Overflow Control Plan

Kansas City Plan Summary ~ November 2008

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CITY OF FOUNTAINS

HEART OF THE NATION

®

KANSAS CITY

MISSOURI

To the Rate Payers + Citizens of Kansas City,

Since 2002, the City of Kansas City has been in negotiations with the Environmental Protection Agency and the Missouri Department of Natural Resources to address overflows from the City's sanitary sewer systems. In January of 2009, the City will submit its proposed Overflow Control Plan. Over the next year, we will actively be working with the agencies to review the proposed plan and finalize the City's commitment to protecting our regions streams and rivers.

We recognize that this plan will be a financial hardship for many of you. While the City has little choice in complying with the regulations, we have utilized opportunities within the regulatory language to try and first address the long term maintenance needs of the system. This investment will extend the life of our sanitary sewers for many years to come. We also have begun actively pursuing green infrastructure strategies that will maximize the economic, social, and environmental benefits associated with this investment.

It will be up to all of us to adapt and adjust this plan so that we are not only providing clean water to our children and grandchildren, but also a viable and sustainable community. In the future, we will be calling on you many times to support these efforts. Thank you for your patience and understanding, and most importantly your guidance as we enter into this prolonged effort.

Sincerely,

John Franklin,
Assistant City Manager
Acting Director, Kansas City's Water Services Department

The people of Kansas City have long had a love affair with water. It began with the first Americans who settled here because of the abundance and quality of water and soil at the confluence of the Missouri and Kansas Rivers. This was documented by Meriwether Lewis in his journal and later by William Clark who returned to create the Fort Osage trading post.

This affinity is celebrated today with the quantity and quality of our fountains, international recognition of Kansas City as the "City of Fountains" and the receipt of national awards for the quality of our drinking water. It has become obvious, however, that our regard for and management of this critical resource has deteriorated. Nationally and locally, demand for water is growing faster than our population, and traditional urban development and conventional methods of storm and waste water management now threaten our historic relationship with water quality. The remarkable expansion of impervious surfaces in our watersheds along with unfathomable increases in pollutants has dramatically diminished the quality of our ground water and the vitality of our soil and landscape. Furthermore our current control system of collecting, conveying and discharging storm water to prevent flooding have failed at many levels. The system has not prevented flooding, and in areas of combined sewers, wastewater overflows are increasingly common. When this system works as intended "the problem" is transferred into our river systems and to our downstream neighbors.

It is time to take a closer look at our relationship with water, our management of this precious resource and its impact on the health and vitality of our community.

Water is a **Resource,** Not a Waste Product

A doctrine, by its definition, governs the direction of all thoughts and ideas generated by the people or groups that embrace it. America's view of water, since the earliest days of its independence, can be viewed as a doctrine of collect, convey, and discharge. Guiding the formation of this doctrine was a medieval belief that low, wet areas were sources of miasma, an agent of disease. As America's water supply was seen as "endless", our country's use and treatment of it focused on effective water mitigation that verged on an "out of site, out of mind" approach. Our society's practices of agricultural land modification, including drainage and many other "modern" agricultural practices, coupled with our headlong surge toward prosperity in the Industrial Age, drove our policies toward water. During these critical early growth and develop-

ment years in our nation, negative consequences were just not in the consciousness of most of our people and leaders.

In the last two centuries, there has been no overt, carefully considered policy development based upon the value of rainwater and its presence in our communities or on the consequences that our development trends might have on future generations. All of the creativity and genius that have influenced strategies and tactics have done so within the influences and constraints of these doctrines: Man does not belong in Nature; water must collected and conveyed from where it falls and discharged "away", off the property as someone else's concern and responsibility. These two doctrines, among others, have led us to where we are today—stuck in an ill-guided convention of capturing our rainwater, often funneling it into our sewer systems, and dumping the overflow into our streams and rivers. Unconsciously absent from our doctrine has been any idea that the rain that falls on us should be stewarded for the resource and blessing it offers.

It wasn't until 1962, when Rachel Carson wrote her book, "Silent Spring," that a generation of Americans was caught flat-footed with the implications of our current doctrines and the realization that only a fundamental change to the way we interact with our planet could avert irreversible harm. On January 1st, 1970 the National Environmental Policy Act was signed into law. Two years later, the Water Pollution Control Act was signed into law, proposing to have "the waters of the United States fishable and swimmable by 1983." The next year brought the Endangered Species Act.

While this flourish of policy was visionary and optimistic, it was not accompanied by any scrutiny of the doctrines that would drive our heartfelt and creative responses. Since that time our society has developed strategies in a doctrine that still collects, conveys, and discharges water, just "less badly." What have become known as "best management practices," including various forms of detention and retention, have proliferated—along with increased flooding, deterioration of water quality, depletion of aquifers, and general imbalances with respect to our water needs.

There will be no lasting solution to combined sewer overflows, or any of our other environmental maladies, until we have examined the doctrines within which our civic leaders, ecologists, engineers, architects, landscape architects, and craftsmen apply their efforts and trades. While we have been brilliant and clever in our solutions, our energies have been misguided. Short-term plans will have to include some existing methodologies, but a long-term plan must acknowledge a new water doctrine that treats water not as the enemy but as a resource and a blessing, a thing to be integrated into our infrastructure, lives, and national spirit by this and the next generation of Americans, who will benefit from our vigilance and build upon what we do today.

ADOPTING A NEW DOCTRINE

As Kansas City begins a new journey of discovery, many undertakings have laid the foundation for future enlightenment. Since 2005, Kansas City has passed, adopted or endorsed the following initiatives:

- Mayor's Climate Protection Plan
- LEED Silver for all City projects
- 10,000 Rain Gardens
- Stream Setback Ordinance
- KC Green
- Chamber's Climate Protection Partnership
- America's Green Region
- KCP&L Renewable Energy
- KC One
- MARC Sustainability Academy
- Conversations of the Environment
- Sustainable Skylines Initiative

