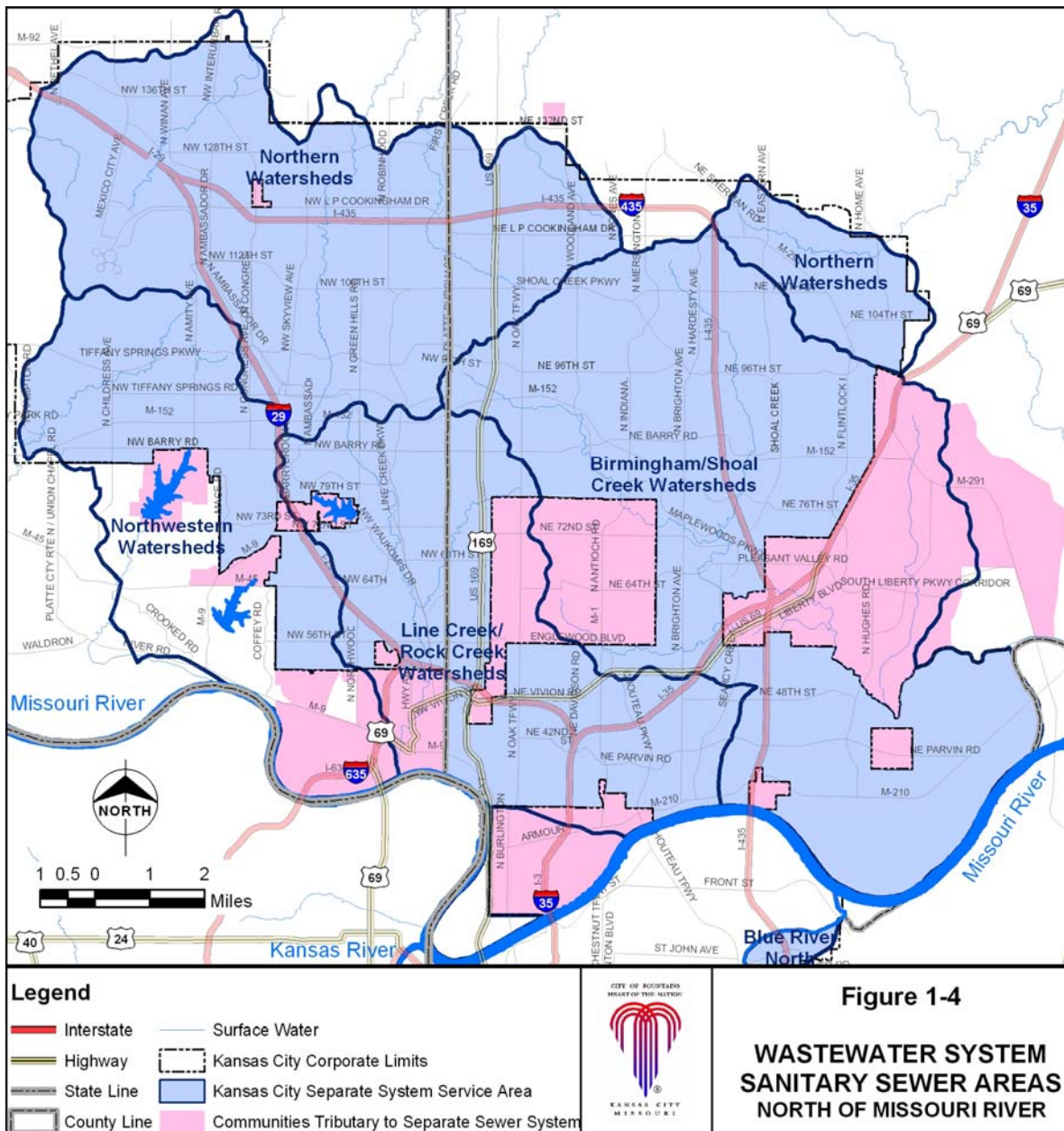
Figure 1-3 illustrates the overflow volume from each of the seven principal combined sewer system basins and the Blue River Interceptor Sewer. Although the annual total of 6.1 billion gallons is significant, it is noteworthy that during a typical year the current system captures 48% of the wet weather flow. There are 162 diversion structures that can overflow to the receiving streams through 96 outfalls.

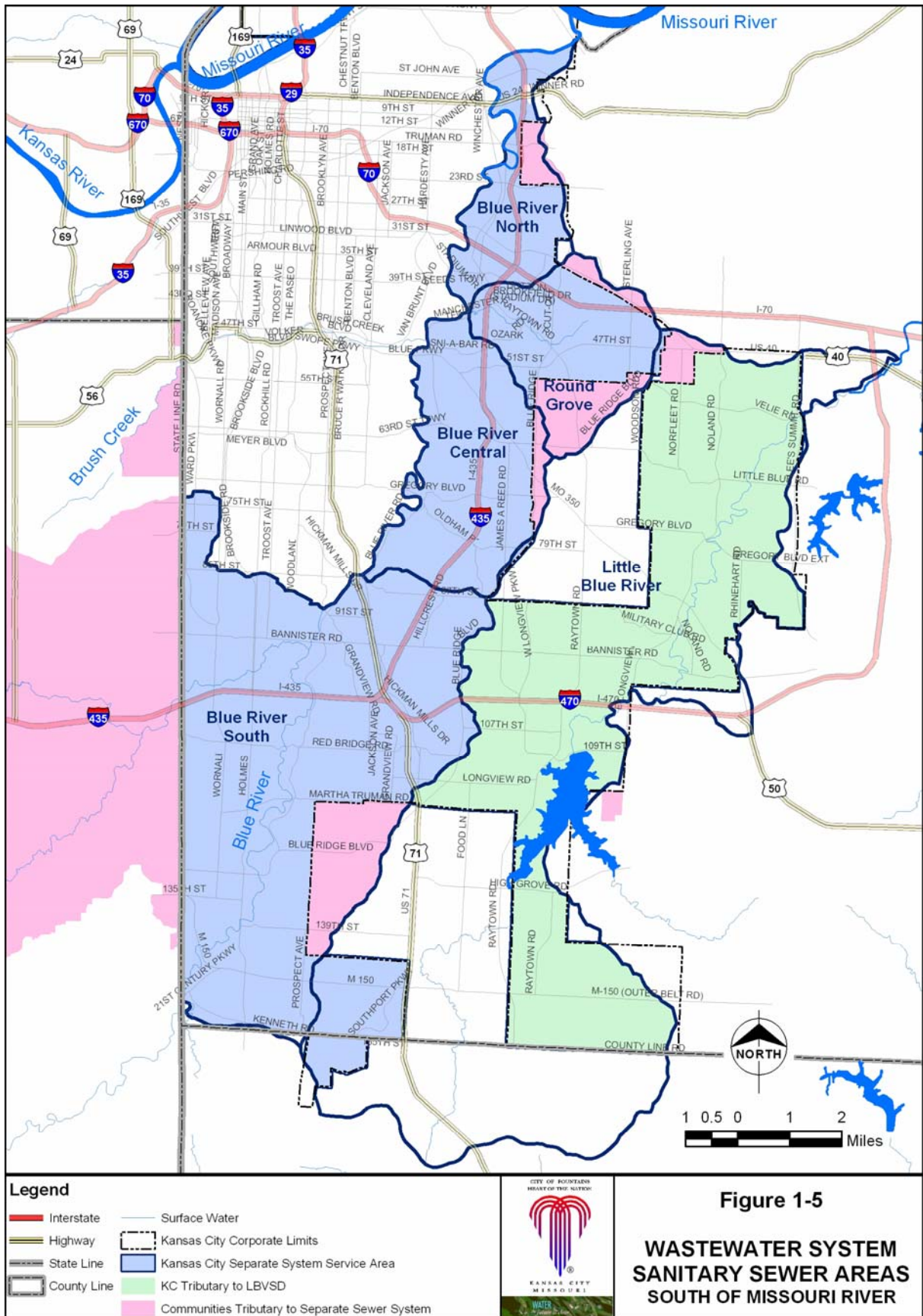


**Figure 1-3
Combined Sewer Overflows in Typical Year**

1.1.2 Separate Sanitary Sewers (Basin Descriptions)

The overall sanitary sewer area tributary to the WSD wastewater treatment plants (including satellite communities) is about 312 square miles, and is shown in Figure 1-1. An additional sanitary sewer area of 36 square miles is tributary to the Little Blue Valley Sewer District. For planning purposes, the area within the City’s separate sanitary sewer system was divided into nine principal basins, as shown in Figures 1-4 and 1-5 (north and south of the Missouri River, respectively). Four of these basins (Line Creek/Rock Creek; Birmingham/Shoal Creek; Round Grove Creek; and Blue River South) were studied in more detail than the other five. They either directly impact the performance of facilities also serving the combined sewer system, or are more likely candidates (due principally to the age of their systems) for priority rehabilitation activities.





Basin characteristics are further defined in Table 1-3. Land use in developed areas is primarily residential and light industrial/commercial.

**Table 1-3
Separate Sanitary Sewer System Basin Data**

Basin	Total Basin Area (acres)	Basin Population (Note 1)			Existing Sanitary Sewers	
		Existing (2005)	2030 (Estimated)	Ultimate (Estimated)	Total Length (ft) (Note 2)	Max. Dia. (in.)
NORTH OF MISSOURI RIVER						
Northern Watersheds	32,760	20,300	38,600	90,300	657,800	48
Northwestern Watersheds	14,980	7,400	8,900	11,000	247,600	27
Line Creek/Rock Creek	22,040	73,300	80,700	104,100	1,815,200	72
City of Liberty, East Pump Station	3,010					
City of North Kansas City	3,270					
Birmingham/Shoal Creek	49,240	48,800	84,600	107,800	1,281,500	120
TOTAL NORTH OF MISSOURI RIVER	119,020	149,800	212,800	313,200	4,002,100	
SOUTH OF MISSOURI RIVER						
Blue River Tributary Basins						
Blue River North	4,000	4,600	3,600	7,600	146,000	30
Round Grove Creek	5,340	9,700	11,500	13,300	302,000	60
Blue River Central	7,420	11,000	11,000	16,900	341,000	96
Johnson County, Kansas Wastewater	31,590					
Blue River South	26,530	51,800	52,800	72,900	1,600,000	96
Subtotal, Blue River Tributary Basins	74,880	77,100	78,900	110,700	2,389,000	
Little Blue River Tributaries						
Little Blue River Tributaries	33,600	61,700	72,400	133,400	889,000	48
TOTAL SOUTH OF MISSOURI RIVER	108,480	138,800	151,300	244,100	3,278,000	
CITY-WIDE TOTALS	227,500	288,600	364,100	557,300	7,280,100	

Notes:

- (1) Population within Kansas City, Missouri corporate limits. Excludes population in satellite communities, if any.
- (2) Excludes satellite community sewer system not owned and operated by Kansas City.

The current sanitary sewer system performance was estimated for the Line Creek/Rock Creek, Birmingham/Shoal Creek, Round Grove Creek, and Blue River South basins using flow meter data and computer models. Only about half of the annual flow in the sanitary sewers is actual wastewater generated by residents and businesses. Increased flows during wet weather and infiltration contribute the other half.

At the lower ends of those major systems, peak flows in the sanitary sewers during heavy rainfall approach ten times the average daily dry weather flow, indicative of excessive inflow and infiltration system in the sanitary sewer system. A constructed Sanitary Sewer Overflow (SSO) is present at the lower end of the Line Creek system. System improvement plans must address elimination of that SSO as an early priority.

Table 1-4 contains information describing the satellite community sanitary sewer systems that are tributary to the Kansas City sewer system. Flows from these sewers were included in the system analysis.

Table 1-4
Satellite Community Sanitary Sewer System Data

SATELLITE COMMUNITY (Note 1)	Population Trib. To KC System		Tributary to (Note 2)	
	Existing (Est.)	Ultimate (Est.)	KCMO Basin	WWTP
Avondale, City of	529	529	Rock Creek	Blue River
Blue Summit	375	375	Blue River North	Blue River
Claycomo, City of	1,267	1,267	Shoal Creek	Birmingham
Ferrelview, City of	334	334	Todd Creek	Todd Creek
Gladstone, City of	16,778	16,778	Shoal Creek	Birmingham
	9,587	9,587	Line Creek	Blue River (Note 3)
Grandview, City of	1,307	2,324	Blue River South	Blue River
Houston Lake, City of	284	284	Line Creek	Blue River (Note 3)
Independence, City of	1,728	1,728	Round Grove	Blue River
Johnson County, Kansas Wastewater	54,264	81,400	Blue River South	Blue River
	2,600	2,600	Brush Creek	
Lee's Summit, City of	0	0	Little Blue	LBVSD
Liberty, City of	24,000	40,000	Shoal Creek	Birmingham
American Water (Ridgewood Estates)	253	253	Burlington Creek	Blue River (Note 3)
North Kansas City, City of	4,714	4,858	Northeast Industrial	Blue River
Northmoor, City of	399	399	Line Creek	Blue River (Note 3)
Oakview, Village of	386	386	Line Creek	Blue River (Note 3)
Oakwood, Village of	37	37	Rock Creek	Blue River
Oakwood Park, Village of	183	183	Line Creek	Blue River (Note 3)
Parkville, City of	363	363	Line Creek	Blue River (Note 3)
Platte County Regional Sewer District	2,050	4,100	Line Creek	Blue River (Note 3)
Platte Woods, City of	377	377	Line Creek	Blue River (Note 3)
Pleasant Valley, City of	1,935	1,935	Shoal Creek	Birmingham
Randolph, City of	47	47	Shoal Creek	Birmingham
Raytown, City of	5,552	7,773	Round Grove	Blue River
			Blue River Central	Blue River
Riverside, City of	2,979	5,000	Line Creek	Blue River (Note 3)
Smithville, City of	427	769	Rocky Branch	Rocky Branch
Waukomis, City of	952	952	Line Creek	Blue River (Note 3)
Weatherby Lake, City of	1,953	1,953	Line Creek	Blue River (Note 3)
Satellite Community Totals	135,660	186,591		

Notes:

- (1) Principal satellite communities shown in bold text; others have minor influence on overall KCMO system.
- (2) Identifies those KCMO basin(s) to which the satellite community is tributary.
- (3) Tributary to both Blue River and Westside WWTP via Line Creek Pump Station.

1.1.3 Wastewater Treatment Plants

Kansas City owns and operates seven Wastewater Treatment Plants (WWTPs). Kansas City’s wastewater collection system also includes 41 pump stations; an additional 16 flood pumping stations provide stormwater drainage service to the City. Significant WWTP characteristics are shown in Table 1-5. Of particular importance to planning for combined sewer system overflow control are the Blue River and Westside Plants, which are the only treatment plants that receive combined sewer flows.

Plant	Permitted Capacity (MGD)	Average Flow – Calendar Year 2006 (MGD)	5-Year Average Flow, 2002-2006 (MGD)	Process
Blue River	105.00	63.7	73.0	Trickling Filter
Westside	22.50	11.6	14.4	Activated Sludge
Birmingham	20.00	10.6	10.7	Activated Sludge
Todd Creek	3.40	1.53	1.42	Extended Aeration
Rocky Branch	2.00	1.29	1.04	Extended Aeration
Fishing River	1.00	0.67	0.60	Extended Aeration
Northland Mobile Home Park	0.09	0.05	0.06	Activated Sludge Package Plant
KCMO Totals	153.99	89.44	101.22	

1.2 Combined Sewer Overflow Receiving Streams

Kansas City's combined sewers overflow to a number of receiving streams. Principal receiving streams include the Kansas River; the Missouri River; the Blue River; and Brush Creek. Brush Creek is tributary to the Blue River, which itself is tributary to the Missouri River. The Missouri River at the Broadway Bridge in Kansas City drains a total of 484,100 square miles. That area includes 59,756 square miles tributary to the Kansas River at De Soto, Kansas (approximately 30 miles upstream of the confluence of the Missouri River and Kansas River). All of Kansas City's combined sewer system basins are eventually tributary to the Missouri River; the Downtown Airport, Central Industrial District and the Northeast Industrial District are each directly tributary to the Missouri River. The total area drained by the Missouri River at Kansas City is roughly 8,275 times the total area served by Kansas City's combined sewer system. The area tributary to the Kansas River at DeSoto, Kansas is roughly 8,075 times the size of Kansas City's Turkey Creek basin (the only Kansas City combined sewer system basin tributary to the Kansas River). The remaining combined sewer system basins in Kansas City (Gooseneck Creek; Lower Blue River; Brush Creek; Town Fork Creek; and the Middle Blue River) are tributary to the Blue River.

Figure 1-6 is a map of those streams that receive combined sewer overflows from Kansas City's system, and indicates the current recreational water quality standard designated by the State of Missouri (or by the State of Kansas, for the Kansas River).

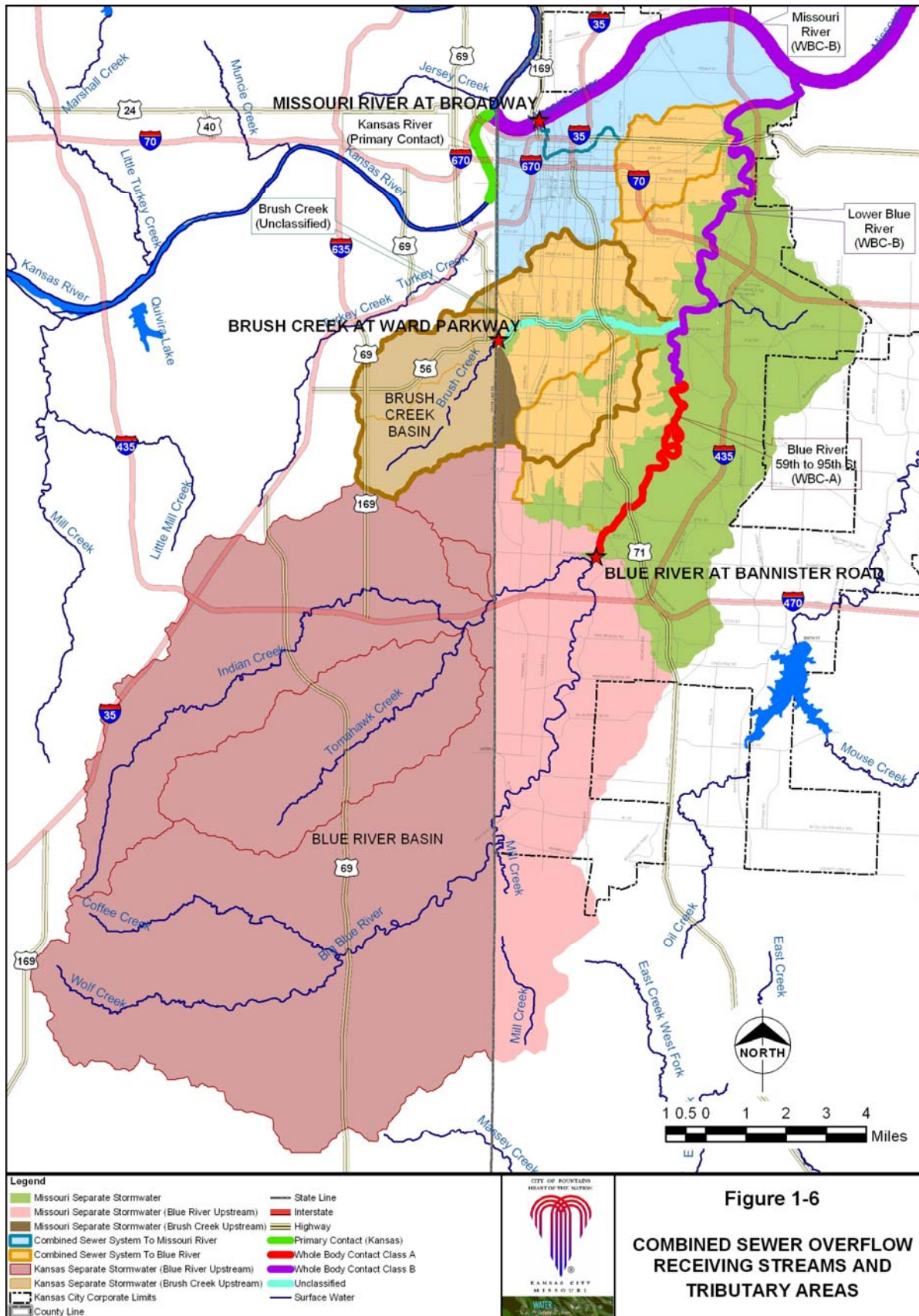


Figure 1-6 shows (in blue) the combined sewer system area directly tributary to the Missouri River (including those areas tributary via the Kansas River). It also shows all areas tributary to the Blue River. The map distinguishes between those tributary areas upstream of Kansas City’s combined sewer overflows (e.g., upstream of the points marked with red stars), and areas directly tributary to those stream reaches that receive combined sewer overflows. Within the Blue River basin, areas directly tributary to those stream reaches that receive combined sewer overflows include both combined sewer systems (shown in yellow) and separate stormwater systems (shown in green). Table 1-6 summarizes the areas tributary to various components of the Blue River.