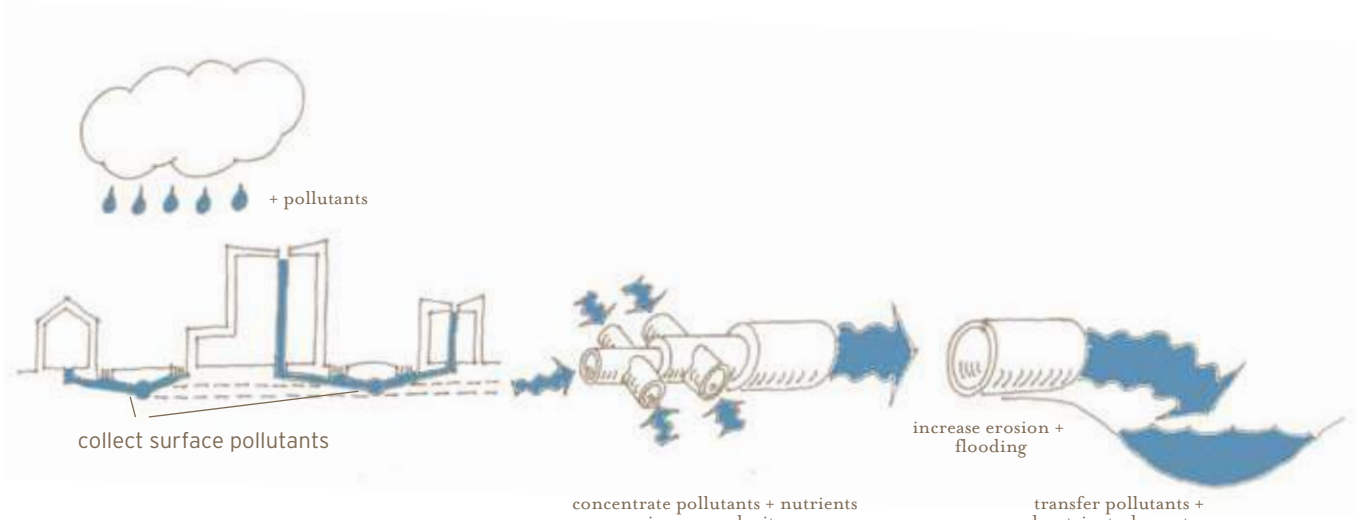
The journey has begun and this Overflow Control Plan represents a significant milestone for change, specifically with regard to water issues that will grow evermore important as the future draws nearer. We must rethink our understanding of water and, in turn, embrace the potential that this vital, life-giving resource can provide to Kansas City and the region.

The amount of water that exists on our planet is finite. To quantify the scarcity of fresh water available to us, it is estimated that only three percent of our planet's water is fresh and usable; of that three percent, only 0.7% is available fresh groundwater, lakes and rivers.

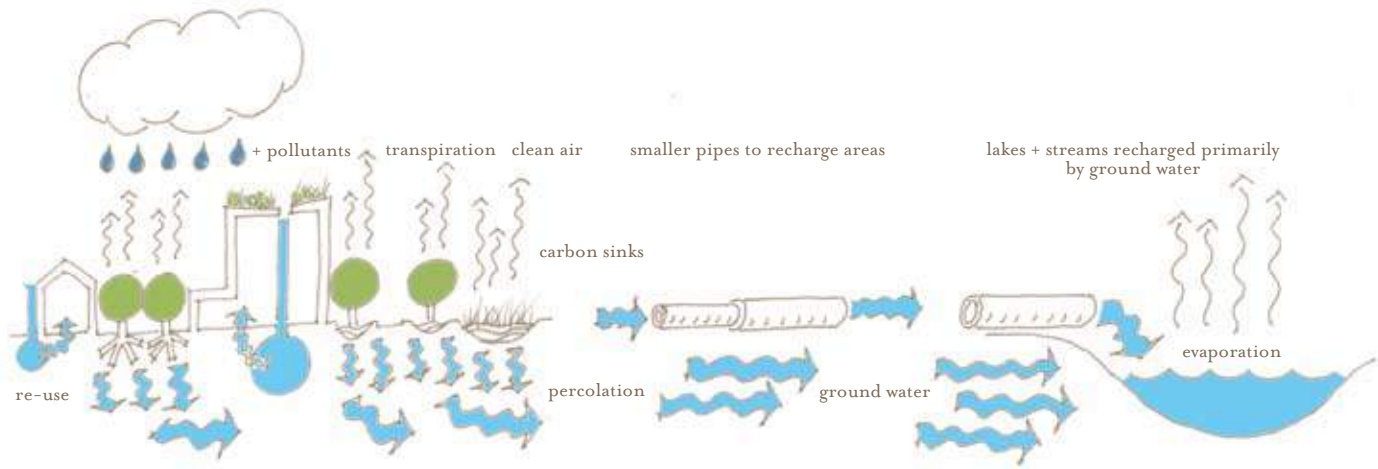
- USGS

"This immense river waters one of the fairest portions of the globe. Nor do I believe that there is in the universe a similar extent of country. As we passed on, it seemed as if those scenes of visionary enchantment would never have an end."

- Meriwether Lewis
(referring to the Missouri River in his Voyage of Discovery Journal)