**Table 1-6
Blue River Tributary Areas**

Stream Name	Location	Tributary Area Description	Tributary Area (square miles)	Percent of Tributary Area at Location
Blue River	Bannister Road	"Upstream" area west of State Line	145.2	77%
		"Upstream" area in KCMO	26.3	14%
		"Upstream" Missouri area outside KCMO	16.5	9%
		Total Tributary Area	188	100%
Blue River	Upstream of Brush Creek	"Upstream" area west of State Line	145.2	66%
		"Upstream" area in KCMO	29.4	13%
		"Upstream" Missouri area outside KCMO	16.5	7%
		Combined sewer system areas	4.1	2%
		Separate storm sewer system areas	24.9	11%
		Total Tributary Area	220	100%
Brush Creek	Ward Parkway	"Upstream" area west of State Line	11.6	95%
		"Upstream" area in KCMO	0.6	5%
		Total Tributary Area	12.2	100%
Brush Creek	Upstream of Blue River	"Upstream" area west of State Line	12.6	42%
		"Upstream" area in KCMO	1.1	4%
		Combined sewer system areas	13.8	46%
		Separate storm sewer system areas	2.6	9%
		Total Tributary Area	30.1	100%
Blue River	Downstream of Brush Creek	"Upstream" area west of State Line	157.8	63%
		"Upstream" area in KCMO	30.5	12%
		"Upstream" Missouri area outside KCMO	16.5	7%
		Combined sewer system areas	17.8	7%
		Separate storm sewer system areas	27.6	11%
		Total Tributary Area	250	100%
Blue River	At Missouri River	"Upstream" area west of State Line	157.8	57%
		"Upstream" area in KCMO	30.5	11%
		"Upstream" Missouri area outside KCMO	16.5	6%
		Combined sewer system areas	27.9	10%
		Separate storm sewer system areas	44.6	16%
		Total Tributary Area	277	100%

Seventy-four percent of the total area tributary to the Blue River (57% west of the state line; 11% within the corporate limits of Kansas City; and 6% in Missouri outside Kansas City’s corporate limits) is located upstream of those reaches of the Blue River and its tributaries that are impacted by overflows from Kansas City’s combined sewer system. An additional 16 percent of the total area

tributary to the Blue River is in areas not served by the combined sewer system. Kansas City's combined sewer system serves 10 percent of the total area tributary to the Blue River.

1.2.1 Water Quality Standards

A primary objective of Kansas City's combined sewer overflow control program is maintaining designated beneficial water uses of receiving streams by attaining appropriate water quality standards. Figure 1-6 identifies current designated beneficial recreational uses for those stream reaches that receive combined sewer overflows. In Missouri, all classified water bodies are designated for whole body contact unless otherwise supported by a Use Attainability Analysis (UAA). The Missouri River and the Blue River downstream (north) of 59th Street are designated by the State of Missouri as Whole Body Contact – Category B (WBC-B). Between 59th and 95th Street, the Blue River is designated as Whole Body Contact – Category A (WBC-A). Category A designates public swimming areas and Category B designates all other classified water bodies. The Kansas River has been designated by the State of Kansas for primary contact recreational use (PCR) – Class B (open public access). Brush Creek, although included in this discussion and shown on Figure 1-6, is at present unclassified and has no state-designated beneficial use.

The Blue River upstream (south) of Bannister Road to the state line is also designated as Whole Body Contact – Category B; Indian Creek between the Blue River and the state line is designated as Whole Body Contact – Category A. As those stream reaches do not receive combined sewer overflows, they are not shown in Figure 1-6, nor are they further considered in this discussion.

In Kansas City, the principal pollutant of concern in the combined sewer overflow receiving streams is bacteria. Missouri's water quality standards define numeric criteria for both fecal coliform and *E. coli* bacteria; the numeric criteria are applied as a geometric mean of values collected during the recreation season (April 1 through October 31). Water quality in those streams is impacted by both the flow volume and bacteria levels in discharges from upstream sources, and by local discharges (which include both combined sewer overflows and runoff from separate stormwater areas). The estimated flow volume and bacteria contributions from those sources to the receiving streams during the recreation season in a typical year are summarized in Figure 1-7 for the Missouri River; Figure 1-8 for Brush Creek; and Figure 1-9 for the Blue River.

The sources listed in Figure 1-7 include discharges from wastewater treatment plants (WWTP) in the Kansas City area (plants owned and operated by either the City of Kansas City, Missouri or the Unified Government of Wyandotte County, Kansas). The "Kansas River Upstream" contributions are based on discharges in the Kansas River at DeSoto, Kansas (roughly 30 miles upstream of the confluence of the Kansas and Missouri rivers). As indicated in Figure 1-7, overflows from Kansas City's entire Combined Sewer System (CSS) are estimated to contribute only 3% of the total *E. coli* bacteria in the Missouri River immediately downstream from its confluence with the Blue River.

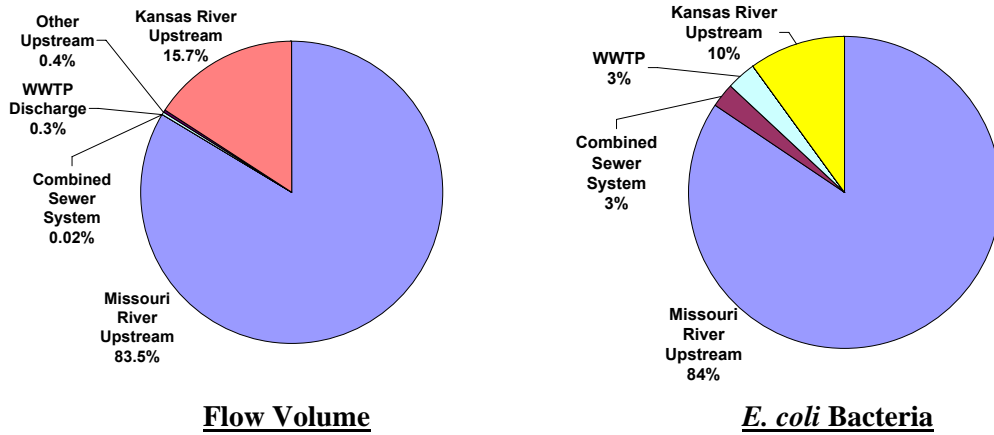


Figure 1-7
Sources of Flow and *E. coli* Bacteria, Missouri River
(downstream of the Blue River)

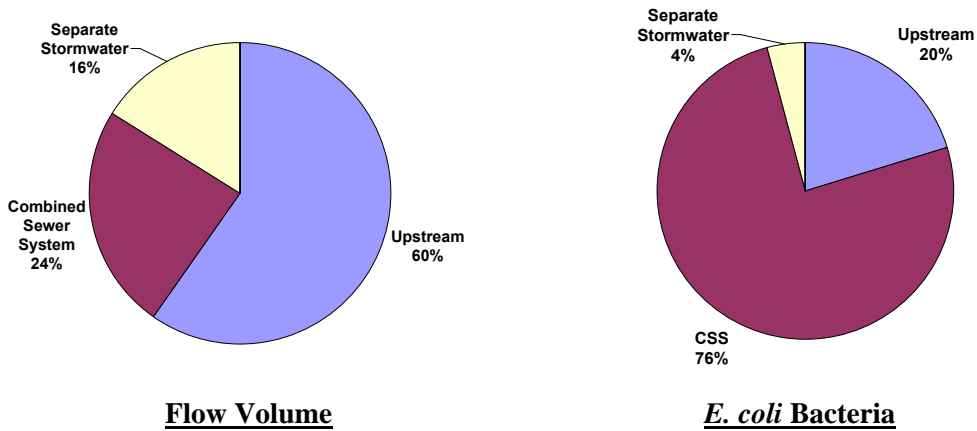


Figure 1-8
Sources of Flow and *E. coli* Bacteria, Brush Creek
(at its confluence with the Blue River)

In a typical recreation season, discharges from the 46% of the Brush Creek tributary area served by combined sewers represent 24% of the total flow volume, but contribute 76% of the total *E. coli* bacteria in Brush Creek (Figure 1-8).

As indicated in Figure 1-9, discharges from the 10% of the Blue River tributary area served by combined sewers represent 4% of the total flow volume in a typical recreation season, but contribute 39% of the total *E. coli* bacteria in the Blue River at its mouth. Roughly one-half (49%) of the total *E. coli* bacteria in the Blue River is estimated to come from the 74% of its tributary area upstream of Kansas City’s combined sewer system. Sixty-one percent of the total *E.*

coli bacteria in the Blue River are estimated to come from sources other than Kansas City, Missouri’s combined sewer overflows.

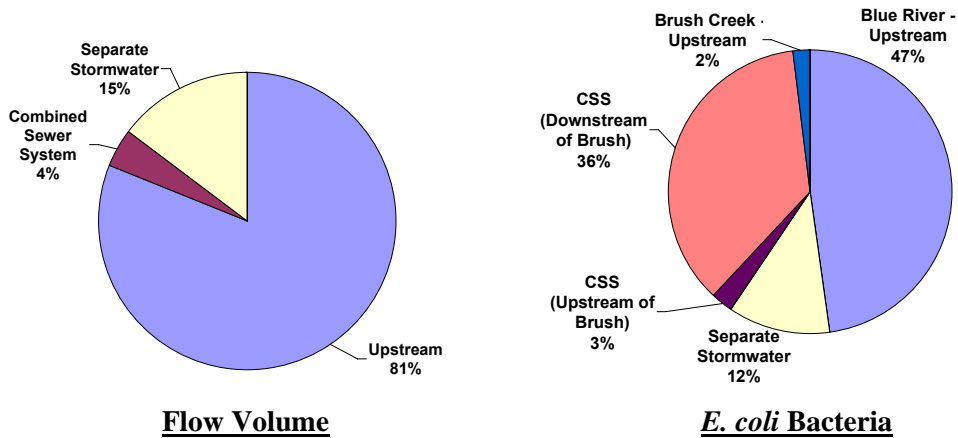


Figure 1-9
Sources of Flow and *E. coli* Bacteria, Blue River
 (at its confluence with the Missouri River)

Table 1-7 summarizes the estimated typical recreation season geometric mean concentration of *E.coli* in Kansas City’s combined sewer overflow receiving streams, and compares those estimates to applicable State of Missouri water quality standards.

Table 1-7
***E. coli* Concentrations in Kansas City’s Receiving Streams**

Stream Name	Location	<i>E. coli</i> Concentration (CFU/100 ml)		Remarks
		Standard	Estimated	
Missouri River	Upstream of Kansas River	548	630	
Missouri River	Just downstream of Kansas River	548	810	Approximately 10% of the <i>E. coli</i> bacteria is contributed by the Kansas River watershed upstream of DeSoto, Kansas.
Blue River	Bannister Road	126	620	Criterion exceeded 100% of time.
Blue River	Upstream of Brush Creek	548	560	
Brush Creek	Ward Parkway	N/A	780	Brush Creek is presently unclassified; no numeric bacteria standard currently applies.
Brush Creek	Upstream of Blue River	N/A	420	
Blue River	Downstream of Brush Creek	548	600	
Blue River	At Missouri River	548	730	
Missouri River	Downstream of Blue River	548	880	

It is estimated that *E. coli* concentrations in Kansas City’s receiving streams are above the State of Missouri’s numeric standards in both those reaches that receive combined sewer overflows and in upstream reaches. The information presented in Table 1-7 suggests that compliance with

current State water quality standards will require bacteria reduction in sources upstream from the combined sewer overflow areas, to a degree that may not be feasibly attainable.

1.2.2 Actual Uses

An evaluation of the water quality in Kansas City's receiving streams needs to consider not only current state-designated uses, but also how the community values and uses those streams. The community's actual receiving waters uses were assessed in 2006 using two methods:

- Site visits, including public interviews; and
- Public surveys.

Field crews visited several sites along each receiving water during the recreation season (monthly, April through October) and recorded observed water and/or surrounding area uses. When on-site, they also interviewed members of the public concerning their use or observed use of the waters. A public survey was also conducted by mail and phone. Over 5,400 households throughout the City participated in the survey.

Results from the field and public surveys generally showed that all waters within KCMO are perceived as recreational sources, but that hiking, walking, bird watching and other shore-oriented activities were the most common activities. The Missouri River was the only Kansas City, Missouri combined sewer overflow receiving water frequently used for in-water recreational purposes such as boating and fishing. Penn Valley Lake was also frequented for fishing. The other combined sewer overflow receiving waters were valued as places to hike or walk but are not used for in-water recreational purposes.

Brush Creek

Public access to Brush Creek is available along much of its reach. Brush Creek Park and Blue Banks Park line the lower portion of the creek and provide walkways, overlooks, benches and other areas for public access. There are no public swimming areas in Brush Creek. During field surveys at four sites along Brush Creek, wading was observed once. The waders were from a University of Missouri class that was studying field sampling for water quality. Four people interviewed during site visits reported their belief that swimming never occurs in Brush Creek. The public survey revealed that residents in the Brush Creek basin view the most common activity near or in lakes and streams in the City to be hiking/walking and that 64% of residents participated in activities such as hiking, walking, picnicking or fishing in or around Brush Creek.

Blue River

For this work, the Blue River within Kansas City, Missouri was divided into three parts:

- Lower Blue River, from 59th Street to the mouth;
- Middle Blue River, from Bannister Road downstream to 59th Street; and
- Upper Blue River, from the state line to Bannister Road.

Public access to the lower Blue River is limited because much of the area is industrialized and/or private property. The channelized stream banks are quite steep in some areas which further limits public access to the water. Riverside parks provide opportunities for people to access the river in this section, but there are no public swimming areas. Field surveys throughout the recreation season at four sites along the lower Blue River revealed no uses, although footpaths, fishing tackle, bait remnants and garbage were present. Public survey results from this basin suggested that hiking/walking was the most common activity near waterbodies in Kansas City, Missouri. Thirty-four percent of lower Blue River residents surveyed participated in these activities near the lower Blue River.

Public access to the middle Blue River is available at several spots along Blue River Parkway and in Swope Park, although stream banks are steep in some areas. Field surveys at three sites in this section revealed no uses. Some evidence of shoreline visitors included footpaths, fishing tackle, and garbage present along the river. Field interviews revealed that boating and wading happens infrequently in this area. The results of the public survey again revealed that hiking/walking was the most common activity in or near Kansas City, Missouri streams, yet only 30% of respondents reported conducting activities near the middle Blue River.

The upper Blue River is accessible to the public in several spots along the Blue River Parkway, but no uses were observed at three sites during field visits. Foot paths/prints, fishing tackle, and litter were present, implying that people may use the river for fishing and hiking. The public survey respondents in this basin revealed that hiking/walking was the most common activity at streams in KCMO and 41% reported conducting recreational activities near the upper Blue River.

Penn Valley Lake

Penn Valley Lake is easily accessible, as it is in a city park. The lake is also stocked with fish by the Missouri Department of Natural Resources, and this draws residents to the lake. Fishing was observed here during two of four visits. No other activities were observed at the lake. In five interviews, recreational users reported that swimming never occurred in Penn Valley Lake, but that fishing was common. This water body was not specifically targeted for the public survey.

Town Fork Creek

Although much of Town Fork Creek flows through private, residential areas, public access to the creek is available at a number of parks. However, no residents were observed using the creek or surrounding areas during field visits to four sites. This basin was not specifically targeted for the public survey.

Missouri River

Public access is available at one riverside park and one boat launch area along the Missouri River in Kansas City. Much of the area is industrialized and/or private property, limiting public access. Five potential recreation sites were visited along the Missouri River during the recreation season.

Uses observed included boating and fishing on multiple visits at a few sites. Interviews at these sites revealed that other water-related activities such as wading, swimming, and jet skiing or water skiing occur infrequently. This basin was not specifically targeted for the public survey.

Kansas River

The Kansas River was not surveyed by field or public survey methods. There are no known public swimming beaches in these waters and public access is limited due to surrounding industrial land uses and flood control structures.

1.2.3 Sensitive Areas

The Federal Combined Sewer Overflow Control Policy states that if sensitive areas are present and impacted, the long term control plan (LTCP) should include provisions to:

- Prohibit new or significantly increased overflows;
- Eliminate or relocate overflows where possible;
- Treat overflows where necessary; and
- Reassess impacts each permit cycle where elimination or treatment is not achievable.

The Control Policy also states that sensitive areas are to be determined by the NPDES Permitting Authority in coordination with State and Federal Agencies. For Kansas City, the NPDES Permitting Authority is the Missouri Department of Natural Resources. The Control Policy indicates that sensitive areas may include the following:

- **Waters designated as Outstanding National Resource Waters (ONRW);**

No ONRWs have been designated by MDNR in the CSO receiving waters in or around KCMO.

- **National Marine Sanctuaries (NMS);**

No NMS have been designated by the U.S. Secretary of Commerce within the KCMO CSO receiving waters.

- **Shellfish beds;**

There are no known commercial shellfish beds nor is shellfish harvesting for consumption by private individuals known to occur within Kansas City's combined sewer overflow receiving waters.

- **Waters with primary contact recreation;**

All classified water bodies in Missouri are designated for whole body contact recreation unless otherwise designated through a Use Attainability Analysis (UAA). The designated use is the use specified for the water body in the water quality standards whether or not it is being attained.

Although there are combined sewer overflow receiving waters designated for primary contact recreation, there are no known public or private swimming areas within those receiving waters. During separate surveys at 25 sites along those receiving waters in July, August, and September 2006, field crews did not observe any primary contact recreation. In interviews with local residents at these sites, the majority of interviewees reported that swimming never occurs in the Missouri River, while three residents noted that swimming occurred in the Missouri River at a maximum of one time per month. All interviewees reported that swimming never occurs in the other combined sewer overflow receiving waters. There are no plans for construction of public swimming facilities along these waterways. Nearly all interviewees viewed fishing as the prominent recreational activity. The absence of public swimming areas; apparent minimal use of the waters for swimming; and physical risks, especially during and following wet weather events, due to debris and current velocity in these streams does not support the consideration of KMCO receiving waters as sensitive areas.

- **Waters with threatened or endangered species and their habitat;**

Federal wildlife agencies identified and verified one federally-listed aquatic species in the vicinity of Kansas City's combined sewer overflow receiving waters. The State of Missouri did not identify any state-listed threatened and endangered species within those receiving waters, while three threatened or endangered aquatic species were identified by the State of Kansas.

The pallid sturgeon is a federally endangered, large river fish that was last noted in the Kansas City area in the Missouri River in 1979. Recovery of the pallid sturgeon is not expected to be dependent on the presence or control of combined sewer overflows.

Kansas City's Turkey Creek combined sewer basin discharges to the Kansas River very near its downstream end and confluence with the Missouri River. The State of Kansas listed species and their critical habitat in the Kansas River include the flathead chub (threatened), the sturgeon chub (threatened), and the silver chub (endangered). Limited information is available on the habitats and water quality requirements of these species. The presence or control of combined sewer overflows from Kansas City's Turkey Creek basin is not likely to affect water quality conditions that may impact the recovery of these species.

The primary pollutant of concern in Kansas City's combined sewer overflows (bacteria) has no impact on the aquatic species of concern. In addition, as combined sewer overflows occur only during wet weather events when receiving water experience higher in-stream flows, the potential influence of other possible pollutants of concern in the combined sewer overflows is minimized.

- **Public drinking water intakes and their designated protected areas.**

There are no public drinking water intakes in any combined sewer overflow receiving waters in Kansas City. Kansas City's drinking water intake on the Missouri is upstream of both its confluence with the Kansas River and the combined sewer overflow locations. The nearest

downstream drinking water intake is approximately 41 miles from Kansas City at the City of Lexington. The State of Missouri defines priority areas for source water protection for large watersheds such as the Missouri River as a 5-mile radius upstream of the intake. Effective treatment of incoming water at the Lexington Plant has not been impacted by variations in water quality in the Missouri River that could potentially be linked to combined sewer overflows from Kansas City. The Missouri River is not a sensitive area due to drinking water intakes.