Collect | Convey | Discharge



filters pollutants, captures nutrients revitalizes soil + landscape

treatment train

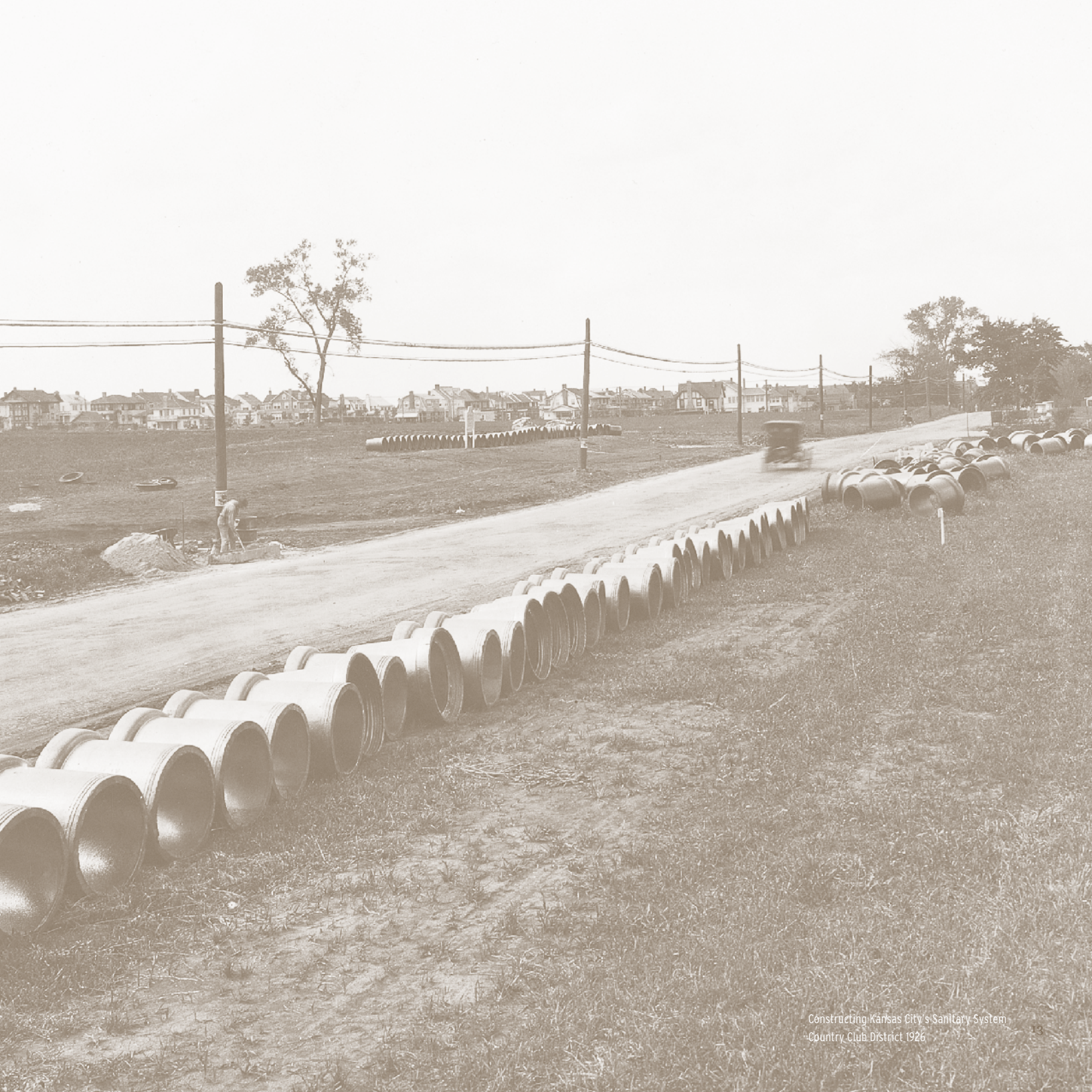
Collect | Convey | **Recharge**

Kansas City's Sanitary Sewer System

Kansas City began building the basic sewer infrastructure that would allow the City to grow and prosper over 150 years ago. Amazingly, some of that infrastructure is still in use today. While focused on controlling overflows, a significant portion of the Overflow Control Plan addresses repairing, improving, and maintaining the City's basic sanitary sewer system so that it can be used by Kansas Citians for years to come.

Kansas City's overall sanitary sewer system is comprised of both combined and separate sewer systems. A combined sewer system is simply a single sewer system that carries both sewage and stormwater. Kansas City has 58 square miles of combined sewers. Typically these systems are in the oldest areas of the City and are not capable of carrying the large amounts of strormwater that now run off of our urban landscape. During moderate to heavy rainfall events, the system will reach capacity, overflow, and discharge a mixture of sewage and stormwater directly to our streams and rivers. Although there is a desire to minimize these overflows, the discharge of combined sewer overflows is not uncommon from combined sewer systems and is allowed under a National Pollutant Discharge Elimination System (NPDES) permit issued to Kansas City's Water Services Department by the Missouri Department of Natural Resources.

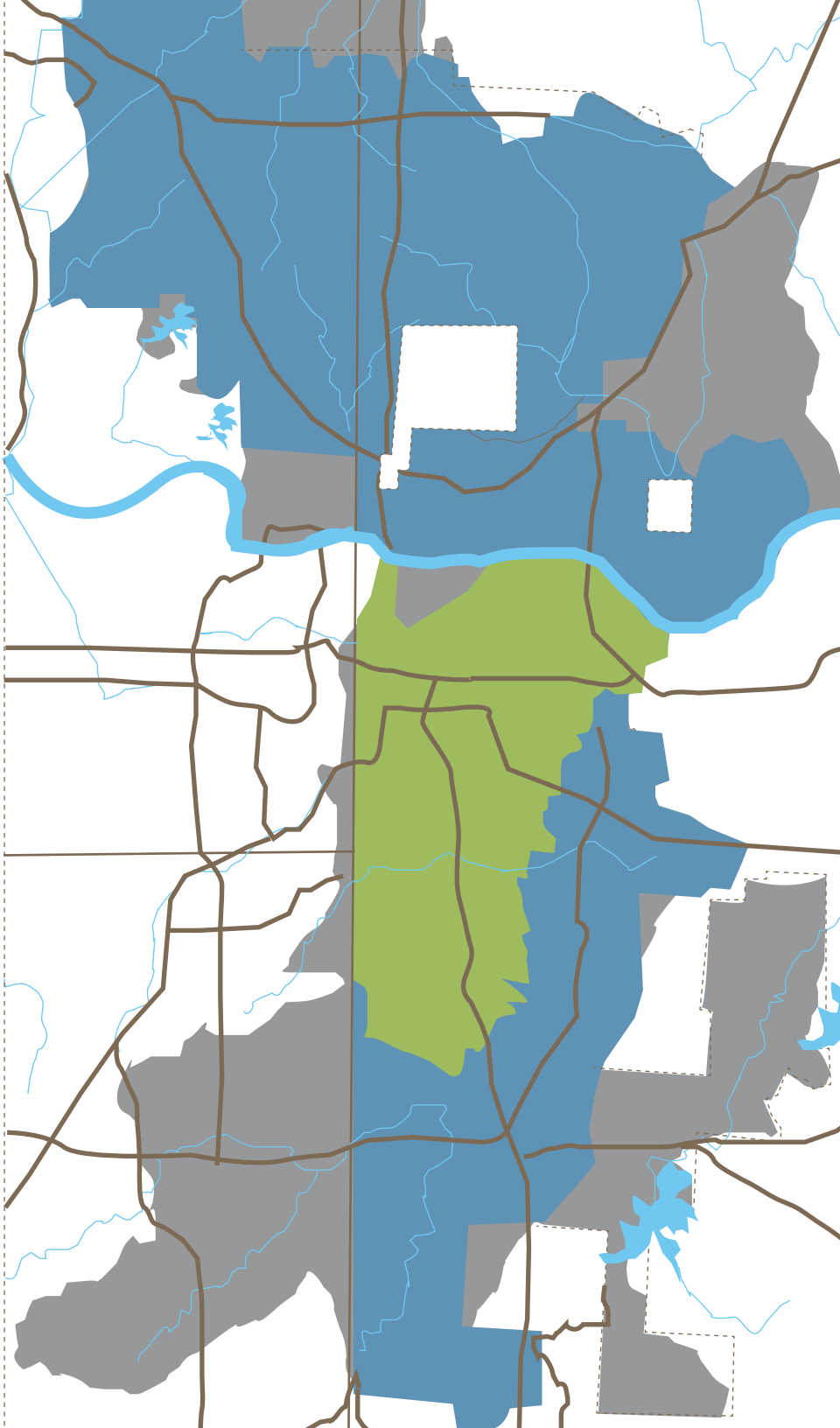
The remainder of Kansas City's sanitary sewer system is considered a separate system. A separate sanitary sewer system collects sewage only and is not typically designed to overflow. In Kansas City, however, the separate sanitary sewer system is in great need of repair. Stormwater entering through joints, broken pipes and manholes, and unpermitted direct connections causes the system to overload during rain events. When this system exceeds its capacity, it too overflows a mixture of sewage and stormwater. Unlike combined sewers, however, overflows from the separate sanitary system are not allowed under a discharge permit.