None of Kansas City's combined sewer overflow receiving streams is considered "sensitive" when evaluated based on the guidance contained in the Control Policy.

1.2.4 Use Attainability Analyses (UAAs)

There have been no Use Attainability Analyses (UAAs) conducted for the receiving waters in the Kansas City area. The potential need for the conduct of a UAA for certain of Kansas City's receiving streams is discussed in Part 4.

1.3 Recent and Ongoing Improvements

The Overflow Control Program Annual Reports for 2004 through 2006 contain descriptions of both routine maintenance activities (such as cleaning 2,006,706 feet of sewer in 2006) and capital projects (such as the Brookside Sewer Improvements which will increase system capacity). Those annual reports track the numerous capital projects that are being conducted by Kansas City's Water Services Department. They are grouped by:

- Collection System;
- In-Fill Sewer (primarily related to septic tank elimination); and
- Facilities (Wastewater Treatment Plants (WWTPs) and other mechanical facilities, such as pumping stations).

The Annual Reports list all significant projects that are active in that year. Since many projects are multi-year in nature, a three year summary is most representative, and is presented in Table 1-8.

Table 1-8		
Significant Capital Projects – 2004 through 2006		
Project type	Number	Cost in Million Dollars
Collection System	29	\$63.9
In-Fill Sewer	37	\$23.7
Facilities	13	\$55.9
Total	79	\$143.5

2 ALTERNATIVES EVALUATION

Kansas City’s wastewater collection and treatment system serves a wide geographic area comprised of both combined sewers and separate sanitary sewers that are interconnected at numerous locations, and which dynamically interact during both dry and wet weather. The development and evaluation of alternatives for the combined sewer system and separate sanitary sewer system, while in general discussed separately in this Part 2, considered this dynamic interaction. Improvements and changes to the separate sanitary sewer system directly impact facilities serving the combined sewer system as well. For that reason, Kansas City’s Control Plan must address the entire system.

Numerous wastewater system facilities serve more than one basin. These facilities are classified as “system-wide”. Principal “system-wide” facilities include:

- The Blue River and Westside Wastewater Treatment Plants. Wastewater collected from roughly one-fifth of the separate sanitary sewer system north of the Missouri River is sent to these treatment plants, which also serve all combined sewer and the bulk of the separate sanitary sewer basins south of the Missouri River. The only area south of the Missouri River not served by those treatment plants generally lies east of Blue Ridge Boulevard, and is tributary to the Little Blue Valley Sewer District;
- The Blue River Interceptor Sewer. It carries combined sewer flows from 70 percent of the combined sewer system and wastewater from over 60 percent of the total separate sewer service area south of the Missouri River to the Blue River Wastewater Treatment Plant;
- The Northeast Industrial District interceptor sewer and Pumping Station. They convey flows from roughly seven square miles of combined sewer system service area and wastewater from separate sanitary sewer areas both north and south of the Missouri River to the Blue River Wastewater Treatment Plant.

The development of City-wide alternatives for the overall Control Plan required assessment of the impact of different management choices for those principal “system-wide” facilities on system response, performance and cost.

The process followed in development of City-wide alternatives was to:

1. Develop and evaluate alternatives for each of the 16 principal basins (seven combined sewer system basins and nine separate sanitary sewer system basins), initially without direct consideration of the impact of each alternative on interconnected parts of the system. In the combined sewer service area, it was necessary to consider a range of performance (i.e., level of control) in the development and evaluation of basin-specific alternatives. Overall, 175 basin alternatives were developed.

2. Combine those basin-specific alternatives into a range of alternatives for larger areas of the system, generally arranged on the basis of the treatment plants to which the basins presently discharge. In total, 192 functional area alternatives were developed. Those functional area alternatives were then evaluated and combined into multiple compatible configurations to form an initial suite of City-wide alternatives.
3. Consider and evaluate the impact of changes in the definition of those larger areas (e.g., modifying the system interconnectedness by changing the areas tributary to the various treatment plants), modifying capacity allocations for system-wide facilities, and adjustments to optimize basin-specific alternatives on the cost and performance of the initial suite of City-wide alternatives.

A total of 27 City-wide alternatives were eventually defined through the above process. This extensive alternatives development and evaluation process led to a set of principal technical conclusions (summarized at the end of this Part 2) that, when coupled with key guidance obtained from the public input process described in Part 3, led to the conceptual Control Plan presented in Part 4.

2.1 Separate Sanitary Sewer System

Over 80 percent of Kansas City's wastewater system service area is served by separate sanitary sewers. Although these sewers are meant to carry only wastewater, significant wet weather flow (inflow and infiltration) does enter these sewers, leading to overflows into basements, streets, and water bodies during wet weather. As reported by the U.S. Environmental Protection Agency (USEPA) in its 2004 Report to Congress on combined and sanitary sewer overflows, thousands of sanitary sewer overflows occur nationally every year. Most are due to blockages, wet weather inflow and infiltration, mechanical or power failure, line breaks, and other causes (including vandalism and contractor error). The USEPA is developing a new policy to clarify regulations governing sanitary sewer overflows. That policy is intended to specify requirements for maintaining and operating separate sewer systems and to clarify when sanitary sewer overflows may be permitted. The policy has been and remains the focus of much debate.

In addition to regulatory compliance, it is Kansas City's goal to prevent wastewater back-ups or overflows during normal wet weather events. Large parts of the separate sanitary sewer service area discharge flows to the combined system for subsequent treatment at plants that also treat combined flows. As a result, separate sanitary sewer flows, particularly increased flows during wet weather, must be considered in any system-wide alternatives analysis.

2.1.1 Criteria and Concepts

The selected design storm for developing wet-weather control alternatives for the separate sanitary sewer areas has a return period (average frequency of occurrence) of once in 5 years, and duration of 24 hours; the total depth of rainfall for that design storm is 4.68 inches.

Any recommended infiltration and inflow reduction projects in the separate sanitary sewer areas will use a systematic (“Nashville”) approach. Under this method, pipe segments found to have a given number of defects are fully rehabilitated. Full rehabilitation includes all pipe, manholes, appurtenances, and house laterals from the main sewer pipe to the property or easement line. Pipe segments located immediately between segments identified for rehabilitation would also be fully rehabilitated.

Experience in 28 separate basins in Nashville showed that focusing rehabilitation efforts on the most deficient parts of the system (typically, roughly 20 percent of the total length of sewer pipe within a basin) resulted in an average removal of 50 percent of the inflow and infiltration. Pilot studies (consisting of actual implementation of the “Nashville” and other approaches in various sub-basins within the City, coupled with pre-and post-monitoring) are underway to verify actual performance in Kansas City.

2.1.2 Priority Areas

As noted in Part 1, four of the nine separate sanitary sewer basins have been studied in detail, as they either directly impact the performance of facilities also serving the combined sewer system, or are more likely candidates (due principally to the age of their systems) for priority rehabilitation activities. Those basins are:

- Line Creek/Rock Creek;
- Birmingham/Shoal Creek;
- Round Grove; and
- Blue River South.

These basins received a higher level of detailed metering, modeling, and improvement analysis than did the remaining five separate sanitary sewer basins. However, additional higher-priority sub-basins within those remaining five basins were identified based on operating experience and the results of previous studies, coupled with more simplified model analyses.

2.1.3 Range of Alternatives

Improvement alternatives within Kansas City’s separate sanitary sewer basins range from simply maintaining existing conditions to complete sewer system rehabilitation using pipe lining and other techniques. Between these extreme end points, localized rehabilitation, storage, and/or additional treatment capacity were considered. Basin-specific alternatives were tailored to resolve wastewater flow issues. Kansas City’s approach would be to continue a vigilant operation and maintenance program, coupled with growth-related and/or repair and reinvestment capital expenditures, in sub-basins that have little inflow and infiltration.

In the four “priority” basins, a variety of structural controls (storage, increased conveyance, and added treatment capacity) were developed, and then coupled with varying levels of inflow and infiltration reduction efforts to identify a range of costs for improvement alternatives. In that manner, the approach expected to be most cost-effective in each basin was identified. Varying levels of inflow and infiltration

reduction efforts were defined by grouping individual sub-basins by estimated inflow and infiltration volumes and total length of sewer potentially requiring rehabilitation.

In the development and evaluation of alternatives for the separate sanitary sewer system, it was assumed that flows to Kansas City's system from its satellite communities would continue at current levels. Kansas City's final Control Plan will address the need for inflow and infiltration reduction efforts by those satellite communities.

The following are brief descriptions of the range of alternatives considered in each of the four "priority" basins.

Line Creek/Rock Creek Basin

This basin also receives wastewater flows from the Northwestern Basins. All discharges from the Line Creek Basin are passed through the Line Creek Pumping Station to both the Westside and Blue River Wastewater Treatment Plants. Line Creek basin discharges to the Blue River plant are subsequently re-pumped at the Buckeye Pumping Station to the Northeast Industrial District Interceptor Sewer and Pumping Station. Flows pumped across the Missouri River at the Buckeye Pumping Station include wastewater from not only the Line Creek/Rock Creek basin, but also wastewater from the City of North Kansas City. Basic questions considered in the alternatives analysis included:

- Should wastewater flows from the Line Creek Pump Station continue to be sent to the Westside Wastewater Treatment Plant?
- Should wastewater flows from the Line Creek Pump Station, Buckeye Pump Station, and the City of North Kansas City continue to be sent to the Blue River Wastewater Treatment Plant?
- Should additional treatment capacity be provided north of the Missouri River, and, if so, and much additional capacity and where?
- What is the most cost-effective combination of structural controls and inflow and infiltration reduction efforts for the Line Creek/Rock Creek basin?

Table 2-1 presents a summary listing of the various principal structural controls and combinations considered for the Line Creek/Rock Creek basin. Potential structural control alternatives were coupled with varying degrees of inflow and infiltration reduction efforts in the Line Creek/Rock Creek basin, and cost estimates were prepared. In all, a total of 64 different combinations of structural controls and inflow and infiltration reduction efforts were considered.

Table 2-1
Structural Control Alternatives for the Line Creek/Rock Creek Basin

<i>Component</i>	Alternative		
	1	2	3
Line Creek Wastewater Treatment Plant	•		
Line Creek Pump Station Upgrade	•	•	
Buckeye Pump Station Upgrade		•	
Line Creek Storage Facilities	•	•	
Buckeye Storage Facilities		•	
Force Main (full length)		•	
Tunnel (full length)			•
Tunnel (Buckeye to Birmingham)	•		
Upgrade Birmingham Wastewater Treatment Plant	•	•	•

Birmingham/Shoal Creek Basin

This basin receives wastewater from a total of roughly 76 square miles of area in Kansas City and a number of satellite communities, the most significant of which are the cities of Gladstone and Liberty. All wastewater flows from this basin are treated at the Birmingham Wastewater Treatment Plant. The principal question addressed in the development of alternatives for this basin was identification of the most cost-effective combination of structural controls and inflow and infiltration reduction efforts for accommodating wastewater flows from over one-fifth of Kansas City’s total separate sanitary sewer service area.

Table 2-2 presents a summary listing of the various structural controls and combinations considered for the Birmingham/Shoal Creek basin.

Table 2-2
Structural Control Alternatives for the Birmingham/Shoal Creek Basin

Component	Alternative			
	1	2	3	4
Replace Birmingham Pump Station	•	•		
Upgrade Birmingham Pump Station			•	•
Expand Primary and Secondary Treatment and/or High-Rate Treatment at Birmingham Wastewater Treatment Plant	•	•	•	•
Wet Weather Storage Facility at Birmingham Pump Station		•		
Wet Weather Storage to Tunnel			•	•

Those potential structural control alternatives were coupled with varying degrees of inflow and infiltration reduction efforts in the Birmingham/Shoal Creek basin. The principal difference between structural control alternatives 3 and 4 was the nature of the tunnel for wet weather storage. In one, it was considered to be a deep facility tunneled in hard rock; in the other, it was considered to be a shallow (near surface) conduit installed by conventional trenching and backfilling methods.

Round Grove Basin

Wastewater from the Round Grove basin is discharged through the Round Grove Pumping Station to the Blue River Interceptor Sewer and is eventually treated at the Blue River Wastewater Treatment Plant. Study efforts in this basin were equivalent to a full Sewer System Evaluation Survey (SSES). The City of Raytown contributes significant flows to the sewer system in the Round Grove basin. Principal questions addressed in the development of alternatives for this basin were:

- What is the most cost-effective level of inflow and infiltration reduction effort?
- Is it more cost-effective to provide relief sewers in this basin to convey wet-weather flows (with or without inflow and infiltration reduction), or to provide facilities to temporarily store excess wet weather discharges until flows subside and the stored wastewater can be safely discharged into the downstream sewers?
- Should additional capacity be added at the Round Grove Pump Station?

Blue River South Basin

The Blue River South Basin includes 41 square miles, principally in Kansas City, but also areas in Grandview and Belton, Missouri. Just over 43 square miles of separate sanitary sewer area in Johnson County, Kansas are also tributary to the Blue River South Basin. Wastewater from that entire 84 square mile area flows to the 87th Street Pumping Station. Wastewater is pumped by the 87th Street Pumping Station through a 72-inch diameter force main that discharges to the Blue River Interceptor Sewer just downstream (north) of Brush Creek. Those flows are then treated at the Blue River Wastewater Treatment Plant. Principal questions addressed in the development of alternatives for this basin were:

- What is the most cost-effective level of inflow and infiltration reduction effort?
- Should additional pumping capacity, structural storage, or some combination of the two be provided to accommodate wet weather flows exceeding the capacity of the existing 87th Street Pumping Station?

A potential increase in the discharge capacity of the 87th Street Pumping Station was eliminated from further consideration early in the alternatives development process due to its high degree of impact on all downstream conveyance and treatment facilities.

Table 2-3 summarizes the full range of capital costs considered in the development and evaluation of capital costs for Kansas City's separate sanitary sewer system.

Table 2-3
Full Range of Estimated Capital Costs for Separate Sewer System Alternatives
(Estimated Capital Costs in \$Million)

Basin	Range of Estimated Capital Costs	
	From	To
NORTH OF MISSOURI RIVER		
Northern & Northwestern Watersheds	\$120	\$140
Line Creek/Rock Creek	\$180	\$250
Birmingham/Shoal Creek	\$340	\$560
TOTAL NORTH OF MISSOURI RIVER	\$640	\$950
SOUTH OF MISSOURI RIVER		
Blue River Tributary Basins		
Blue River North & Blue River Central	\$10	\$13
Round Grove	\$10	\$30
Blue River South	\$340	\$430
Subtotal, Blue River Tributary Basins	\$360	\$473
Little Blue River Tributaries		
Little Blue River Tributaries	\$28	\$35
TOTAL SOUTH OF MISSOURI RIVER	\$388	\$508
CITY-WIDE TOTALS	\$1,028	\$1,458

The total cost range of approximately **\$1.0-\$1.5 billion** reported in Table 2-3 includes an estimated range of \$220-\$270 million for inflow and infiltration reduction efforts. The range of estimated costs for inflow and infiltration reduction was developed upon the assumption that the reductions targeted for individual sub-basins might not be realized (given the uncertainty in actual results basin-by-basin). That overall range of cost will be reduced by \$70 million to \$90 million if the actual performance of those efforts meets expectations.

The information summarized in Table 2-3 does not include consideration of potential impacts of the various alternatives in the separate sanitary sewer system on the cost for combined sewer overflow control. The impact of the various alternatives on aggregated City-wide costs was one subject of the area-wide and City-wide alternatives development and evaluation process summarized earlier in this Part 2.

2.1.4 Conclusions

The following principal conclusions were reached in the development and evaluation of alternatives for Kansas City's separate sanitary sewer system:

- Generalized analysis (based on widespread use of the "Nashville" approach) in the Line Creek/Rock Creek, Birmingham/Shoal Creek, and Blue River South "priority" basins led to the preliminary conclusion that an overall reduction of approximately 30 percent in inflow and infiltration is achievable and would be cost-effective in Kansas City. The result of that

generalized analysis was confirmed by the results of a detailed SSES in the Round Grove “priority” basin, which recommended a reduction of 29 percent. The actual results of inflow and infiltration reduction efforts can typically vary markedly from projections. An overall reduction of 30 percent at the basin scale is considered reasonably attainable;

- The lowest overall cost for wastewater system improvements in Kansas City will result from continuing to pump wastewater (dry weather flows) from the Northwestern and Line Creek/Rock Creek basins to the Westside and Blue River Wastewater Treatment Plants;
- Additional treatment capacity should be provided in those basins north of the Missouri River for both wet weather flows and future increases in dry weather flows associated with increasing population in these developing basins;
- The most cost-effective method of providing treatment for wet weather flows from the Northwestern and Line Creek/Rock Creek basins is to construct a tunnel (for both conveyance and storage) from the Line Creek Pumping Station to the Birmingham Wastewater Treatment Plant. The Birmingham Wastewater Treatment Plant would be expanded to accommodate both increasing dry weather flow (i.e., increase the primary and secondary treatment capacity) and wet weather flows from the Northwestern, Line Creek/Rock Creek, and Birmingham/Shoal Creek basins. Additional storage for wet weather flows is also needed at the Birmingham Pump Station (which pumps flow from the Birmingham/Shoal Creek basin to the treatment plant);
- The present capacity of the Round Grove Pumping Station is adequate, but it is necessary to extend a second force main from that station to take advantage of its full capacity; and
- Storage for wet weather flows is needed at or upstream of the 87th Street Pumping Station. Additional storage may be needed in the future as the population and flows tributary to that pumping station increase.

The overall range of separate sanitary sewer system alternatives was then refined based on the above principal conclusions and with consideration of City-wide costs, leading to the conceptual plan for control of sanitary sewer overflows presented in Part 4.

2.2 Combined Sewer System

Fifty-six square miles within Kansas City, Missouri south of the Missouri River are served by combined sewers. These pipes convey both wastewater and stormwater runoff. They deliver flow to numerous diversion structures which can overflow during wet weather, discharging to receiving streams via nearly 100 outfalls. Federal and State regulations require that improvements be implemented to reduce combined sewer overflows. This section summarizes the results of a preliminary development and evaluation of alternatives for reduction of combined sewer overflows in Kansas City.

2.2.1 Presumptive vs. Demonstrative

The following material is an excerpt from the USEPA’s “Manual for Reviewing CSO LTCPs” (Combined Sewer Overflow Long-Term Control Plans):

“The overall objective for development and implementation of the LTCP is to meet water quality standards and protect existing and designated uses. . . . The CSO Control Policy offers the following two approaches for permittees (i.e., Kansas City) to consider when developing LTCPs:

- *The “Presumptive approach” with performance criteria (i.e. 4-6 untreated overflow events or 85% by volume capture) used as an endpoint for LTCP development and implementation;*
- *The “demonstration approach”, which entails developing and implementing an LTCP that includes a suite of CSO controls sufficient to meet applicable water quality standards.*

Under the presumption approach, the controls selected for implementation in the LTCP should be required to meet one of the following criteria:

- *No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year;*
- *The elimination, or capture for treatment, of no less than 85% by volume of the combined sewage collected in the CSS during precipitation events on a system-wide annual average basis; or*
- *The elimination or removal of no less than the mass of the pollutants identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort for the volume that would be captured for treatment above.*

The CSO Control Policy identifies four criteria for successful use of the demonstration approach. An LTCP based on the demonstration approach should show that:

- *The CSO control program will protect water quality standards unless the standards cannot be met as a result of natural conditions or other pollution sources;*
- *The overflows remaining after implementation of the control program will not prevent the attainment of water quality standards;*
- *The planned control program will achieve the maximum pollution reduction benefits reasonably attainable; and*
- *The planned control program is designed to allow cost effective expansion or cost effective retrofitting if additional controls are subsequently determined to be necessary to meet water quality standards, including protection of designated uses.*

Where water quality standards cannot be met because of other pollution sources, a TMDL (Total Maximum Daily Load) will need to be developed to apportion pollutant loads.

2.2.2 Criteria and Concepts

The development and evaluation of alternatives for the combined sewer system were structured to follow:

- The above-noted regulatory guidance (*Presumptive vs. Demonstrative approaches*);

- The Wet Weather Solutions Community Panel’s mission statement (*protect the public health and the environment, and meet regulations at an appropriate cost*); and
- The results of an extensive effort to obtain public input, more fully described in Part 3.

Major criteria and concepts included:

- Maximize use of the existing system;
- Take a watershed approach;
- Reduce extraneous water entering the sewer system;
- Innovate, measure results, and adapt based on demonstrated performance;
- Focus on investments that achieve the greatest return; and
- Seek to amend water quality standards only where necessary.

Unlike the separate sanitary sewer system, where technologies are both well-defined and relatively few in number and performance objectives are less complex to establish, the development and evaluation of alternatives for the combined sewer system necessarily considered:

- A wide range of potential control technologies (see below);
- The impact of varying levels of combined sewer overflow control on water quality (particularly bacteria levels) in receiving water bodies (see Section 2.2.4); and
- The cost for achieving varying levels of combined sewer overflow control (see Section 2.2.5).

Various combined sewer overflow control technologies were initially considered on a basin-specific basis. Typically, a combination of technologies produced the most cost-effective improvements. The potential CSO control technologies can be grouped into four different control/treatment categories based on their defining characteristics:

- Source Controls (which include both conventional technologies and “Green Solutions”);
- Collection System Controls;
- Storage Technologies; and
- Treatment Technologies.

Those categories are further defined below.

Source Controls and Green Solutions

Source controls affect the quality or the quantity of stormwater runoff **before** it enters the combined sewer system. Many items included in this category are Best Management Practices (BMPs) used to improve water quality. In addition, many of the listed controls could be implemented as “pollution prevention”, one of the specified Nine Minimum Controls in the Combined Sewer Overflow Control Policy. Source controls do one or more of the following to reduce combined sewer overflows:

- Attenuate peak flows;
- Reduce the volume discharged to the combined sewer system; and/or

- Reduce pollutant loads to the combined sewer system.

Source controls generally require less capital investment than controls further downstream in the system. However, some types of source controls require more labor-intensive operation and maintenance costs than other types of combined sewer overflow controls. Source controls can help reduce the required size and cost for downstream combined sewer overflow control facilities by reducing stormwater pollutant loads and stormwater quantities entering the combined sewer system.

“Green Solutions”, as described in a Wet Weather Community Panel position paper and as endorsed by the City Council (see Part 3), are considered to be source controls. “Green Solutions” and other, more conventional source controls (such as downspout and sump pump disconnection) will be used to form a significant part of Kansas City’s Control Program.

Collection System Controls

The Collection System Controls category includes technologies and practices that affect combined sewer overflow volumes and pollutant loads **after** the stormwater enters the sewer system. These controls may reduce combined sewer overflow volume and frequency in several ways:

- Maximizing in-system (sewer line) storage;
- Maximizing flow treated at the wastewater treatment plants; and/or
- Improved operation and maintenance of the combined sewer system.

Storage Technologies

Storage technologies store wet weather flows already present in the combined sewer system for subsequent conveyance and treatment. Stored volumes are directed to the treatment plant once the storm has subsided and conveyance and treatment capacity are available. In order to reduce the storage volumes and costs needed to control combined sewer overflows, storage technologies (such as storage tanks or tunnels) are often combined with source controls, inflow reduction, and other technologies in combined sewer overflow control plans.

Treatment Technologies

Physical Treatment

Technologies included in the Physical Treatment category reduce pollutant loading to the receiving waters by treating combined sewer overflows prior to discharge. These technologies are primarily oriented to reducing settleable solids and floatables present in the overflows. They can also provide some lesser reductions in biochemical oxygen demand, nutrients, and metals. Physical treatment technologies do not significantly reduce combined sewer overflow bacteria loads and may need to be combined with disinfection technologies to meet applicable water quality standards.

Biological Treatment

Biological treatment technologies reduce biochemical oxygen demand and nutrient loadings to receiving waters by stabilizing organic materials present in the combined sewer overflows prior to discharge. These technologies may also reduce non-settleable solids.

Due to the extended dry periods and highly fluctuating hydraulic loads associated with combined sewer overflows, traditional biological treatment facilities dedicated solely to treatment of such overflows are generally not feasible. Storage or detention facilities utilized in series prior to biological treatment can reduce the impacts of these factors on the biological treatment process, but the combination is usually prohibitively expensive.

Disinfection

Disinfection is used to destroy or inactivate bacteria in combined sewer overflows prior to its discharge to receiving waters. Reduction of solids in the overflows is also generally necessary to provide satisfactory reduction in bacteria loads. Therefore, disinfection processes may need to be combined with physical and/or biological treatment processes to provide effective treatment. If chlorination is used, dechlorination should also be considered as part of the chemical treatment process because by-products created during chlorination can be harmful to aquatic life.

The utility and potential applicability of the various combined sewer overflow control technologies were considered in each individual basin as alternatives were developed. Particular emphasis was placed on the potential role of source controls, and in particular “Green Solutions”, in meeting varying levels of combined sewer overflow control.

For any given combination of control technologies and level of combined sewer overflow control (i.e., an “alternative”), the targeted performance was expected to result from a combination of conventional structural controls and an aggressive, City-wide implementation of Green Solutions and conventional source controls. There exist a wide range of possible contributions to overall system performance attributable to green solutions. As much as a 35-40 percent runoff reduction has been estimated for individual sub-basins where green solutions are aggressively and broadly implemented. Conversely, failure to effectively engage the community, and in particular the private sector, in development of on-the-ground green infrastructure would lead to a much lower impact on overall system performance.

Opportunities exist throughout each of the combined sewer system basins for the installation of small-scale green infrastructure such as rain gardens, vegetated filter strips, porous pavement, roadway curb “bumpouts”, green roofs, bioretention, etc. However, it is difficult to predict the influence of numerous dispersed Green Solutions (which maximizes their utility and cost-effectiveness) with any reasonable certainty as their extent (and the schedule on which they are established) cannot presently be reliably quantified. Those smaller-scale opportunities can be most broadly implemented as a part of redevelopment and in connection with the construction of other public facilities, as well as on individual

parcels. A long-term implementation program, coupled with monitoring, will be needed to quantify the benefits of widely dispersed Green Solutions on a macro level (i.e., at the basin scale).

It is also possible to structure Green Solutions as larger-scale, publicly-constructed improvements addressing stormwater runoff from larger areas. This possibility was the subject of extensive analysis during the alternatives development process. Potential sites for such facilities in all combined sewer system basins were identified through use of aerial photography, City planimetrics data, and a BMP (Best Management Practice) “locator” developed by KC-ONE (the City’s stormwater management plan).

A total of over 80 potential sites for such facilities were identified. Those sites were then screened for their potential utility considering:

- The topography of the site and its tributary area;
- The size of the available area (typically publicly-owned land) and site drainage patterns;
- The nature and character of the upstream sewer system;
- Each site’s potential for reducing the volume of combined sewer overflow; and
- Whether or not stormwater discharges from the site when its capacity is exceeded could be delivered directly to receiving water bodies in lieu of being reintroduced to the combined sewer system.

As a result of that screening process, 33 sites were selected for further evaluation considering:

- Their potential for improving water quality;
- The degree to which they might enhance public awareness and serve as highly visible demonstration projects;
- Whether they might improve existing community facilities and serve as an amenity;
- The degree of effort (cost) necessary to separate stormwater runoff from wastewater flows in their tributary area; and
- The extent to which they might reduce either or both stormwater runoff and flows to the combined sewer system.

In that evaluation, the number of sites remaining under consideration was further reduced to 21 for which cost estimates and more detailed evaluations of benefits were developed. In aggregate, those sites were projected to serve a total tributary area of 2,100 acres and, for individual wet weather events:

- Reduce the volume of stormwater runoff by up to 22 million gallons; and
- Reduce the volume of combined sewer overflow by up to 18 million gallons.

The estimated capital cost for those 21 sites was \$127 million. It was further estimated that, if all were implemented, the estimated capital cost for structural combined sewer overflow controls could be

reduced by as much as \$65 million. Certain of the sites were considered more cost-effective than others, and some much more visible (increasing their value as demonstration projects) than others. Much work remains to select individual projects for publicly-constructed Green Solutions, which would serve most appropriately as demonstration projects implemented early in the Control Plan to educate and involve the public in a much broader implementation strategy.

2.2.3 Priority Areas

Receiving water uses, water quality standards, and public perception/suggestion lead to the conclusion that the Blue River and its tributaries (such as Brush Creek) be considered for a potentially higher level of combined sewer overflow control. Combined sewer system basins that contribute directly to the larger receiving streams (the Kansas and Missouri rivers) may be considered for a relatively lower level of combined sewer overflow control. While there are no “sensitive areas” in Kansas City’s combined sewer overflow receiving streams, public input was obtained to assess local water body uses and public preferences as a guide as to the relative benefits of combined sewer overflow reductions in different combined sewer overflow receiving water bodies.

2.2.4 Water Quality

The ultimate goal of Kansas City’s Control Plan is to meet regulatory requirements in a manner that reflects the Kansas City community’s interests. A significant regulatory requirement is to comply with water quality standards. For this reason, water quality sampling and analysis and the application of water quality models were undertaken to support Control Plan development. Water quality data and models were used to understand and evaluate:

- Pollutant loading from various sources;
- Existing conditions in the receiving streams;
- The relative benefit of various CSO control levels; and
- The influence of other watershed sources on water quality conditions.

Water Quality Monitoring

Water quality sampling and analysis have been conducted and continue to be conducted by Kansas City through a number of coordinated programs:

- Kansas City has conducted routine bi-weekly sampling and analysis at 10 key locations in the combined sewer overflow receiving streams beginning in 2005. That effort is on-going;
- Kansas City has supported hydrologic and water quality monitoring being conducted by the United States Geological Survey (USGS) in the Blue River and Brush Creek basins. This program has been on-going since 1996 and includes stream flow gauging and baseline and wet weather event water quality monitoring. Kansas City has also supported special studies by the USGS including monitoring of the Kansas and Missouri Rivers and biological monitoring in combined sewer overflow receiving streams; and
- In 2005 Kansas City conducted intensive water quality monitoring of combined sewer overflows, stormwater discharges and receiving stream conditions. In-situ measurements of water quality

were conducted as well as the collection of approximately 500 samples during 4 wet weather events at 17 receiving water locations, 9 combined sewer outfalls, and 6 separate stormwater discharge locations. Samples were analyzed for approximately 30 water quality parameters, totaling nearly 13,000 analytical results.

The monitoring activities have all been conducted in accordance with quality assurance plans and data validation reviews. The data were used to assess existing conditions, including spatial and temporal trends, and to develop and calibrate the water quality models of the receiving streams.

The key findings from the water quality monitoring included:

- Water quality conditions in the receiving streams are typical of what is found in other urban settings and combined sewer communities across the country;
- The primary pollutants of concern are pathogens as measured by indicator bacteria such as fecal coliform and *E. coli*. Dissolved oxygen levels are also a concern in Brush Creek pools; and
- Numerous pollutant sources contribute to water quality concerns. These sources include not only combined sewer overflows in Kansas City, but also separate stormwater runoff in Kansas City; stormwater runoff from upstream watersheds; wastewater treatment plant discharges; and potential wet weather overflows or bypasses in areas upstream of Kansas City.

Water Quality Model Development

A comprehensive suite of model simulation tools, which complement and build on the water quality datasets and analyses, were developed. The water quality modeling tools were configured, calibrated, and applied to evaluate existing and potential future (i.e., following full implementation of the Control Plan) water quality conditions within the waters receiving overflows from Kansas City's combined sewer system.

A linked hydraulic – water quality modeling framework was applied to represent those receiving water bodies. The “Full Equations” (FEQ) model, which was developed by the USGS, was selected as the hydraulic component for the linked modeling framework. The “Water Quality Simulation Model – Version 5” (WASP5) model, which was developed by the USEPA, was selected as the water quality model component. The selected modeling framework provides the necessary scope and flexibility to produce realistic and reliable simulations of hydraulic and water quality conditions in the receiving water bodies.

The model domain includes the primary receiving water bodies impacted by Kansas City's combined sewer system discharges, including:

- Blue River - Bannister Rd. to the mouth (~20 miles);
- Brush Creek - State Line Rd. to the mouth (~5 miles);
- Penn Valley Lake;
- Kansas River – DeSoto, KS to the mouth (~30 miles); and

- Missouri River – from the KCMO drinking water intake (upstream from the Kansas River confluence) to Waverly, MO (~70 miles).

Based on the outcome of the data collection efforts and subsequent data analysis for each of the five receiving water bodies, key parameters selected for simulation within the model are *E. coli*, fecal coliform, suspended solids, dissolved oxygen, carbonaceous biochemical oxygen demand (CBOD), ammonia, and relevant nutrients (such as nitrogen and phosphorus). The water quality model was calibrated to wet and dry weather in-stream data collected for these parameters.

Modeling of Existing Conditions and Levels of Control

The water quality models were applied to predict water quality conditions in the receiving streams for a variety of typical wet weather event conditions. This was accomplished through the selection and simulation of a “typical year” (or recreation season). The use of a “typical year” approach also allows evaluation of water quality standards that are intended to be applied on a seasonal basis. For example, Missouri water quality standards for *E. coli* are represented as a geometric mean applied to the full length of recreation season (April-October) for a given calendar year.

The results of the water quality modeling for the typical year under existing combined sewer system conditions and upstream watershed loadings is discussed in Part 1 of this document. These results generally showed that under existing conditions current water quality standards for *E. coli* are being exceeded in the Blue River and Missouri River and that upstream watershed sources contribute significantly to *E. coli* concentrations.

Varying combined sewer overflow control levels were simulated using the water quality models and the results were evaluated to assess the benefit. Model results are presented in Figures 2-1 through 2-3 for key locations in the Blue River, Missouri River, and Brush Creek. The results show that combined sewer overflow controls provide little benefit in reducing the geometric mean of *E. coli* concentrations over the recreation season. Slight improvement is shown for reducing overflows from an average of 36 per year to 18 per year, minimal improvement for reductions to 12 overflows per year, with further increases in the level of control providing negligible benefits. These results also demonstrate the significance of the loadings from upstream watershed sources. Upstream locations, not influenced by Kansas City’s combined sewer overflows, include the Bannister Road location in the Blue River (Figure 2-1), the Upstream of Kansas River location in the Missouri River (Figure 2-2), and the Ward Parkway location in Brush Creek (Figure 2-3). The results summarized in Figures 2-1, 2-2 and 2-3 were developed with the assumption that the contributions of bacteria from upstream sources remain at current levels.

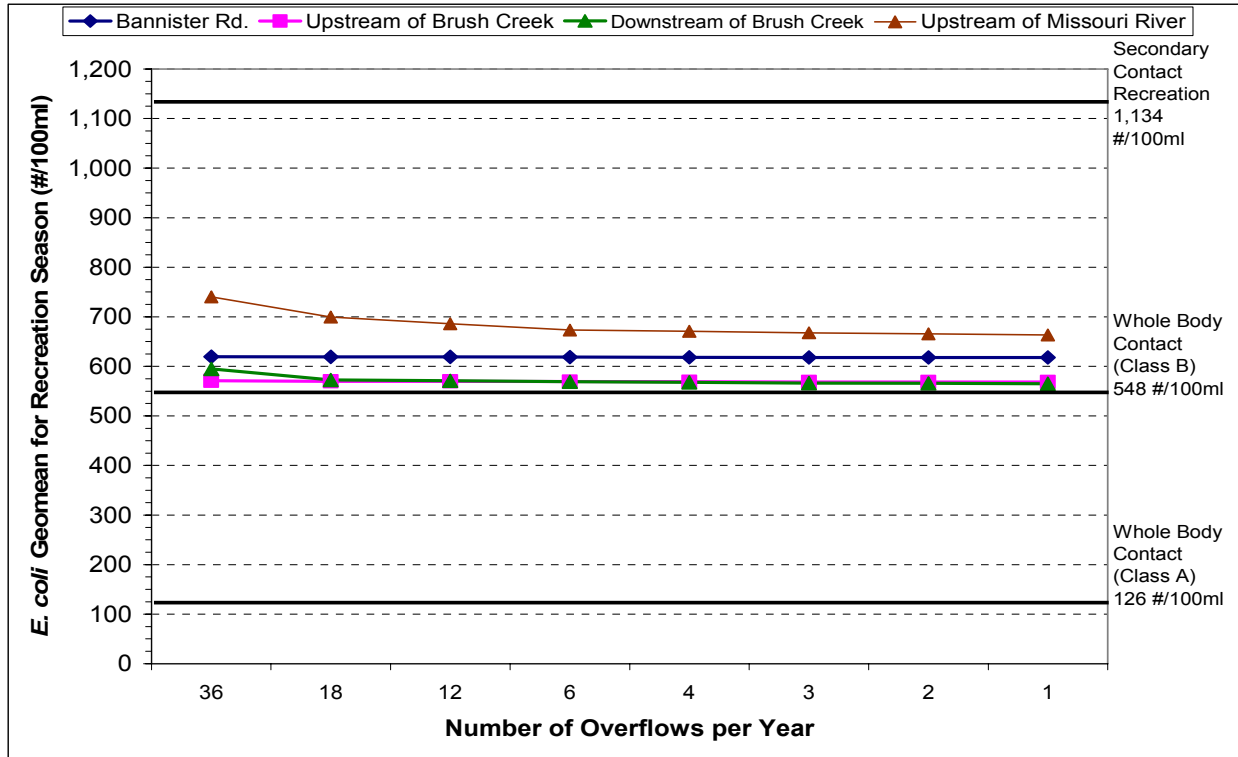


Figure 2-1

Impact of Combined Sewer Overflow Control on *E. coli* Concentrations in the Blue River

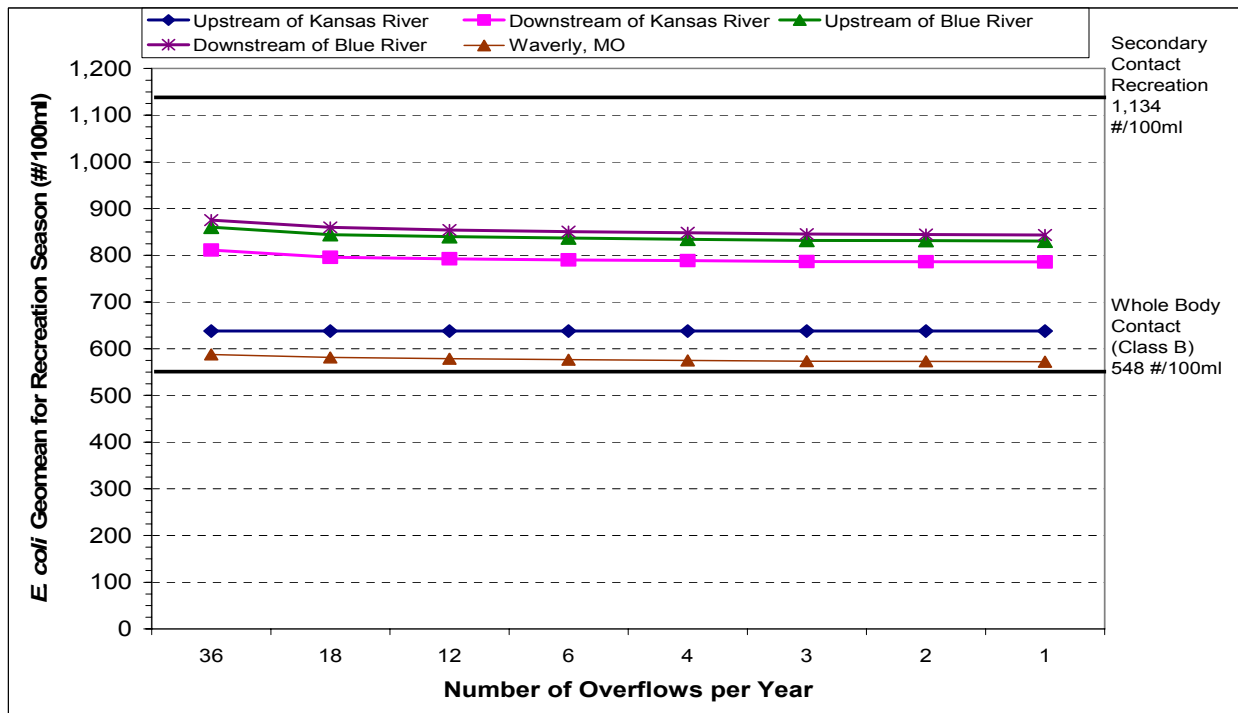


Figure 2-2

Impact of Combined Sewer Overflow Control on *E. coli* Concentrations in the Missouri River