Constructing Kansas City's Sanitary System
Country Club District 1926

Over 652,000 people are served by Kansas City's sewer system. The system includes over 1,750 miles of sanitary sewer, over 950 miles of combined sanitary / storm sewer, and seven wastewater treatment plants.

Annually, the City treats almost 40 billion gallons of sewage.



Legend

Separate Sanitary Sewer System Area
Combined Sewer System Area
Communities Tributary to KCMO

Developing the Overflow Control Plan

In 2003, Mayor Kay Barnes appointed the Wet Weather Citizen's Panel to help guide the City's efforts in addressing combined sewer overflows and flooding issues. This group has met extensively over the last five years and established goals by which the Overflow Control Plan and Kansas City's stormwater initiatives have developed.

Goals and objectives of the Wet Weather Citizen's Panel are as follows:

- **Minimize loss of life and injury and reduce property damage due to flooding**
- **Improve water quality**
- **Maximize economic, social and environmental benefits**

Almost 300 different alternative solutions were evaluated during the five year development of the Overflow Control Plan. Alternatives were evaluated by cost, feasibility, ability to control overflows, and multi-benefit potential to help control stormwater. In an effort to maximize benefits received from the investment, final alternatives were also evaluated for potential to incorporate green infrastructure as part of the proposed solution.

TRIPLE BOTTOM LINE

People, Planet + Prosperity: Sustainable design establishes a balance between social, economical and environmental factors – between people, prosperity and the planet. Within the triple bottom line cycle, the benefits propagate naturally into other areas.

SYSTEMS THINKING

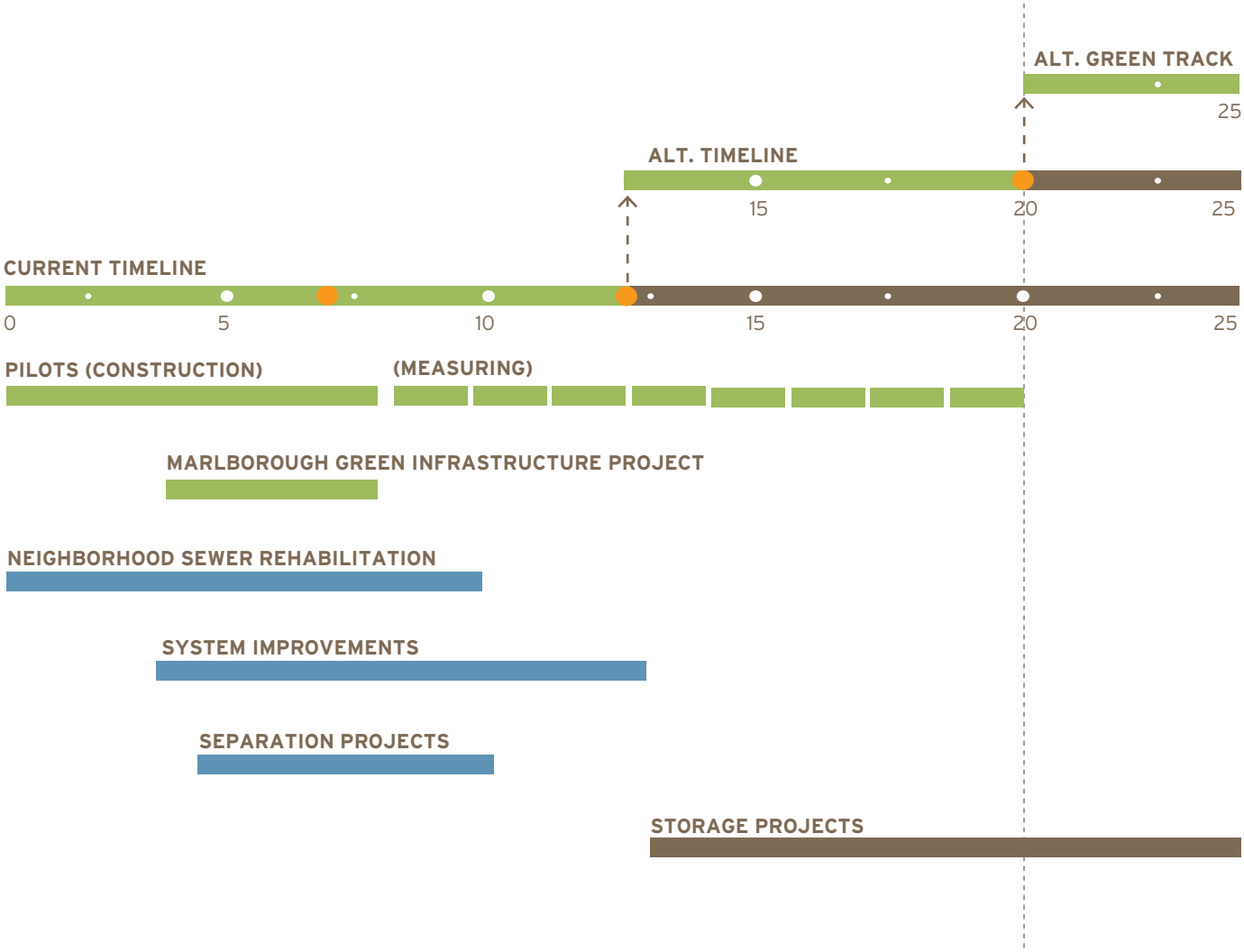
Systems thinking is a unique approach to problem-solving that examines systems in a holistic manner. Essentially, the only way to fully comprehend why a problem or issue occurs is to understand the part in relation to the whole.