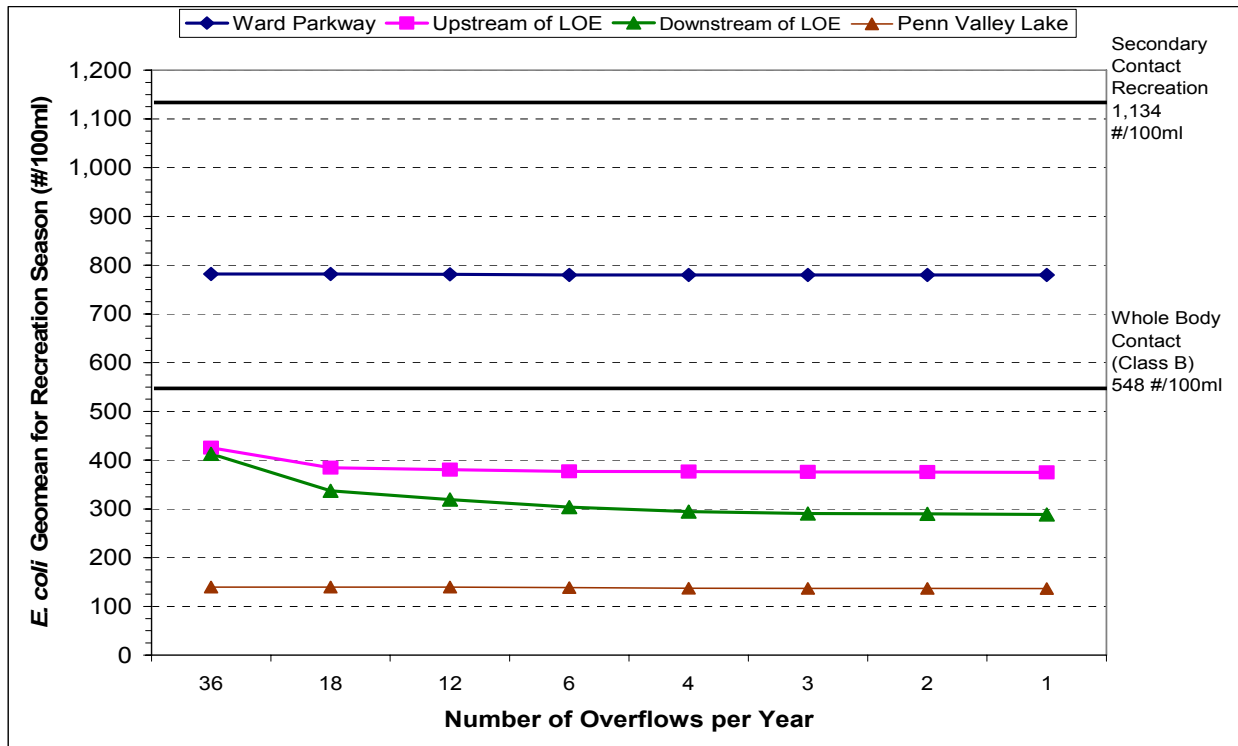


Figure 2-3

Impact of Combined Sewer Overflow Control on *E. coli* Concentrations in Brush Creek

Given the importance of upstream watershed loadings, additional model simulations were conducted to assess the combined benefit of combined sewer overflow control and reductions in upstream loadings. Varying levels of combined sewer overflow control were again simulated, but with a 25% reduction in upstream loadings. Simulation results are presented in Figures 2-4 through 2-6 for Blue River, the Missouri River, and Brush Creek, respectively.

The results shown in Figures 2-4, 2-5 and 2-6 demonstrate the significant benefit of reducing watershed loadings upstream in reducing the recreation season geometric mean of *E. coli* concentrations and complying with applicable water quality standards. The potential benefits of combined sewer overflow control assuming a 25 percent reduction in upstream loadings are similar to what could be expected under existing upstream loadings: slight improvement is shown for reducing overflows from an average of 36 per year to 18 per year, minimal improvement for reductions to 12 overflows per year, with further increases in the level of control providing negligible benefits in terms of complying with water quality standards.

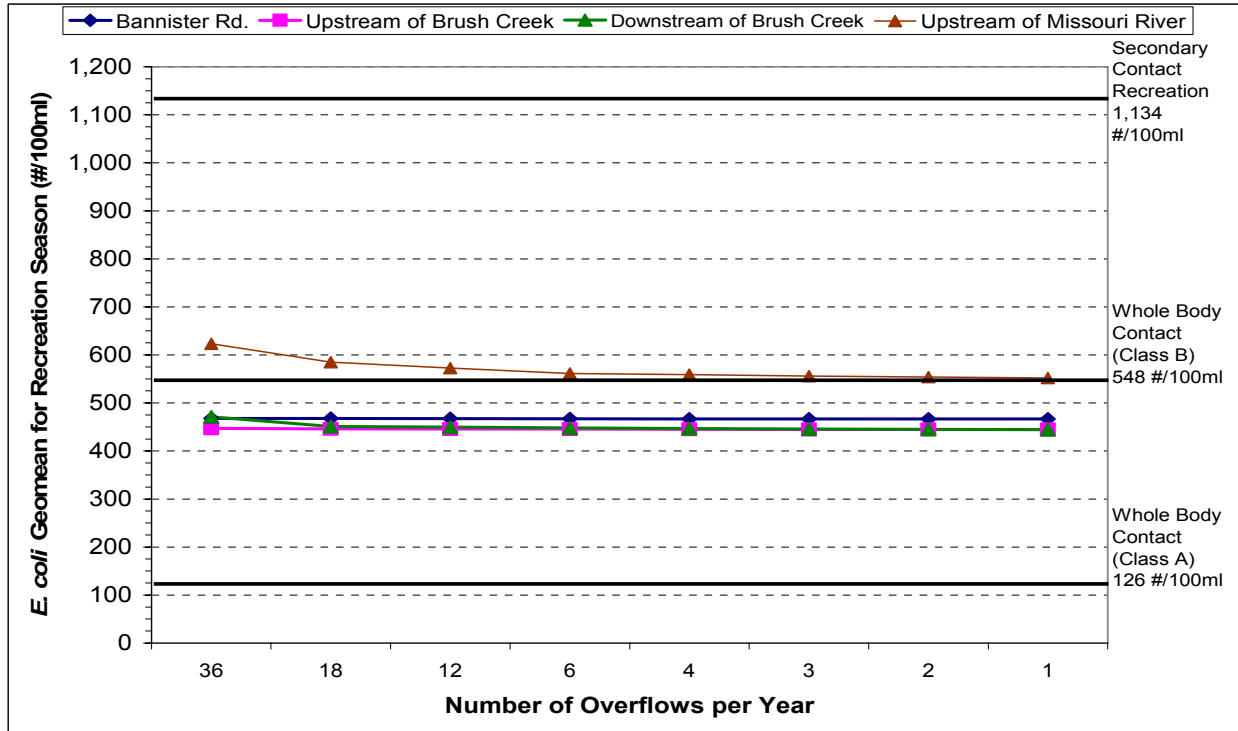


Figure 2-4.

Combined Impact of Overflow Control and Upstream Source Reduction (25%) in the Blue River

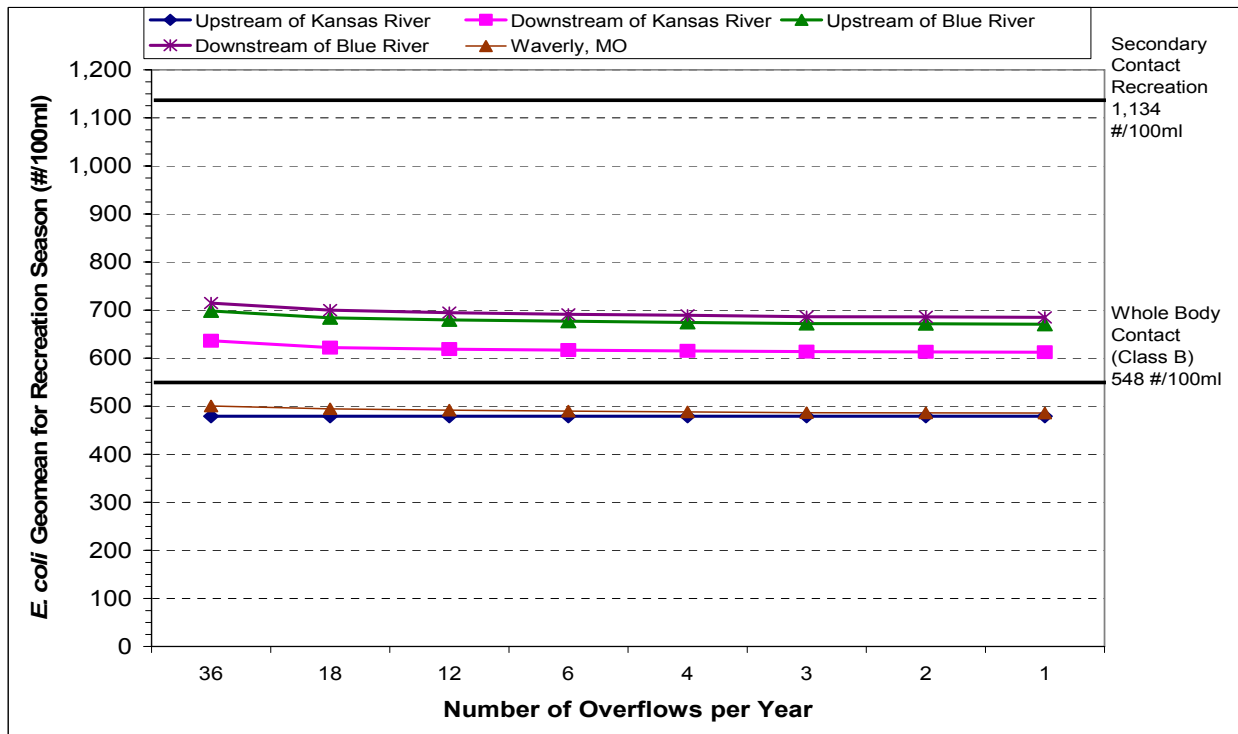


Figure 2-5

Combined Impact of Overflow Control and Upstream Source Reduction (25%) in the Missouri

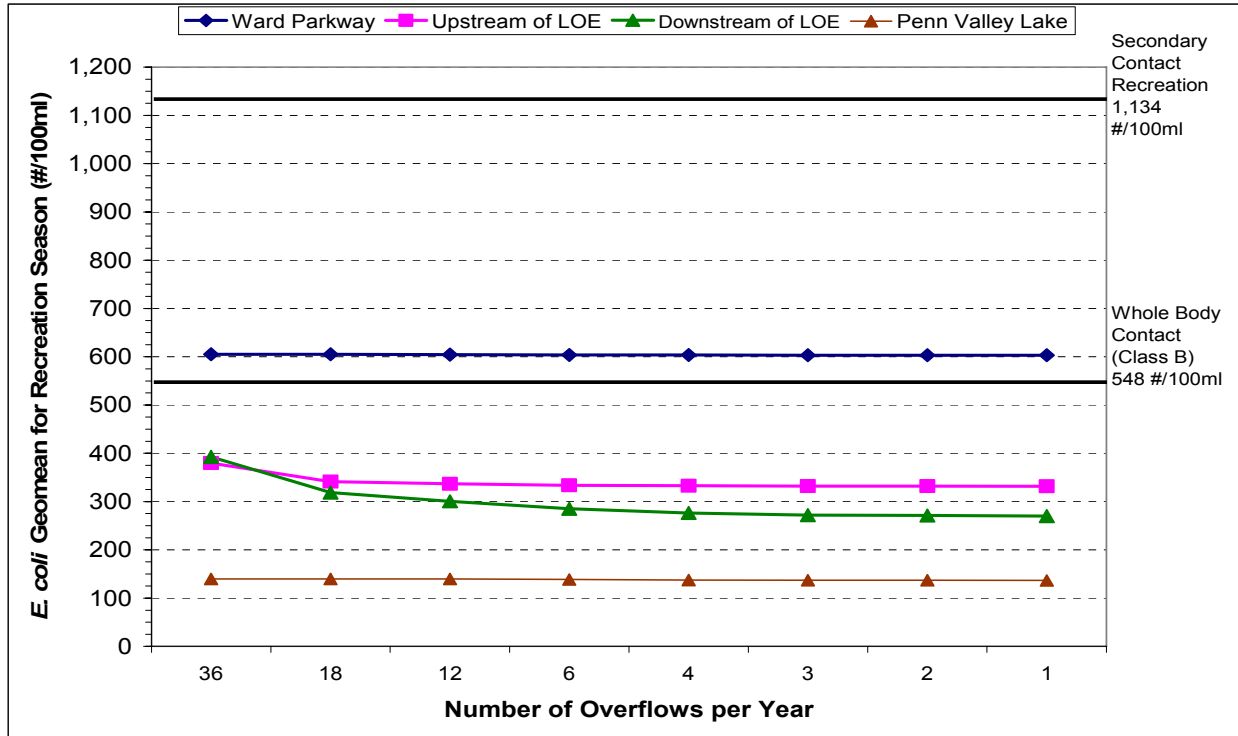


Figure 2-6

Combined Impact of Overflow Control and Upstream Source Reduction (25%) in Brush Creek

2.2.5 Range of Alternatives

The development and evaluation of structural alternatives for combined sewer overflow control focused on identifying the least-costly combination of conventional control technologies capable of meeting varying levels of combined sewer overflow control, without direct consideration of the benefits (or costs) of Green Solutions and other source controls. Basic questions considered in the alternatives analysis included, for any given level of combined sewer overflow control (expressed in terms of the average number of remaining overflow events at each outfall in a typical year):

- What combined sewer overflow quantities must be addressed to achieve varying levels of control?
- What is the least cost for achieving any given level of control by structural means (mixes of control technologies were changed with varying levels of control)?
- For a given level of control (applied uniformly across the City’s entire combined sewer system), what percent capture of wet weather flows can be expected?
- What are the incremental costs for incremental increases in the percent capture of wet weather flows in the combined sewer system?

The general process followed in the development and evaluation of alternatives is described in the opening section of this Part 2. The results of that analysis for assessing varying levels of control in the combined sewer system are presented graphically in Figures 2-7 through 2-10.

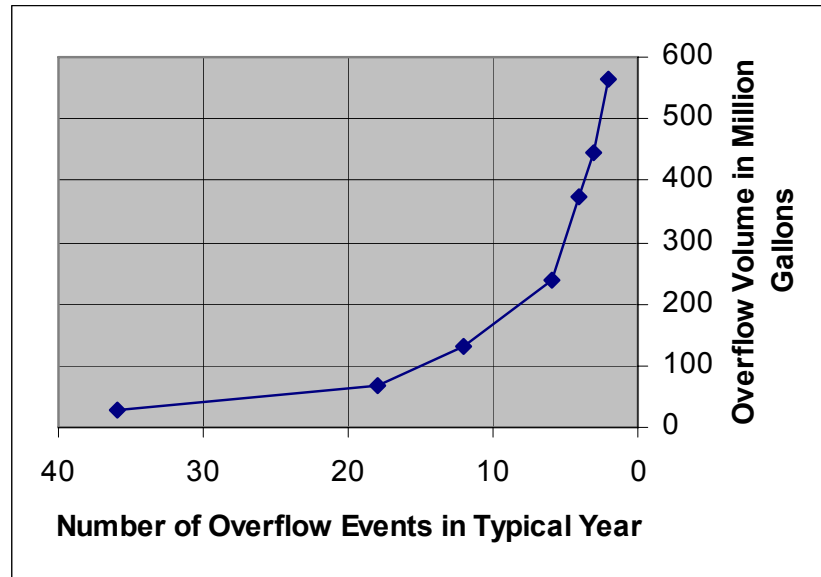


Figure 2-7
Overflow Volume vs. Overflow Event Frequency

Figure 2-7 (above) demonstrates the dramatic increases in the volume of combined sewer overflows that must be captured as the level of control increases above that necessary to reduce the remaining number of overflow events per year to an average of less than 12.

Initial capital cost estimates for achieving varying levels of combined sewer overflow control are shown in Figure 2-8. Those estimated capital costs were developed following completion of the “City-wide” alternatives evaluation described in the opening section of this Part 2. The costs summarized in Figure 2-8 are not fully inclusive of all anticipated Control Plan costs for the combined sewer system basins. Anticipated costs for source controls and other efforts to reduce the frequency and extent of sewer backups are not included in that figure. Programmatic costs for the following anticipated elements of the overall Control Plan are also not reflected in Figure 2-8:

- Long-term flow monitoring and ongoing evaluation of system performance; and
- Enabling support for institution of private source inflow reduction efforts; and

The estimated capital costs shown in Figures 2-8 and 2-10 are expressed in 2006 dollars (specifically, an Engineering News Record Construction Cost Index, or ENR CCI, of 8500), and are subject to continuing refinement.

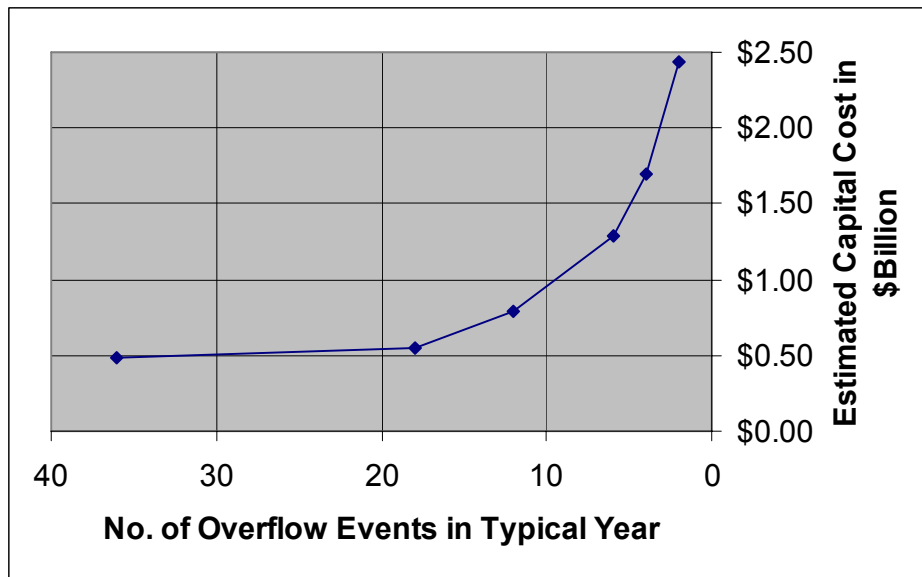


Figure 2-8
Estimated Capital Cost vs. Frequency of Remaining Overflows

The dramatic increases in the volume of combined sewer overflows that must be captured as the level of control increases above that necessary to reduce the remaining number of overflow events per year to an average of less than 12 significantly impact the estimated capital cost. Conversely, the water quality modeling results summarized in Figures 2-1 through 2-6 indicate that reducing the remaining number of overflow event to an average of less than 12 has an insignificant impact on the geometric mean concentration of *e.coli* during a typical recreation season.

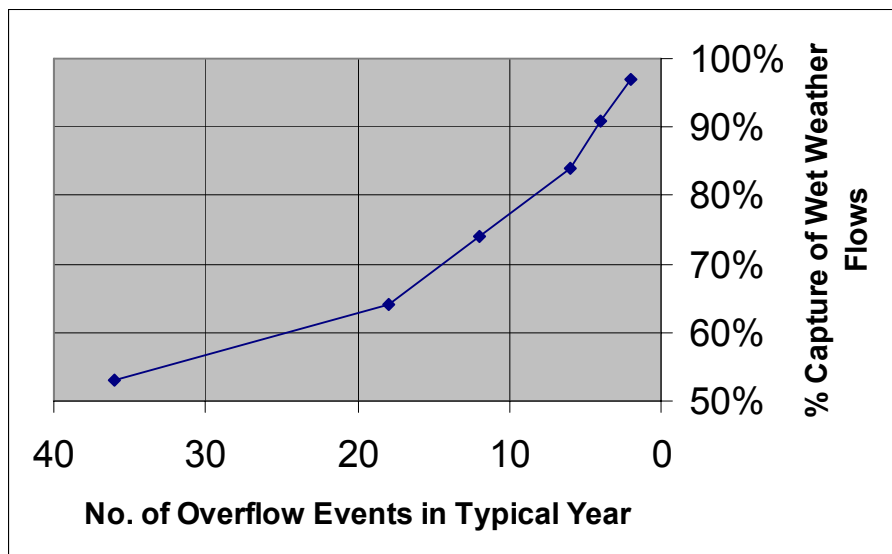


Figure 2-9
Estimated % Capture of Wet Weather Flows vs. Frequency of Remaining Overflows

Reducing the average frequency of remaining combined sewer overflows to 12 in a typical year would result in the capture of roughly 75% of the wet weather flows in the combined sewer system. The capture of 85% of the wet weather flows (suggested as one possible criterion in the US EPA's presumptive approach) would require that the average frequency of remaining combined sewer overflows be reduced to just fewer than 6 in a typical year.