INTEGRATED DESIGN

Through a process of integrated design, which is both an organized collaboration between disciplines and an interweaving and interconnectivity of built and natural systems, teams create design solutions that are both environmentally responsible and that achieve the highest level of design excellence. The practices of our civic leaders, ecologists, engineers, architects, landscape architects, and craftsmen requires an understanding of a number of complex and varied issues and the ordering of those issues, based project needs, wants and abilities. Successful design requires a process that includes all stakeholders in its dialogue and encourages feedback in a process of continuous refinement and improvement.


People
Prosperity
Planet

ADAPTABLE TIMELINE



Adaptability in Future Years

This Overflow Control Plan is premised on an adaptive management approach. Adaptive management integrates design, management, and monitoring to systematically test assumptions, learn from results, and adapt future plans throughout implementation. Its uniqueness is grounded in the flexibility it can bring to the Overflow Control Plan and the City's ability to meet regulatory requirements and achieve "triple bottom line" results. Integrating adaptive management principles into the Overflow Control Plan will require strong leadership, strategic business planning, an effective performance measurement system, and a "continual improvement" operational framework.

The adaptive management framework will be applied to the Overflow Control Plan on various levels. Adaptive management will be part of the overall programmatic approach, and will also be specifically applied at the basin and project level. Data gathered through project implementation will provide opportunities for feedback loops that subsequently inform decision-making at the basin level and ultimately at the overall program level.

A critical aspect of adaptive management is the ability to measure and evaluate project activities, which requires the identification of performance indicators, or measures of success. As this Overflow Control Plan moves forward, performance indicators that relate to overall program development and implementation will be formulated to measure program success in reducing sewer overflows and maximizing social, economic and environmental opportunities for the Kansas City community. Additionally, specific performance indicators will be devised to evaluate success at both the project and basin level.

As part of the adaptive management approach, the proposed Overflow Control Plan focuses on first repairing the existing system, reducing inflow and infiltration, and measuring the potential of green infrastructure. Completing these activities early in the program allows for monitoring, modeling and measurement, focused evaluation of program results, and the flexibility to adapt the plan before constructing more expensive structural controls.

In addition to conducting a regulatory review of the plan every five years, the Overflow Control Plan incorporates intermediate, internal program reviews occurring at the midpoint of each 5-year cycle that will focus on the direction of the plan and its benefit to the rate payers and citizens of Kansas City.

The members of the Wet Weather Citizens Panel have spent 5 years guiding development of the overflow control plan.

Public Policy Changes

The Overflow Control Plan is just one element of a comprehensive approach to position Kansas City as America's Green Region. The broader approach will systematically incorporate low impact development strategies, tools, and practices that focus on maintaining the natural hydrologic cycle to achieve program goals. A great example of this strategy is the City's recent adoption of a stream setback ordinance in August of 2008. Other initiatives which will enhance the effectiveness of this plan include:

INTEGRATION WITH OTHER CITY AND REGIONAL EFFORTS
The Overflow Control Plan will complement and be integrated with other city and regional programs related to integrated water resource management, climate protection, land use, community development, parks and trails, air quality, and transportation.

DEVELOPMENT REGULATIONS
FOR PUBLIC AND PRIVATE PROPERTY
A review of the full city development code to support broad low impact development strategies will be used to formulate proposed code revisions to be submitted to the City Council for its review and approval.

STORMWATER ENGINEERING CRITERIA, STANDARDS AND SPECIFICATIONS FOR NEW AND REDEVELOPMENT PROJECTS
Existing standards applied to public and private projects alike, will be reviewed to ensure that low impact development benefits are maximized through state-of-the-art stormwater management practices.

URBAN AND COMMUNITY FORESTRY PROGRAM
Expanded urban forestry programs will achieve multiple benefits, such as improved air and water quality, reduced energy use and urban heat islands, and restored habitat and biodiversity.

STANDARD OPERATING PROCEDURES
City operations and maintenance practices will be guided by new procedures to capitalize on the many opportunities to implement more distributed, green infrastructure solutions, and to ensure the long term effectiveness of these practices.

The EPA considers waste water costs below 2% of median household income to be an acceptable cost burden to rate payers.

Cost and Affordability

A financial capability assessment for the recommended Overflow Control Plan was prepared using procedures defined by the EPA. The EPA's approach requires evaluating costs of the proposed improvements against Kansas City's median household income. In general, the EPA considers wastewater costs below 2% of median household income to be an acceptable cost burden to ratepayers.

As required by the EPA, costs for implementing the Overflow Control Plan were estimated in current day dollars at $2.4 billion. Based on the cost and the recommended 25-year implementation schedule, the affordability assessment determined that the Overflow Control Plan would result in a cost to Kansas City residents equal to 1.7% of median household income. While under the 2% threshold, this plan is considered a heavy financial burden for Kansas City residents.

Overflow Control Plan

The Overflow Control Plan was developed to meet regulatory requirements put forth by the Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR) related to reducing overflows from the combined sewer system and preventing overflows from the separate sewer system. This plan meets those objectives over a 25-year time period by providing a planned list of improvements targeted at capturing for treatment, 88% of combined sewer overflows, and eliminating sanitary sewer overflows during a 5-year rainfall event. While it would be desirable to completely eliminate all system overflows, the financial burden that would be placed on the rate payers to achieve those goals would simply be too great.

The Overflow Control Plan addresses issues beyond sewer overflows, such as deferred maintenance, repairs, and overflow control in all parts of the sanitary sewer system. Completing these repairs not only extends the life of the system for future generations, but they also help in reducing the size of the problem which Kansas City must overcome.