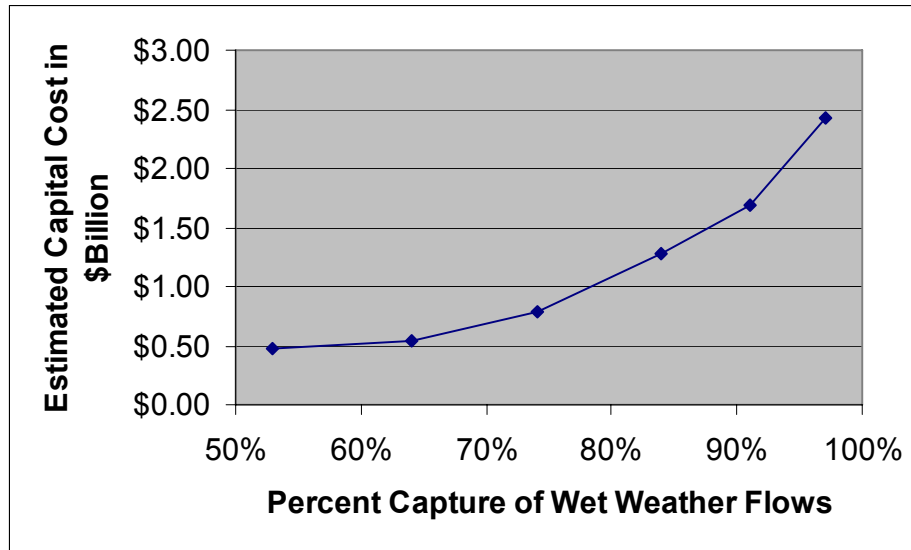


Figure 2-10
Estimated Capital Cost vs. Percent Capture of Wet Weather Flows

Attempts to increase the percent capture of wet weather flows in the combined sewer system from 75% to 85% can be expected to require a minimum additional capital investment of roughly \$540 million.

2.2.6 Conclusions

The following principal conclusions were reached in the development and evaluation of alternatives for Kansas City's combined sewer system:

- Green Solutions and source controls can have a significant impact on the size and cost of conventional structural controls for combined sewer overflows; however,
- It is not presently possible to reliably predict that impact given the uncertainty in both the extent of Green Solutions that can be implemented and the schedule by which they can be placed in service; nonetheless
- Targeted wet weather flow capture percentages are expected to result from a combination of conventional structural controls and an aggressive, City-wide implementation of Green Solutions and source controls;
- Combined sewer overflow controls that reduce the annual overflows to fewer than 12 in a typical year can be expected to provide negligible improvement in compliance with water quality standards, primarily considering *E. coli* concentrations;

- Compliance with water quality standards for *E. coli*, where applicable in the Blue River and Missouri River, cannot be attained through combined sewer overflow control alone. Reductions in other watershed loadings (e.g., from upstream watersheds and from separately sewered stormwater areas) are needed to attain current standards;
- Compliance with the current water quality standards of Whole Body Contact Class A for the reach of the Blue River from 95th Street to 59th Street (approximately represented by the Bannister Rd. and Upstream of Brush Creek locations on Figures 2-1 and 2-4) cannot be attained even with substantial reductions in upstream loadings and high levels of CSO control;
- Significant reductions in bacteria from upstream sources would be needed to attain compliance with water quality standards of Whole Body Contact Class B for the receiving streams analyzed, regardless of the level of combined sewer overflow control provided;
- City-wide, estimated costs for combined sewer overflow control increase disproportionately to the benefit for controls that reduce the annual overflows to fewer than 12 in a typical year.

The above conclusions were gained from analyses developed on the basic assumption that a uniform level of control would be developed for all combined sewer outfalls in Kansas City. It is also possible to consider differing levels of control for specific basins (and receiving water bodies), and for different outfalls within any given basin. Given that, and the above conclusions relative to Kansas City's ability to attain compliance with water quality standards through combined sewer overflow control, the following questions were brought to the Wet Weather Solutions Community Panel in order to obtain additional public input:

1. Do you agree that Kansas City should place a higher emphasis on control of combined sewer overflows in the Blue River basin than on areas that discharge directly to the Kansas and Missouri rivers?
2. Should Kansas City enter into a process to modify the current water quality standard applicable to the Blue River between 59th Street and 95th Street, and to establish interim wet-weather standards?
3. Do you agree that higher investment emphasis and implementation priority should be placed on those outfalls where improved flood protection and storm drainage service can result from implementation of combined sewer overflow controls?
4. Do you agree that lesser emphasis can be placed on reducing the frequency of overflows at outfalls that discharge relatively low volumes, in favor of focusing on reducing the quantity of overflow at larger contributing outfalls?

3 PUBLIC INPUT

3.1 Process

Kansas City's effort to reduce overflows from its combined and separate sanitary sewer systems (the Overflow Control Program) is but one element of the City's broader Wet Weather Solutions Program. The Wet Weather Solutions Program is structured to address all wet weather issues facing the City, including sewer overflows, storm drainage and flood protection needs, and the combined impact of both sewer overflows and stormwater runoff on water quality in our streams. Public participation efforts were organized to provide the citizens of Kansas City with a comprehensive and consolidated opportunity to participate in the development of solutions for all wet weather issues facing the City. A cornerstone of the public participation effort was an intense effort with the Community Panel, a citizen task force appointed by the Mayor of Kansas City, coupled with efforts to engage and educate the public at large. A summary of the major meetings held with the Panel and other groups since initiation of the public participation program in 2003 is presented in Table 3-1.

Category	2003	2004	2005	2006	2007 (through July)
Community Panel	5 (#1 thru #5)	2 (#6 & #7)	6 (#8 thru #13)	14 (#14 thru #25, plus 2 orientations)	7 (#26 thru #32)
Watershed		4			
Basin Coordinating Committees	NA	NA	NA	24	33
Neighborhood Associations & Other Organizations		6	9	10	25
Elected Officials & City Departments				4	8
Area City/County/State Departments				1	1
Other/ Workshops			1		2
Construction		1			1
Total	5	13	16	53	76

Through July of 2007, 34 meetings have been held with the Community Panel as a whole; numerous additional meetings have been held with a number of subcommittees of the Panel. In

addition, fifty-seven meetings have been held with eleven different Basin Coordinating Committees, structured to both inform the community and solicit input from the community in development of specific plans for the overflow control program in the various principal watersheds within the community. Sixty-two additional presentations (the Wet Weather Solutions “Road Show”) on the Wet Weather Solutions Program and the challenges facing Kansas City have been held with neighborhood associations and similar groups, other City departments, and elected officials. Those additional presentations were attended by over 1,300 people.

The scope and scale of Kansas City’s efforts to involve its citizenry early and often in the development of a plan to control overflows from its wastewater system have been extensive. That effort has been coupled with an extensive, more general public education and awareness effort. One element of that effort (the “10,000 Rain Gardens” program) has in itself has received national recognition. A media campaign including radio, TV and print had a net reach of 3,078,300. “How-To” Workshops were held regarding residential and professional rain garden design and installation. Over 5700 people attended these workshops. A website was developed and has had over 164,758 unique hits. Some additional activities and features of the public education and awareness effort have included:

- A press conference to present results of United States Geological Survey (USGS) water quality monitoring was held. The study was conducted by the USGS in cooperation with the City of Kansas City, Missouri Water Services Department, and led to a report on water quality in the Blue River Basin based upon six years of data. The report includes analysis of nutrients, common household chemicals and personal care products, pesticides, pharmaceuticals, bacteria and bacteria sources, and aquatic organisms in streams in the Kansas City area. This study characterizes the water quality of receiving streams, provides a better understanding of the myriad of factors that influence water quality in the Blue River Basin, and provides scientific data to assist in the overflow control plan development.
- Approximately 60 people attended World Water Quality Monitoring Day on October 18, 2006. Speakers included representatives from the Blue River Watershed Association, the Water Services Department, the USGS, Missouri Department of Natural Resources and the United States Environmental Protection Agency. Participants at the World Water Monitoring Day broke into smaller groups and discussed what should be done in the region to improve water quality. The recommendations were considered by the OCP team and were presented to the Community Panel.
- An electronic “e-blast” sharing information regarding wet weather issues was distributed to approximately 500 people on 30 different topics;
- Articles about wet weather issues were included in the City’s water bill and on the city’s website; and
- A statistically valid representative population of Kansas City (5,430) households participated in a Community Survey. Over 14,000 surveys were distributed to ensure the

completion of at least 400 in each basin. The results of the Community Survey were shared with the Community Panel.

The following is a listing of key results from the Community Survey:

- 92% of those surveyed indicated that they value natural resources;
- 77% of those surveyed thought that the quality of local streams affects property values;
- 43% understood that stormwater runoff contributes the most to pollution in lakes, rivers and streams;
- 87% of those surveyed thought it was important to improve water quality in streams in Kansas City;
- 85% of those surveyed thought it was important to make improvements that would minimize sewer overflows into creeks and streams during heavy rains but most were not willing to support substantial tax or utility rate fees (the majority said they would be willing to pay an 1/8th of cent sales tax and up to \$5 more per month in utility fees for both sewers and stormwater); and
- Most residents said they would be willing to change their behavior and take steps on their property to reduce to improve water quality.

3.2 Results

The following paragraphs briefly summarize the results to date of Kansas City's efforts to engage its citizens in the development of the Wet Weather Solutions Program. A summary of key guidance from the Community Panel reflected in this *Conceptual Control Plan Overview* is presented in Section 3.3.

- Community Panel Tasks Completed:
 - Establishment of guiding principles for the Panel by the Guiding Principles Subcommittee;
 - Establishment of Wet Weather Solutions Program goals and objectives;
 - Endorsement of the Wet Weather Solutions Program Public Participation Plan;
 - Establishment of priority factors for evaluation of basin plans;
 - Determination of evaluation criteria for basin plans;
 - Discussion of potential strategies, service levels and performance measures;
 - Discussion of potential technologies for each basin;
 - Development of an interim Sewer Back-Up Program by the Sewer Back-up Program Subcommittee; and
 - Endorsement of the Stormwater Policies created by the KC-One Program.
- Creation of the Panel's Green Solutions Subcommittee to investigate opportunities for green solutions further led to the Panel's adoption of additional principles:
 - Water is a vital and valuable natural resource; and
 - Protecting water as a valuable resource is top priority.

- Community Panelist public advocacy resulted in:
 - *Storm Inform 2007* presentation to the Kansas City, Missouri City Council, City Manager and Mayor; and
 - The introduction of a Resolution at the July 26, 2007 Legislative Session of the Kansas City, Missouri City Council. The resolution was approved by unanimous vote of the City Council on August 9, 2007.

RESOLUTION - Establishing the policy of the City to integrate green solutions protective of water in our City planning and development processes, particularly in our comprehensive Wet Weather Solutions Program; directing the City Manager to submit a plan within 90 days for implementing the strategies set out in the Green Solutions Position Paper created by the City's Wet Weather Community Panel; and directing the City Manager to incorporate green solutions, when possible, in the City's conceptual long-term control plan for sewer overflows.

- Basin Coordinating Committees were organized to educate and plan at the basin level. Four planning meetings plus an open house (Wet Weather Fair) were held for each of eleven basins, totaling nearly 60 basin public meetings. Twenty-four of these meetings took place in 2006 and 33 meetings took place in 2007. Over 200 participants were involved in the basin planning meetings.
- As part of the Basin Coordinating Committee meeting process, eleven Wet Weather Fairs attended by over 400 people were conducted in April and May of 2007. These meetings were publicized by:
 - Water bill insert sent to all Kansas City, Missouri water customers;
 - Local radio commercials and interviews;
 - Personal announcements sent to the 2006 public opinion survey respondents (over 5,000 people);
 - Personal announcements sent to Road Show presentation attendees, neighborhood organizations, local businesses and civic organizations (over 1,000 groups or organizations); and
 - School backpack flyers (25,000 flyers).
- Significant findings from the Basin Coordinating Committee process include:
 - Citizens' desires varied by basin;
 - Citizens are most interested in sewer back-ups and flooding – not overflows;
 - Citizens are concerned about how to pay for improvements; and
 - Public Education is working – more people know they live in a watershed, and that stormwater runoff is a principal contributor of pollutants in Kansas City's streams, lakes and rivers.

Figure 3-1 is a City-wide summary of the relative importance citizens’ place on various possible performance factors as expressed through the Basin Coordinating Committee (BCC) process. As noted above, citizens’ desires varied by basin. Figures 3-2 and 3-3 are results specific to two of the eleven Basin Coordinating Committees, and demonstrate that basin-specific variation in citizens’ desires. In Figure 3-1, factors represented with red bars were considered very important on a City-wide basis; factors represented by blue bars were considered important; factors represented by turquoise bars were considered desirable; and the BCC members were neutral on factors represented by green bars. The height of the bars on the figures is indicative of the relative degree of importance placed on the factors by the BCC members.

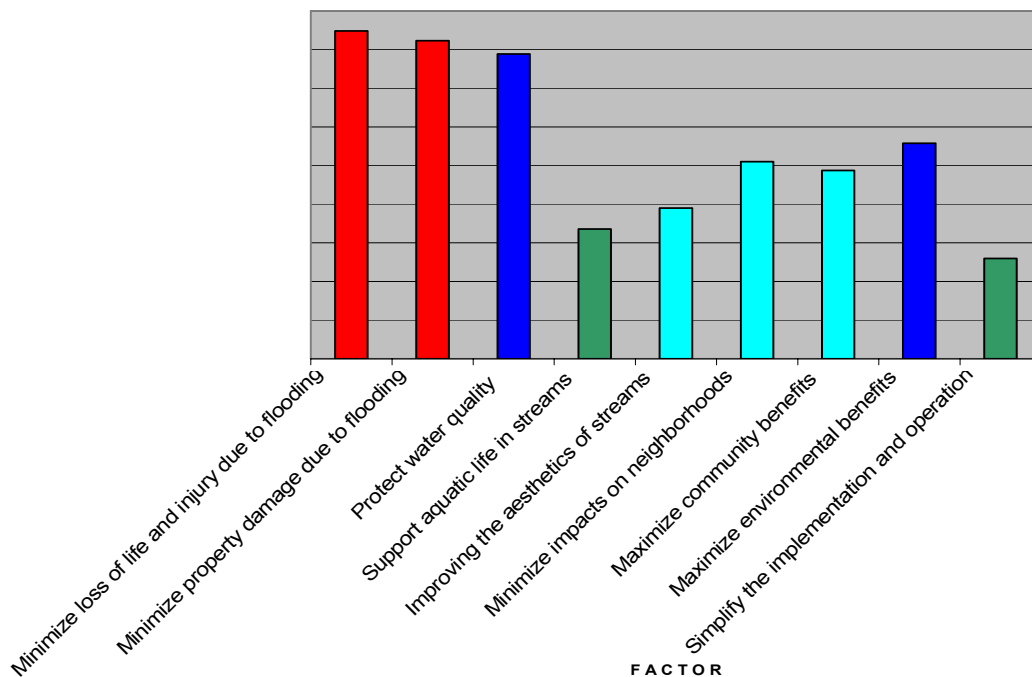


Figure 3-1
City-Wide Summary of Citizens’ Desires from BCC Process

According to the Basin Coordinating Committee Meeting attendees, the following priorities were considered to be **very important** to **important** in the Shoal Creek basin:

- *Very Important: Minimize property damage due to flooding & sewer back-ups*
- *Important: Minimize loss of life and injury due to flooding*

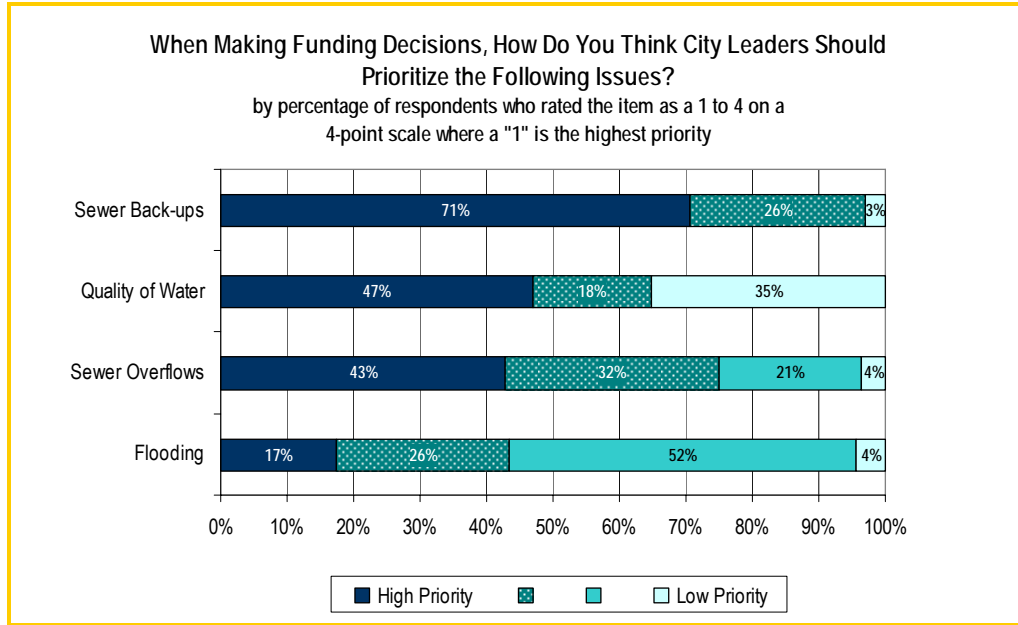


Figure 3-2
Citizens’ Desires from Shoal Creek BCC Process

The following priorities were considered to be **very important** to **important** in the Middle Blue River basin:

- *Very Important: Minimize loss of life and injury due to flooding*
- *Important: Minimize property damage due to flooding; Maximize environmental benefits; Maximize community benefits*

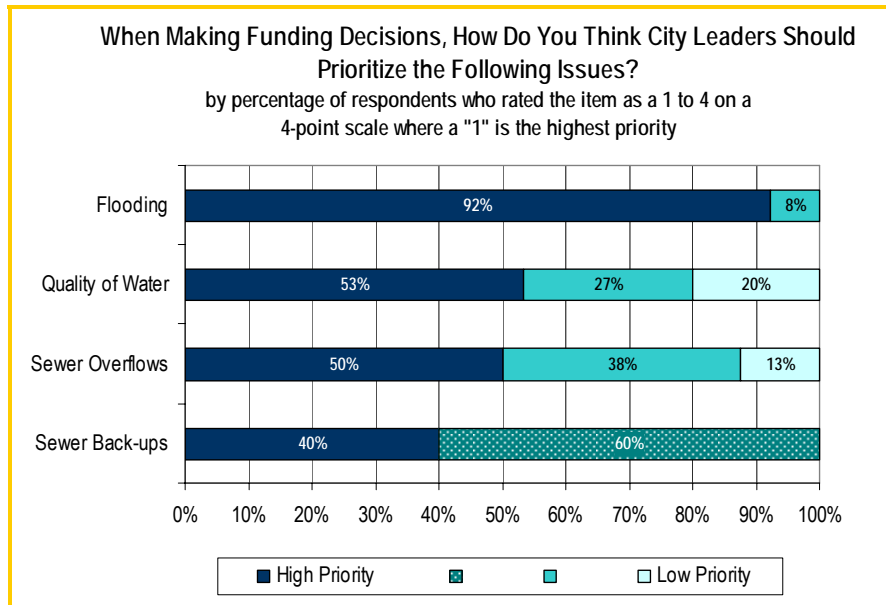


Figure 3-3
Citizens’ Desires from Middle Blue River BCC Process

3.3 Key Guidance

The conceptual control plan presented in Part 4 of this document has been developed to embrace key guidance provided by the Community Panel. Principal elements of that guidance include:

- Guiding Principles;
- Goals and Objectives; and,
- The role of Green Solutions in efforts to control sewer overflows and improve water quality in Kansas City’s streams, lakes, and rivers.

3.3.1 Guiding Principles

Ten Guiding Principles for the Wet Weather Solutions Program were established by the Community Panel at its February, 2006 meeting. Those Guiding Principles were established to assure that “Through strong creative **leadership** and a **stewardship** ethics, the Wet Weather Solutions Program will **take action** to manage the City’s water resources in a sustainable way”.

- **Leadership:**
 - Communication: use plain language;
 - Participatory: Citizens will have a meaningful say in actions that affect their lives and spend their tax dollars/user fees;
 - Collaborative: Stakeholders are partners in each aspect of the decision-making;
 - Accountable: Stakeholders, the project team and the City Council are all accountable in their respective roles for successful program development and implementation; and
 - Transparent: Strive for openness in all actions.
- **Stewardship:**
 - Watershed-based: Consider all sources of problems and solutions; and
 - Maximize environmental, community and economic benefits so that the legacy of the Program is a stronger, more appealing, and more prosperous community.
- **Take Action:**
 - Innovative: Innovate while developing the program – let experience inform future plans; and
 - Show Progress: Actively seek out existing projects that can demonstrate quick progress.

3.3.2 Goals and Objectives

The Community Panel adopted Goals and Objectives for the Wet Weather Solutions Program at its May, 2006 meeting. That guidance states that the Wet Weather Solutions Program will be structured to accomplish three primary goals:

Minimize loss of life & injury and reduce property damage due to flooding, and improve water quality while maximizing economic, social, and environmental benefits.

Specific objectives were defined for each goal:

- **Goal: Minimize loss of life and injury and reduce property damage due to flooding:**
 - Warn the public of the dangers of high water;
 - Provide passable roads during flooding;
 - Reduce flood damage to structures; and
 - Protect public infrastructure from flood damage.

- **Goal: Improve water quality:**
 - Protect streams and natural resources;
 - Reduce pollution in streams, lakes and rivers; and
 - Meet or exceed all applicable regulations.

- **Goal: Maximize economic, social and environmental benefits:**
 - Create and sustain recreational opportunities;
 - Support economic development and sustainable growth;
 - Optimize infrastructure investment; and
 - Enhance natural habitats.

3.3.3 The Role of Green Solutions

At its July, 2007 meeting, the Community Panel adopted its “Green Solutions Position Paper”, and approved a motion to forward that paper to the City Council with a request for Council endorsement. As defined by the Panel, “**Green Solutions** are strategies that result in on-the-ground projects which are specifically designed to reduce stormwater runoff, reduce water pollution, create recreational amenities, and protect our natural resources through the use of ‘green infrastructure’ (also referred to as ‘natural systems’) such as rain gardens, bio-retention facilities, stream restoration, stream buffers and other scientifically proven methods”. The purpose of the Position Paper was to advocate for adoption of a formal policy for the City of Kansas City, Missouri, that recognizes water as a vital and valuable natural resource, and that integrates the protection of water into every component of the City’s comprehensive wet weather solutions plan. The paper outlines four specific implementation strategies, and recommends a series of specific action steps to be taken under each implementation strategy.

The strategies presented in the Position Paper are structured to:

- Educate and engage the public. Create community and regional partnerships;

- Enact regulations and create enforcement programs that protect natural resources. Eliminate any ordinance provision or enforcement practice that discourages the use of green, multi-purpose solutions;
- Create incentives to integrate green solutions into the community; and
- Invest public dollars in green, multi-benefit solutions.

4 THE PLAN – IN CONCEPT

This Part 4 describes in concept Kansas City's plan for decreasing the frequency and volume of overflows from its combined and separate sanitary sewer systems. More refinement will take place prior to the July 2008 submittal of the official Control Plan. Additional steps to be taken in completion of the official Control Plan are briefly described in Part 5 of this document.

While the Control Plan will touch on stormwater management in the combined sewer system, KC-One (Kansas City's stormwater management plan) will provide recommendations to address stormwater issues throughout the City. The Control Plan is designed to work in concert with KC-One to achieve three primary goals defined by the Wet Weather Community Panel (see Part 3 of this document):

Minimize loss of life & injury and reduce property damage due to flooding, and improve water quality while maximizing economic, social, and environmental benefits.

Achieving those goals and meeting regulatory requirements will require more than simply decreasing the frequency and volume of overflows from Kansas City's combined and separate sanitary sewer systems. A watershed approach is needed, coupling overflow control with forward-looking stormwater management and a community-wide emphasis on protecting water quality and reducing runoff. Green Solutions, stormwater Best Management Practices, and conventional source reduction techniques must all play significant and early roles in an adaptive program structured to achieve those many objectives at an appropriate cost.

The Control Plan will be structured to:

- Reduce the problem before we try to solve it by getting as much stormwater as practicable out of the combined and separate sanitary sewers. This will be accomplished through widespread implementation of both Green Solutions and conventional source controls early in Control Plan implementation;
- Address flood protection needs while reducing combined sewer overflows;
- Provide a platform to facilitate implementation of a comprehensive Green Solutions initiative;
- Engage the entire metropolitan community in a comprehensive effort to improve our urban lakes, streams and rivers;
- Maximize use of the existing system through improved operation and maintenance coupled with an appropriate level of investment in continuing repair and replacement of system components as they age; and
- Establish an adaptive approach to long-term plans for structural solutions so that they can be modified to reflect the results and benefits of early efforts (Green Solutions and conventional source controls) on the response of the combined sewer system to rainfall events.

4.1 Plan Components

Control Plan components will fall into one of three principal categories:

- Actions that are programmatic in nature;
- Actions targeted primarily to address overflows in the separate sanitary sewer system; and
- Actions targeted primarily to reduce overflows in the combined sewer system.

The anticipated plan components are developed from the conclusions presented in Part 2 of this document and input received from the City Council and the Wet Weather Community Panel.

4.1.1 Programmatic Actions

A wide range of system-wide policy and management actions are needed to complement the actions specifically targeted to the separate sanitary sewer and combined sewer system.

Green Solutions

The Control Plan will include recommendations to implement Green Solutions as a comprehensive and fully integrated part of Kansas City's Wet Weather Solutions Program. Green Solutions are strategies that result in on-the-ground projects that are specifically designed to reduce stormwater runoff, reduce water pollution, create recreational amenities, and protect our natural resources through the use of "green infrastructure" (also referred to as "natural systems") such as rain gardens, bio-retention facilities, stream restoration, stream buffers and other scientifically proven methods.

The application of Green Solutions and source controls to reduce the amount of stormwater entering the sewer system are expected to reduce annual combined sewer overflow volumes and improve the quality of separate stormwater discharges.

Kansas City will adopt the philosophy of "every drop counts" meaning it is important to reduce stormwater entering the system wherever practicable. This will be accomplished through changing the way the community develops and redevelops; educating citizens regarding steps they can take to reduce the amount of stormwater entering the sewer system; enabling citizens to take those steps; incorporating green infrastructure in the design of public infrastructure; and making targeted public investments in green infrastructure demonstration projects.

The City Council's unanimous approval on August 9, 2007 of a resolution "Establishing the policy of the City to integrate Green Solutions protective of water in our City planning and development processes..." lends credence to an approach in which Green Solutions will be constructed on public property as targeted public investments. These demonstrations of Green Solutions will be monitored and evaluated for their effectiveness. The findings will be

documented and communicated in a form readily transferable to the private sector for use in understanding the potential benefits of Green Solutions in reducing overall program costs and improving water quality.

Publicly-funded Green Solutions will be emphasized in the early years of program implementation. A comprehensive effort will be made to encourage the development of dispersed Green Solutions on individual parcels through public policy, regulation, and support for private development of Green Solutions.

The impact of this combined public and private effort in the development of Green Solutions on reducing combined sewer system overflows (volume and frequency) will be quantified, and the results incorporated into the final design of conventional structural solutions. In this manner, the benefits of Green Solutions will be considered, and reductions in the size and cost of conventional structural solutions can be maximized.

Watershed Management Plan for the Blue River

Kansas City's water quality monitoring data reveal that water quality in the combined sewer overflow receiving streams generally meets current water quality standards for most pollutant parameters. However, bacteria are a notable exception. Combined sewer overflow receiving streams do not meet current state standards for bacteria. There are three primary sources of pollution in the streams that receive combined sewer overflows: stormwater runoff from upstream sources; stormwater runoff from both separate sewer areas adjacent to the streams and in the combined sewer areas; and untreated wastewater in combined sewer overflows. If Kansas City's combined sewer overflows are reduced (or even eliminated), water quality would still not meet state bacteria standards in the Missouri River and Blue River.

A watershed approach that reduces pollutants from each of the primary sources is needed. In its Control Plan, Kansas City will commit to the development and implementation of a Watershed Management Plan for the Blue River and its tributaries. That Watershed Management Plan is intended to be multi-jurisdictional, bi-state, cost-effective, collaborative and comprehensive. The Control Plan will establish a proposed process for garnering the support and active involvement of other political jurisdictions in the preparation of the Watershed Management Plan. The Watershed Management Plan will include goals, objectives and specific strategies, including an implementation plan. Progress will be monitored and adjustments made to the Watershed Management Plan during implementation to ensure real improvement in water quality directed toward eventual compliance with water quality standards.

Reduce Inflows from Private Property

An aggressive approach will be taken to the disconnection of downspouts, sump pumps, and other sources of stormwater inflows from private property to the sewer system. The specific nature of that approach will be developed in consultation with the Mayor and City Council and the City

Manager. The most effective approach is expected to be mandatory in nature, coupled with incentives or reimbursement for those instances in which mandatory disconnection is problematic.

Monitor, Evaluate, and Adapt

Flow meters and level sensors will be installed in both the combined and separate sanitary sewer system and monitored to:

- Measure flows to the separate sanitary sewer system from the more significant satellite communities;
- Quantify over time the response of the overall sewer system to rainfall;
- Assess the impact of Green Solutions and inflow and infiltration reduction efforts on the response of the sewer system to rainfall events; and
- Confirm the impact of incremental system improvements on that response.

The results of the monitoring will be evaluated through computer modeling of the sewer system , and adjustments made to the design, construction and operation of remaining Control Plan components throughout implementation of the Control Plan.

The Control Plan will also include recommendations for an expanded water quality monitoring plan for Kansas City's lakes, streams, and rivers. This monitoring plan will develop the information necessary to measure progress toward attainment of water quality standards, and to assist in development of the Blue River Watershed Management Plan. The water quality monitoring plan will build upon present efforts, eliminate gaps between existing efforts and information needs, and identify resources to implement the plan (staffing, equipment, and analytical services).

Management, Operation, and Maintenance (MOM) Program

The Control Plan will include recommendations for increased investment and emphasis on management, operation, and maintenance of the sewer system. Policies and practices will be more highly standardized and formalized. In addition, the Control Plan will include recommendations for increasing the current level of investment for system repair and replacement.

Interim Sewer Back-Up Program

In recognition that completion of Control Plan measures directed to reduction of sewer backups may take an extended period of time, the Control Plan will include an interim Sewer Back-Up Program. That interim Sewer Back-Up Program will be structured to assist customers experiencing back-ups related to a lack of system capacity until the Control Plan measures are fully implemented.

Seek to Amend Water Quality Standards Only Where Necessary to Make Them Achievable

For the majority of the Blue River, State water quality standards designate the stream use as Whole Body Contact Class B. Water quality with this designation should support wading and occasional swimming. The Blue River from 59th to 95th Street is currently designated by the State of Missouri as Whole Body Contact Class A. This designation is intended to protect public swimming areas. Polling of Community Panelists, Basin Coordinating Committee members, and personal interviews at various locations along streams and through the public opinion survey indicates very few citizens use or have observed use of the Blue River for swimming. The data show most people use the Blue River for fishing, hiking and walking, and picnicking. According to the public opinion survey, 92% of citizens surveyed said they would not consider swimming in any lakes or streams during or immediately after a rainstorm.

The only combined sewer basin that is tributary to the Blue River between 59th and 95th Street is the Middle Blue River basin. Combined sewer overflow controls in this basin will not substantially improve water quality in the Blue River, which is largely determined by the quality of water from upstream sources. Whole Body Contact Class A (swimming) can only be achieved by reducing roughly 80% of upstream sources. Upstream sources of stormwater pollution in the Blue River would need to be reduced by roughly 15% to meet current water quality standards for Whole Body Contact Class B. It is not reasonable to expect that Whole Body Contact Class A in the Blue River can be attained. As part of the Overflow Control Program, the City anticipates a review of the current designated recreational use and associated water quality standards. The goal of this process (a Use Attainability Analysis, or UAA) is to refine the designated uses to better reflect actual uses and attainable standards.

It is anticipated that full implementation of the Control Plan will take many years, especially if Green Solutions are given a reasonable chance to succeed. Until such time as the Control Plan (and the associated Watershed Management Plan for the Blue River and its tributaries) is fully implemented, it is probable that current water quality standards, even after the above-described review, will not be fully met.

4.1.2 Separate Sanitary Sewer System

Proposed strategies in the separate sanitary sewer system are to (1) reduce inflow and infiltration where cost-effective; (2) provide a combination of wet weather storage and treatment to address remaining wet weather inflows; and (3) accommodate population growth. Table 4-1 summarizes the basic nature of system improvements expected to be included in the Control Plan in each of the separate sanitary sewer system basins.

**Table 4-1
Separate Sanitary Sewer System Improvements**

Basin	Control Plan Components								
	Reduce Inflow & Infiltration	Expand Primary & Secondary Treatment Capacity	Tunnel for Storage & Conveyance of Wet Weather Flow	Relief Sewers	Expand Capacity of Major Pumping Station	Construct Tank Storage for Wet Weather Flows	High Rate Treatment for Wet Weather Flows	Other Collection System Improvements	
Northern Watersheds	✓	✓		✓				✓	
Line Creek/Rock Creek & Northwestern	✓		✓	✓				✓	
Birmingham/Shoal Creek	✓	✓	✓		✓		✓		
Blue River North & Blue River Central	✓							✓	
Round Grove	✓			✓				✓	
Blue River South	✓			✓		✓		✓	
Little Blue River Tributaries	✓							✓	

It is anticipated that wet weather flows from the Line Creek/Rock Creek and Northwestern basins will be sent through a conveyance and storage tunnel to the Birmingham Wastewater Treatment Plant (WWTP). That tunnel system would also temporarily store excess wet weather flows from the Birmingham/Shoal Creek basin. The existing primary and secondary treatment capacity of the Birmingham WWTP will be increased to accommodate population growth. It is also anticipated that High Rate Treatment will be added to the Birmingham plant to address peak wet weather inflows.

Line Creek Sanitary Sewer Overflow

A constructed Sanitary Sewer Overflow (SSO) exists in the Line Creek/Rock Creek basin, just upstream of the Line Creek Pumping Station. Addressing overflows from this SSO are a priority; eventual elimination of the constructed SSO is required. The conveyance and storage tunnel from the Line Creek basin to the Birmingham Wastewater Treatment Plant will permit the eventual elimination of this SSO; however, it can be expected that several years will be required for completion of the tunnel.

As an interim measure, it is anticipated that a temporary High Rate Treatment facility will be added in the immediate vicinity of the Line Creek Pumping Station to address overflows at that location. It is expected that facility would be designed to address the peak rate of overflow under a one-year rainfall event, leading to treatment (subject to confirmation in subsequent analysis) of 40-50 million gallons per day during significant wet weather events. The temporary facility would serve as a large-scale pilot program that would provide design data for the permanent facility (to be constructed at the Birmingham WWTP), operations and maintenance information, and increased confidence in the ability of the permanent facility to meet permit requirements.

4.1.3 Combined Sewer System

Proposed strategies in the combined sewer system basins are framed in the context of accomplishing the goals established by the Wet Weather Community Panel, meeting regulatory requirements, and providing multiple benefits with judicious investment of public dollars for infrastructure improvements.

Water Quality Priorities: In order to develop an approach and specific strategy for each basin, input was gathered regarding the importance and priority for water quality improvement. Kansas City residents were asked how they use their streams and what importance they place on water quality. Data were also gathered on the impacts of combined sewer overflows on water quality. Table 4-2 shows the ranking of basins in terms of the importance of improving water quality, based on the public input received to date. A ranking of 1 for water quality means that the principal receiving stream in this basin is judged the most important to protect and improve, 2 is second most important and so on to 7 which means it is the least important.

Water Quality Philosophy: The resulting philosophy is to focus water quality improvement efforts in the Blue River basins (Middle Blue, Town Fork Creek, Brush Creek, Lower Blue River and Gooseneck Creek) and to spend less effort on basins that drain directly to the Kansas and Missouri rivers (Turkey Creek, Central Industrial District, Northeast Industrial District). Roughly 3% of the bacteria in the Missouri River just downstream from its confluence with the Blue River are associated with Kansas City's combined sewer overflows. Funds expended to address this relatively small source of bacteria in the Missouri River would be better spent to address water quality in streams that are more directly influenced by Kansas City's actions, such as the Blue River.

Flood Damage Reduction Opportunities: The risk of loss of life and injury and property damage can be reduced in some basins by increasing the size and/or extent of structural solutions intended primarily for combined sewer overflow control.

Flood Damage Reduction Philosophy: The philosophy is to increase the level of combined sewer overflow control in those areas where doing so can cost-effectively provide significant flood damage reduction benefits. These areas fit four primary categories:

- There is a great potential for loss of life or injury due to flooding; or
- There is a substantial potential for property damage; or
- The property and areas of town are of significant community value; or
- There is an opportunity to spur reinvestment in and redevelopment of economically depressed areas of the City.

Opportunities to Maximize Economic, Social and Environmental Benefits: Structural controls and Green Solutions should present opportunities to get and give economies of scale and alignment of purpose with other community development projects to maximize the environmental, economic, cultural and historic benefits that can be achieved.

Benefit Maximization Philosophy: Green Solutions offer the potential for multiple benefits and for that reason can be more desirable than structural controls, particularly those that do not provide flood damage reduction benefits. Publicly-funded Green Solutions will be proposed in targeted areas where they improve water quality in a cost-effective manner. Dispersed Green Solutions on privately held land (or publicly held individual parcels) will be a strategy encouraged throughout the city through regulation and enabling support.

In addition, detailed planning for individual projects will include identification of other benefits that can be realized, such as neighborhood revitalization, street improvements, park improvements and redevelopment opportunities. The identification of the additional benefits (and funding for their incorporation into individual projects) will result from a cooperative effort by the various City departments.

The Conceptual Control Plan is based on the strategies discussed below. These strategies result from consideration of the conclusions presented in Part 2 of this document, and the response of the Wet Weather Community Panel to the questions brought before. Those questions, identified in Part 2, are repeated below, together with the responses provided by the Panel at its August 14, 2007 meeting.

1. Do you agree that Kansas City should place a higher emphasis on control of combined sewer overflows in the Blue River basin than on areas that discharge directly to the Kansas and Missouri rivers?

Panel Response: Yes

2. Should Kansas City enter into a process to modify the current water quality standard applicable to the Blue River between 59th Street and 95th Street, and to establish interim wet-weather standards?

Panel Response: Yes

3. Do you agree that higher investment emphasis and implementation priority should be placed on those outfalls where improved flood protection and storm drainage service can result from implementation of combined sewer overflow controls?

Panel Response: Yes

4. Do you agree that lesser emphasis can be placed on reducing the frequency of overflows at outfalls that discharge relatively low volumes, in favor of focusing on reducing the quantity of overflow at larger contributing outfalls?

Panel Response: Yes

Common Strategies for All Combined Sewer Basins:

Three strategies that will be applied in all the basins are:

1. Improve the aesthetics of the receiving streams. This means implementing technologies and management practices to control “floatables” which includes trash, debris and solid human and animal waste that floats in combined sewage. Proposed improvements will include plans to reduce the discharge of floatables early in the program.
2. Change the way the community develops and redevelops; educate citizens regarding steps they can take to reduce stormwater entering the system and change the design of public infrastructure during construction and reconstruction to incorporate Green Solutions. Enable and motivate the private sector to reduce stormwater runoff over time.
3. Reduce the volume of water entering the system and sewer backups through a combination of small sewer rehabilitation and inflow reduction (e.g., downspout disconnection, sump pump disconnection, etc.) throughout the City’s combined sewer area.