While this Overflow Control Plan is recognized as one of the "greenest" ever developed, it is understood that there is a desire for it to be even greener. There is a desire to utilize above ground, green infrastructure in a manner which provides substantial ancillary benefits to Kansas Citians beyond sewer overflow control, such as cleaner air, cooler ambient air temperatures, recreational and aesthetic amenities, and economic opportunities. This plan lays the ground work for Kansas City to realize those benefits with a substantial, initial investment in green infrastructure and an adaptive management approach that will allow additional green infrastructure to be utilized as its benefits to the system and the City are measured and confirmed.

PUBLIC EDUCATION AND OUTREACH

Active citizen participation will be critical to the overall success of the Overflow Control Plan. To facilitate this participation, the City will partner with neighborhood associations to develop a public education and outreach program that helps inform citizens of the problem and their role in the solution. Creating successful individual projects is also highly reliant on positive citizen participation. Throughout the life of the plan, public education and outreach will also focus on informing citizens about proposed project designs, schedules and progress towards completion. Funding for public education and outreach has been estimated at 0.5% of the plan costs, equating to $12 million, to be spent over the life of the program.

RAIN GARDENS AND DOWNSPOUT DISCONNECTS

Since 2005, Kansas City's award-winning 10,000 Rain Gardens Campaign has focused on educating homeowners on the positive effects of rain gardens. In the Overflow Control Plan, the campaign's focus will be expanded to include an aggressive rain garden establishment program along with a new downspout disconnection program. Funding for the program is estimated at $5 million. The initiative, which will incentivize citizens to disconnect their downspouts, will also include assistance and information related to helping homeowners and businesses manage and hold water on their own property.

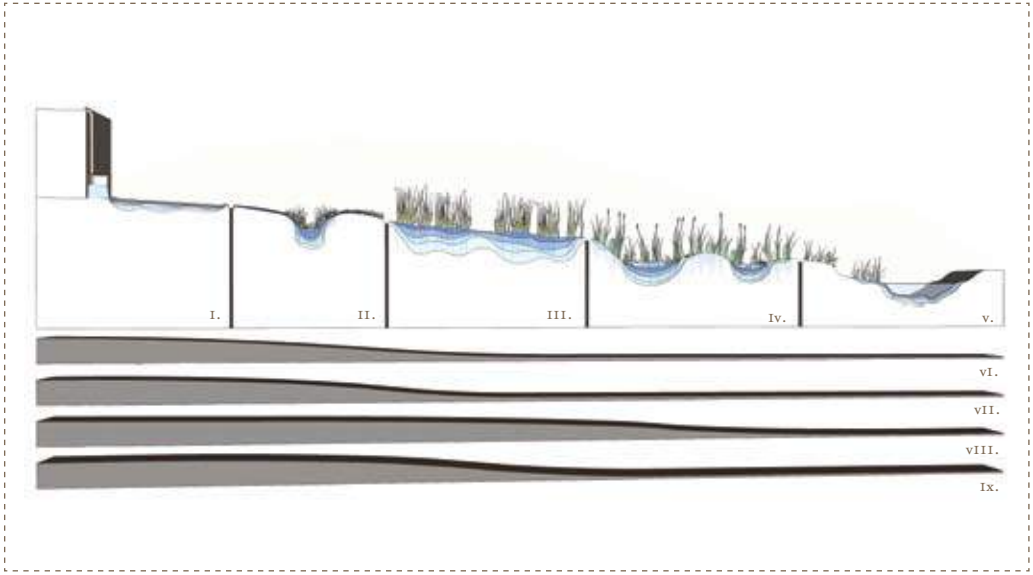
GREEN COLLAR JOBS AND WORKFORCE DEVELOPMENT

Preparing our community for the work required in the Overflow Control Plan is critical. Every dollar of this $2.4 billion investment that can be kept within Kansas City is a dollar of economic development opportunity for our local businesses and residents. To keep those dollars home, local minority and woman owned business enterprises, design firm, contractors, and the City itself will have to ramp up their capabilities and skill sets. The plan includes $5 million to be utilized in job creation and work force development initiatives related to program specific objectives. The City will work with job training and work force development organizations to develop a green collar jobs program related to green infrastructure and sustainable projects proposed in the program. New jobs will help address many concerns, among them unemployment, community support and long term maintenance obligations for green infrastructure.

MONITORING AND MODELING

One of the first activities in the Overflow Control Plan will be to install additional flow meters and level sensors in both the combined and separate sanitary sewer systems. The results of monitoring will help in the development of enhanced system models, evaluating improved performance in the system and measuring water quality.

Current system models analyze performance characteristics in pipes 24 inches in diameter and larger. In order to evaluate the potential impact of green infrastructure solutions, these models will need to be extended further up the drainage basins. Technical models will be complemented by a triple bottom line evaluation framework including well specified social, economic, and environmental metrics. Once system models and related evaluation frameworks are developed, adjustments to the design, construction, and operation of remaining components will be analyzed throughout implementation of the Overflow Control Plan. Funding for the enhanced monitoring and modeling activities has been estimated at 1% of the plan costs, equating to $24 million over the life of the program.



Legend

I. Urban II. Urban bmp III. Prairie IV. Wetland V. Stream VI. Total suspended solids VII.Phosphorus VIII. Nitrogen IX. Metals

Green infrastructure is not a singular solution, nor does it provide a singular benefit. It takes the cumulative effect of a system to realize the true benefit of green infrastructure. It is this treatment train that proves water quality and water quality benefits.

"We can not solve our problems with the same thinking we used when we created them."

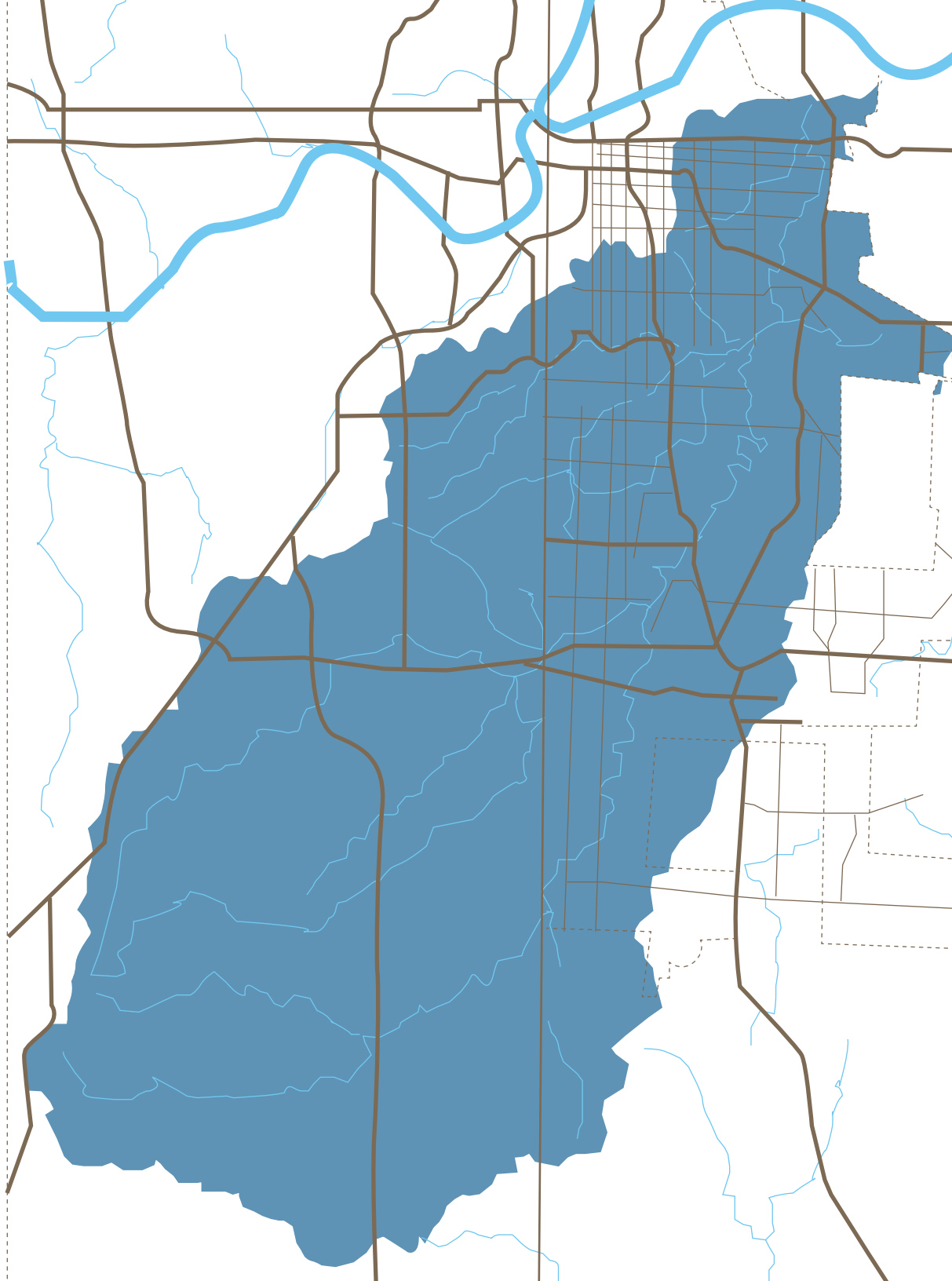
- Albert Einstein

Blue River Watershed Plan

One important premise of this Overflow Control Plan, and indeed the City's more comprehensive approach to managing water resources, is to approach planning and management from a holistic watershed perspective. The benefits of watershed-based planning and management are many. Approaching water resource management from a watershed perspective allows the resource itself to become the focal point of study, leading to a more complete understanding of the various impacts on the water body. A watershed approach is also more cost-effective, since it involves critical stakeholders in the process and allows for coordination and communication in addressing pollution sources and issues. As well, a watershed approach is the best method of maximizing social, economic, and environmental benefits, since the approach itself is grounded in a broader focus on all activities within a watershed that might have an impact on human health and the environment.

System Fact ~
63% of the Blue River Watershed is upstream of Kansas City.

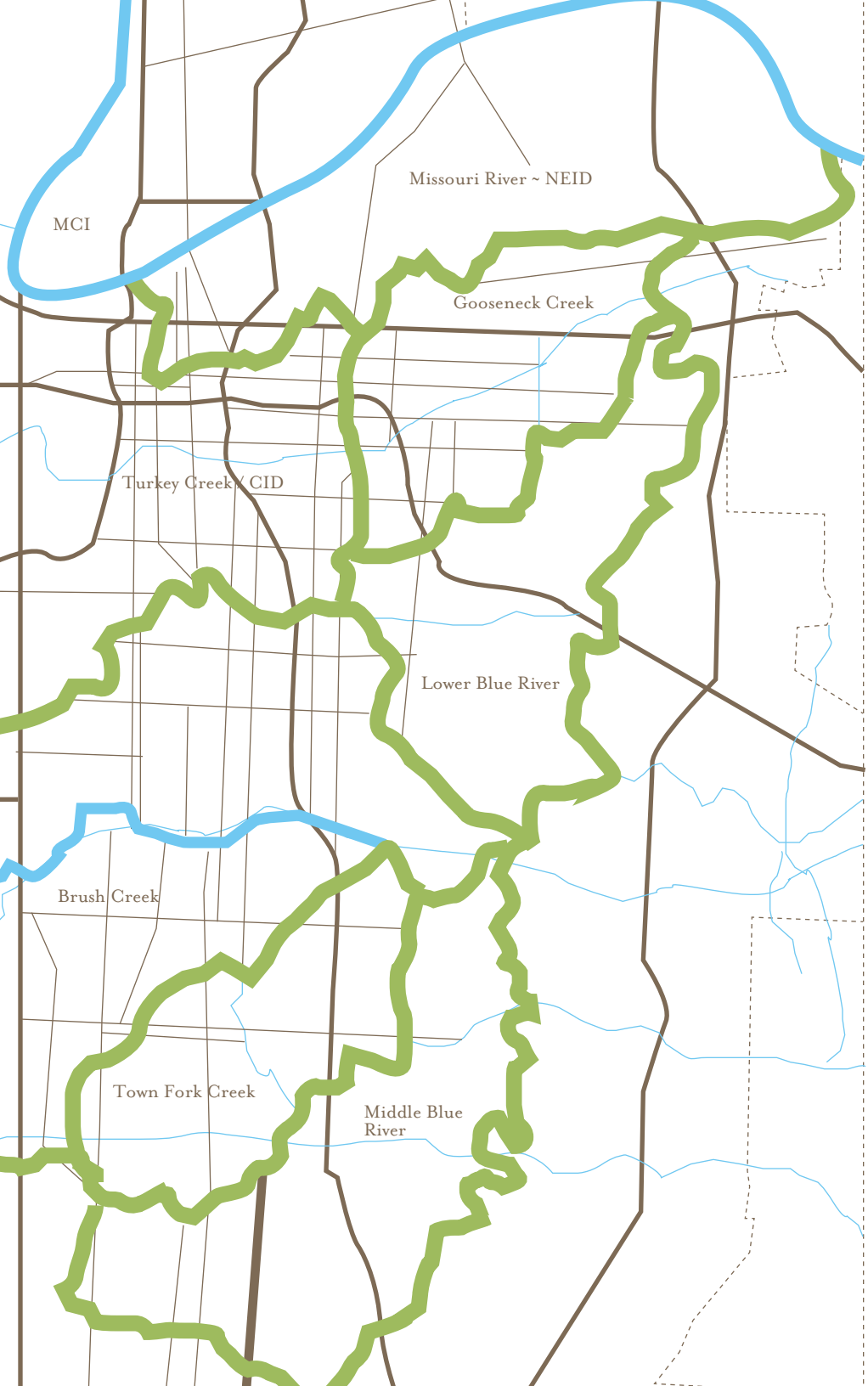
A large portion of the flow and bacterial loading in the Blue River comes from upstream of Kansas City. For this reason, simply reducing overflows from Kansas City's sewer system may not be enough to meet MDNR's water quality standards in the stretch of the Blue River between 59th and 95th Streets. The water quality standard in this stretch of the Blue River is more stringent than the standards applicable to adjacent upstream and downstream reaches of the Blue River. For these reasons, the Overflow Control Plan includes $2.0 million as Kansas City's contribution to the preparation of a Blue River Watershed Management Plan. A watershed management plan for the Blue River, developed together with Johnson County and other significant watershed stakeholders, is critical to determining the best methods to address the pollution issues that plague this crucial waterway, and to determining appropriate water quality standards for all reaches of the Blue River