The first of the above strategies is meant to build early public support. The second and third strategies are meant to reduce the eventual investment in structural controls by getting stormwater out of the system and improve customer service.

Overall Level of Control:

Based on water quality modeling results, reducing the overall frequency of combined sewer overflows to fewer than an average of roughly twelve events per year will have little or no measurable impact on water quality in Kansas City’s receiving streams. That conclusion applies given both the present level of pollutant loads from upstream sources and separate stormwater areas, and a future condition in which the loads from upstream sources are reduced. That level of control would, for the City as a whole, result in a capture of just under 75% of the total wet weather flows in the combined sewer system. It is presently anticipated that the Control Plan will be developed to result in a capture of approximately 80% of the total wet weather flows in the combined sewer system.

Targets Vary by Basin

Table 4-2 provides a sense of priority in terms of water quality improvement, the need to reduce flood damages, and the opportunity to maximize economic, social and environmental benefits. In addition, the table includes the presently anticipated nature of systemic improvements (in addition to those described above). **The specific nature of those improvements (and their targeted performance) is still being developed and refined, with the result that the information shown simply reflects current best judgment as to the probable results.** It is anticipated that achieving the targeted performance by basin will result in a capture of roughly 75% of the wet weather flows in those basins that discharge directly to the Kansas and Missouri rivers, and roughly 83% in those basins that are tributary to the Blue River (including consideration of remaining overflows from the Blue River Interceptor Sewer).

Those targeted capture percentages are expected to result from a combination of conventional structural controls and an aggressive, City-wide implementation of Green Solutions. The

proportion of the overall performance target that can be achieved by Green Solutions will be better defined as Kansas City gains implementation experience and learns from the experience of other cities. While the influence of individual projects can be estimated, success will depend largely on the extent to which Green Solutions will be embraced and implemented by the private sector in the combined sewer system basins.

From a strategic perspective, Green Solutions have a wide range of effectiveness. As much as a 35-40% annual runoff reduction in local areas can be achieved where Green Solutions are aggressively and broadly implemented. Conversely, failure to successfully engage the community, and in particular the private sector, in development of on-the-ground green infrastructure would lead to a much lesser impact on overall system performance. It is for that reason that a key component of the overall strategy is early implementation of an overall green strategy within the City, coupled with monitoring of results on a basin and sub-basin scale, so that the actual effects of those early efforts can be reflected in the final design (e.g., size, capacity and configuration) of conventional structural solutions. It is anticipated that any reasonable overall schedule for implementation of the Control Plan will provide an opportunity to maximize the benefits of Green Solutions and source controls in reducing the cost of conventional structural solutions.

Table 4-2 Goals, Strategy & Targets by Basin*

BASIN	Water Quality	Flood Damage Reduction	Maximize Benefits	Proposed Strategy	% Capture of Wet Weather Flow in Combined Sewers
Middle Blue River <i>(South of Brush Creek)</i>	1	6	3	<ul style="list-style-type: none"> ✓ Separate selected areas and install green infrastructure for improved water quality. ✓ Install new pipe in selected areas to address sewer backups & allow for redevelopment of blighted areas. ✓ Build storage tanks to the extent necessary to meet overall targets after early efforts to reduce volumes. 	88
Town Fork Creek	2	1	1	<ul style="list-style-type: none"> ✓ Construct a tunnel for overflow control and flood damage reduction which will allow for stream restoration. ✓ Separate selected areas and install green infrastructure for improved water quality. ✓ Install new pipe in selected areas to consolidate diversion structures and reduce overflows in neighborhoods. 	89
Brush Creek	3	4	2	<ul style="list-style-type: none"> ✓ Construct a tunnel or tunnels for overflow control and flood control up into selected areas of the watershed as the flood control project handles main channel. ✓ Consolidate outfalls and build new pipe. 	89
Lower Blue River <i>(Flood Control Channel)</i>	4	7	4	<ul style="list-style-type: none"> ✓ Separate selected areas and install green infrastructure for improved water quality. ✓ Install new pipe in selected areas to address sewer backups & allow for redevelopment of blighted areas. ✓ Build storage tanks to the extent necessary to meet overall targets after early efforts to reduce volumes. 	89
Gooseneck Creek	5	3	7	<ul style="list-style-type: none"> ✓ Construct a tunnel for overflow control and flood control. 	85
Turkey Creek & Central Industrial District	6	2	5	<ul style="list-style-type: none"> ✓ Separating one area totaling 66 acres above Penn Valley Lake. ✓ Construct a tunnel for overflow control and flood control. ✓ Build CID stormwater drainage improvements providing necessary combined sewer overflow storage. 	80
Northeast Industrial District (NEID)	7	5	6	<ul style="list-style-type: none"> ✓ Construct new sanitary sewers for separation in one sub-basin. ✓ Construct structural storage (either or both tanks and tunnels) for combined sewer overflows after early efforts to reduce volumes. 	65

*** Green Solutions will be included in the strategies for all basins.**

Implementation of the strategies in Table 4-2 is expected to reduce combined sewer overflow volumes in a typical year from 6.1 billion gallons to 1.8 billion gallons, as shown in Table 4-3 and Figure 4-1.

**Table 4-3
Planned Combined Sewer System Performance in Typical Year**

Basin	Typical Year Wet Weather Flow (billion gallons)	Estimated Overflow Volume (billion gallons)	Capture of Wet Weather Flow (%)
MISSOURI RIVER BASINS			
Downtown Airport (Note 1)			
Turkey Creek /Central Industrial District	2.67	0.53	80%
Northeast Industrial District	1.19	0.42	65%
Subtotal, Missouri River Basins	3.86	0.94	76%
BLUE RIVER BASINS			
Gooseneck Creek	1.02	0.15	85%
Lower Blue River	0.62	0.07	89%
Town Fork Creek	0.88	0.10	89%
Brush Creek	1.83	0.22	88%
Middle Blue River	0.62	0.07	88%
Subtotal, Blue River Basins	4.97	0.61	88%
Blue River Interceptor		0.23	N/A
Total to Blue River	4.97	0.84	83%
CITY-WIDE TOTALS	8.8	1.8	80%

Notes:

(1) Data not available

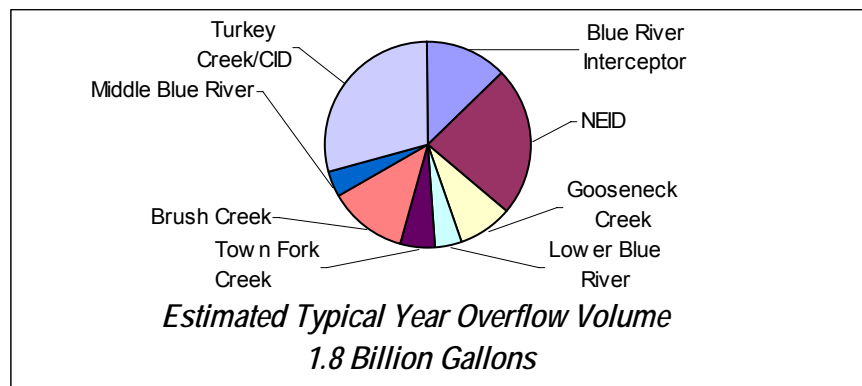


Figure 4-1 Planned Combined Sewer Overflows in a Typical Year

The projected performance of the proposed combined sewer overflow controls in reducing overflow volumes remains subject to confirmation by additional analysis.

4.2 Water Quality Impacts

It is anticipated that the following actions described in this Conceptual Control Plan will collectively result in eventual compliance with appropriate water quality standards in that reach of the Blue River that receives overflows from Kansas City's combined sewer system:

- Implementation of Green Solutions as a policy and philosophy of the City of Kansas City, in accordance with the recommendations of the Wet Weather Community Panel and guidance received from the City Council in the form of a unanimously approved resolution to that effect;
- Completion of structural combined sewer overflow controls, appropriately sized and configured given the results of the Green Solutions initiative to meet the target performance objectives defined in Table 4-2;
- Completion of the Watershed Management Plan for the Blue River, and implementation of recommendations developed in that Plan; and
- Modification of the designated recreational use of one section of the Blue River to reflect attainable water quality standards, particularly with respect to bacteria.

It does not appear possible for Kansas City's actions alone to lead to eventual compliance with water quality standards for bacteria in the Kansas and Missouri rivers. It is anticipated that the Control Plan elements in those basins directly tributary to the Kansas and Missouri rivers will be adequate to provide assurance to the regulatory agencies that Kansas City's combined sewer overflows do not cause violation of water quality standards in those streams.

4.3 Cost

The estimated capital cost for anticipated control elements in the separate sanitary sewer and combined sewer systems are shown in Table 4-4 and Table 4-5, respectively. Estimated costs for programmatic components of the overall Control Plan have not yet been developed. Estimated capital costs remain conceptual in nature, and are subject to change and refinement as Control Plan development continues. All estimated capital costs are expressed in June 2006 dollars, and will be updated during continued preparation of the Control Plan to:

- Incorporate cost escalation between June 2006 and January 2008;
- Reflect refinements to the physical configuration and capacity of individual plan components resulting from ongoing, more detailed analysis of the ability of the Control Plan to meet the targets presented in Section 4.1 of this document; and
- Incorporate estimated costs for programmatic components as they are more fully developed.

**Table 4-4
Estimated Capital Costs, Separate Sanitary Sewer System Basins**

Basin	Estimated Range of Capital Costs (\$ Million)					
	Reduce Inflow & Infiltration		All Other Improvements		Total Capital Cost	
	From	To	From	To	From	To
NORTH OF MISSOURI RIVER						
Northern Watersheds	\$9	\$12	\$62	\$75	\$71	\$87
Line Creek/Rock Creek & Northwestern	\$29	\$37	\$213	\$273	\$242	\$310
Birmingham/Shoal Creek	\$33	\$41	\$252	\$308	\$285	\$349
TOTAL NORTH OF MISSOURI RIVER	\$72	\$90	\$526	\$656	\$598	\$746
SOUTH OF MISSOURI RIVER						
Blue River Tributary Basins						
Blue River North & Blue River Central	\$10	\$12	\$0.2	\$0.3	\$10	\$12
Round Grove	\$4	\$5	\$11	\$13	\$15	\$18
Blue River South	\$33	\$40	\$331	\$405	\$364	\$445
Subtotal, Blue River Tributary Basins	\$47	\$57	\$342	\$418	\$389	\$475
Little Blue River Tributaries						
Little Blue River Tributaries	\$19	\$24	\$6	\$7	\$25	\$31
TOTAL SOUTH OF MISSOURI RIVER	\$66	\$81	\$348	\$425	\$413	\$506
CITY-WIDE TOTALS	\$137	\$171	\$874	\$1,081	\$1,011	\$1,252

The estimated capital costs in Table 4-4 include expansion of primary and secondary treatment capacities at the Birmingham, Fishing River, Rocky Branch and Todd Creek wastewater treatment plants to accommodate future population growth. Those estimated costs also include the addition of High Rate Treatment (HRT) at the Birmingham wastewater treatment plant to handle wet weather flows from the Line Creek/Rock Creek and Birmingham/Shoal Creek basins.

**Table 4-5
Estimated Capital Costs, Combined Sewer System Basins**

Basin	Total Length of Sewer ≤ 12" Dia. (ft)	Small Sewer Rehabilitation		Overflow Controls		Total for Basin	
		Estimated Range of Capital Cost (\$ Million)		Estimated Range of Capital Cost (\$ Million)		Estimated Range of Capital Cost (\$ Million)	
		From	To	From	To	From	To
MISSOURI RIVER BASINS							
Downtown Airport	33,000	\$1.2	\$1.4	\$10	\$20	\$11	\$21
Turkey Creek /Central Industrial District	409,000	\$14.4	\$17.6	\$270	\$320	\$284	\$338
Northeast Industrial District	151,000	\$5.3	\$6.5	\$100	\$120	\$105	\$126
Subtotal, Missouri River Basins	593,000	\$20.8	\$25.5	\$380	\$460	\$401	\$485
BLUE RIVER BASINS							
Gooseneck Creek	317,000	\$11.1	\$13.6	120	150	\$131	\$164
Lower Blue River (& Div. Str. 205)	405,000	\$14.4	\$17.7	70	85	\$85	\$103
Town Fork Creek	340,000	\$12.0	\$14.6	130	160	\$142	\$175
Brush Creek	936,000	\$32.9	\$40.2	330	440	\$363	\$480
Middle Blue River	428,000	\$15.0	\$18.4	80	95	\$95	\$113
Subtotal, Blue River Basins	2,426,000	\$85.3	\$104.2	730	930	816	1,035
CITY-WIDE TOTALS	3,019,000	\$106	\$130	\$1,110	\$1,390	\$1,217	\$1,520

The above estimated capital costs were developed without consideration of the benefits to be obtained from Kansas City’s Green Solutions initiative and other source controls, which cannot be presently quantified with any reasonable degree of certainty. The Control Plan will address the manner in which the capacity and configuration of the combined sewer overflow controls will be adjusted after a suitable period of implementation, monitoring and evaluation of those early efforts.

Table 4-5 does not include estimated capital costs for the addition of High Rate Treatment at the Westside and Blue River wastewater treatment plants necessary to treat the combined sewer overflows captured by the Control Plan components. The capital cost of those additions, together with additional solids handling capacity at the Blue River plant, is presently projected to add between \$160 million and \$240 million to the estimated capital cost of the overall Control Plan.

Overall, it is anticipated that the capital cost for all elements of the Control Plan (other than the programmatic components, for which cost estimates are not yet available) will range from **\$2.4 billion to \$3.0 billion** (in June 2006 dollars), composed of:

- Between \$1.0 and \$1.25 billion for improvements in the separate sanitary sewer system;
- Between \$1.2 and \$1.5 billion for improvements in the combined sewer system basins; and
- Between \$160 and \$240 million for improvements at the Blue River and Westside wastewater treatment plants.

Implementation of the anticipated Control Plan will also substantially increase annual expenditures for operation and maintenance.

4.4 Implementation Schedule

Funding for the anticipated Control Plan will impose a substantial burden on the Kansas City community. Much work remains to develop a funding plan acceptable to the community, the Mayor and City Council, and the City Manager. A Financial Capability Assessment is now being prepared that will help guide final definition of the overall implementation schedule. At present, it is anticipated that a period of 25 years or more will be needed to complete implementation of the Control Plan without imposing an undue burden on the community and to maximize the benefits of Green Solutions.

It will also be necessary to consider the potential impact of future changes in regulations on the cost to Kansas City for remaining in compliance. As one example, the Missouri Department of Natural Resources recently revised the Missouri State Operating Permit for the Blue River Wastewater Treatment Plant. That revised Operating Permit establishes new effluent limits on ammonia which, if not changed, will become effective in June 2010. Existing processes at that wastewater treatment plant were not designed to reduce ammonia. While estimates of the cost for plant modifications necessary to meet those new limits have not been developed, the capital cost for necessary modifications at that one wastewater treatment plant might be expected to range from \$80-\$120 million.

In addition, there is an increasing national momentum toward new effluent nutrient (i.e., nitrogen and phosphorus) limits driven primarily by water quality impacts from nutrient loads being discharged into the Gulf of Mexico from the Mississippi River. A recent draft report issued by the U.S. Environmental Protection Agency's Science Advisory Board recommends new nutrient limits for all municipal wastewater treatment plants in the Mississippi River basin greater than 1 million gallons per day in size. If

adopted and eventually included in operating permits, each of Kansas City's wastewater treatment plants could be affected.

At the Blue River Wastewater Treatment Plant alone, the estimated capital cost of \$80-\$120 million for ammonia reduction (new permit limits) could be expected to increase to as much as \$140-\$180 million should total nitrogen reduction (possible future permit limits) also eventually be required.

5 NEXT STEPS

5.1 Plan Completion

The Control Plan for reducing overflows from Kansas City's combined and separate sanitary sewer systems is to be submitted to the regulatory agencies (Missouri Department of Natural Resources and the United States Environmental Protection Agency) in July, 2008. Much work remains to complete that much more detailed and specific Control Plan.

The following tasks must be completed prior to submittal of the Control Plan to the regulatory agencies:

- Conduct computer modeling of the proposed combined sewer system and separate sanitary sewer system control alternatives to verify anticipated control performance and water quality benefits. Modeling of the proposed controls will be performed to optimize control measures, simulate the resulting reductions in combined sewer overflow frequency and volume, and verify that sanitary sewer overflows will be controlled to the proposed level of service. Modeling of the receiving waters will be completed to verify anticipated water quality benefits associated with combined sewer overflow control measures.
- Review water quality standards and designated uses. Assess the attainable water quality in the combined sewer overflow receiving streams given the proposed combined sewer system controls while recognizing the impact of other watershed sources. If necessary, Use Attainability Analyses (UAAs) will be prepared to support appropriate revisions to water quality standards to correspond with attainable levels of water quality.
- Perform an EPA-required Financial Capability Assessment (FCA) to evaluate the ability of the community to pay for the proposed overflow controls without experiencing economic hardship.
- Complete a cost-of-service analysis for Kansas City's wastewater system that allocates costs to major classes of users.
- Develop an Implementation Plan and Schedule. The implementation plan and schedule will provide recommendations for a phased execution of design and construction of facilities that provides early environmental and community benefits consistent with operational constraints and financial capability.
- Develop recommendations on how to fund the Control Plan. This analysis will be conducted in parallel with preparation of the implementation plan and schedule. The funding plan will estimate implementation and operation costs over the long term and develop recommendations for financing options that should be considered in funding the final Control Plan. The funding plan will be coordinated with the FCA, cost of service, and utility rate design studies. Development of the funding plan will require close consultation and coordination with the Mayor and City Council, the City Manager, and community stakeholders.

- Continue discussions with satellite communities (i.e., other political jurisdictions tributary to the separate sanitary sewer system) to (1) establish performance goals for reduction of inflow and infiltration in their system; (2) define future service population and flows; (3) and assess the financial impact of their flows on the cost of the proposed controls. The results of this task, when coupled with completion of the cost-of-service analysis, are expected to form the foundation for subsequent modification of the terms and conditions of their service contracts.
- Develop a plan for operating and maintaining the control measures recommended in the Control Plan. Because numerous projects and facilities are anticipated, the plan will contain an overall operating strategy to optimize the operation of the various components. It will also include interim operating strategies to address the phased implementation of the Control Plan.
- Develop a post-construction monitoring plan to measure the effectiveness of the Long-Term Control Plan in meeting program goals and water quality objectives. The monitoring plan will be tailored to the selected combined sewer overflow controls and the overall implementation plan. The post-construction monitoring plan will define (1) flow metering locations; (2) water quality monitoring locations, frequencies, and parameters; (3) use of models for assessing changes in the system; and (4) protocols to be followed. In addition to assessing individual project and overall program implementation progress/success, an objective of the monitoring plan will be to assess, both at a project-specific level and at the basin scale, the benefits that Green Solutions can provide in reducing the size and cost of structural controls.
- Prepare a Management, Operation and Maintenance (MOM) program and associated control measures.

5.2 Public Education & Participation

The public education and participation process that has been conducted throughout development of the Control Plan will be continued. Stakeholders will continue to provide input into the following final Control Plan specifics:

- Level of control and impact on water quality;
- Operations and maintenance improvements;
- Planned projects and priorities;
- Schedule;
- Costs; and
- Funding.

The specific manner in which public input on funding alternatives is obtained will be developed in consultation with the Mayor and City Council and the City Manager.

5.3 City Council Oversight

The City Council will be kept informed of progress in completion of the final Control Plan through regular updates before the Council's Transportation and Infrastructure Committee. The purpose of those

updates will be to obtain Council input on key decisions as they are being made and to keep the Council current on the status of the Control Plan development.

A draft of the proposed Long-Term Control Plan will be submitted to the Transportation and Infrastructure Committee in April, 2008 followed by a 30-day formal public comment period. That draft will then be revised as necessary to respond to the Council's input and the results of the public comment period. The City Council and/or administration will then need to take final action on the Control Plan so that it can be submitted to the regulatory agencies in July, 2008.