Blue River Watershed

"Whatever befalls the earth befalls the sons and daughters of the earth."

- Chief Seattle



Combined Sewer System Basins

COMBINED SEWER SYSTEM

About 58 square miles within Kansas City are served by combined sewers. This area is generally bound 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. The area served by the combined sewer system is subdivided into seven principal basins, Gooseneck Creek, Lower Blue River, Town Fork Creek, Brush Creek, Middle Blue River, Northeast Industrial District, and Turkey Creek/Central Industrial District. North of the river, the Charles B. Wheeler Municipal Airport is also served by combined sewers.

The estimated overflow volume from Kansas City's combined sewer system in a typical year is 6.3 billion gallons. Overflow frequency varies significantly within the individual basins, with the estimated average overflow frequency estimated at more than 20 times in a typical year.

In the combined sewer system, repairs to the existing system are scheduled to occur early in the implementation of the Overflow Control Plan. The early years of the plan will also include aggressive pilot projects focused on developing green infrastructure solutions, which will modify proposed structural solutions scheduled for construction in the later years of the plan. The middle years of the plan will focus on maximizing the capacity within the existing system and analyzing the results of source volume reductions and pilot projects, together with improvements to the City's wastewater treatment plants. The final years of the plan will address necessary improvements to the City's wastewater treatment plants and adjustment and construction of proposed structural storage solutions.

NEIGHBORHOOD SEWER REHABILITATION

The first objective of the Overflow Control Plan is to maximize the effectiveness of the existing system. The Overflow Control Plan includes $124 million in capital maintenance and repairs to neighborhood sewers in the combined sewer system. These repairs will help reduce the amount of stormwater entering the system, will address significant deferred maintenance items, and will improve system performance and life span. To minimize disruption to the neighborhood and improve efficiencies, the City will coordinate sewer rehabilitation efforts with other planned infrastructure projects.

GREEN INFRASTRUCTURE PILOTS AND PARTNERSHIPS

The Overflow Control Plan includes $28 million of funding dedicated to developing green infrastructure pilot projects and partnerships in the combined sewer basins. While proven individually or as part of small systems, green infrastructure has yet to be utilized in a widespread effort to address combined sewer overflows. By developing large scale pilots, the City will be gathering the information required to effectively implement green infrastructure on a much broader scale while simultaneously constructing a portion of the basin specific solution. Green infrastructure partnerships will focus on creating private sector participation in the pilots and proposed basin solutions.

The first pilot project will be implemented in the Middle Blue River Basin as part of the Marlborough Green Infrastructure Project. In this pilot, green infrastructure is planned to provide distributed storage of stormwater throughout a 100-acre area of the neighborhood. The area is primarily residential, but does include commercial businesses. In addition to gaining valuable information about the effectiveness of green infrastructure in controlling combined sewer overflows.

This initial pilot will also evaluate alternatives to achieve additional plan objectives, including:

- Effectiveness of green infrastructure as a systematic solution;
- Codes and ordinances in conflict with green infrastructure utilization;
- Socio-economic benefits/change;
- Construction techniques and costs on a wide-scale programmatic level;
- Potential changes in City services in green infrastructure areas;
- Maintenance approaches and costs;
- Public/Private partnership opportunities; and
- Community interaction and support of green infrastructure practices.

Other pilot projects will be developed in the early years of the plan based on the specific basin solutions proposed. In order to develop green infrastructure strategies that will be applicable across Kansas City, it is important that the development of those pilots consider different land uses such as industrial areas and urban areas.

The 100-acre Marlborough Pilot Project area represents the largest focused installation of green infrastructure for combined sewer overflow control in the United States currently.

MARLBOROUGH GREEN INFRASTRUCTURE PROJECT

As mentioned in the previous section, the Marlborough Pilot Project will help define the utilization of green infrastructure across many areas of the City. However, this 100-acre pilot project is only a portion of the area in Marlborough where the use of green infrastructure looks very promising.

During the six-month time extension provided by the EPA, three basin areas were evaluated to determine the opportunity for green infrastructure utilization. Based on this analysis, it was determined that an area in the Middle Blue River Basin, was a prime candidate to implement a green infrastructure approach. This area, located in and around the Marlborough neighborhood, is comprised of approximately 744 acres draining to combined sewer overflow outfalls 059 and 069.

The original plan called for two underground storage tanks and associated pumping equipment to store and transfer approximately 3.5 million gallons of anticipated overflow from these outfalls. In the revised plan, these tanks have been replaced with an equivalent amount of storage in the basin itself through the use of green infrastructure.

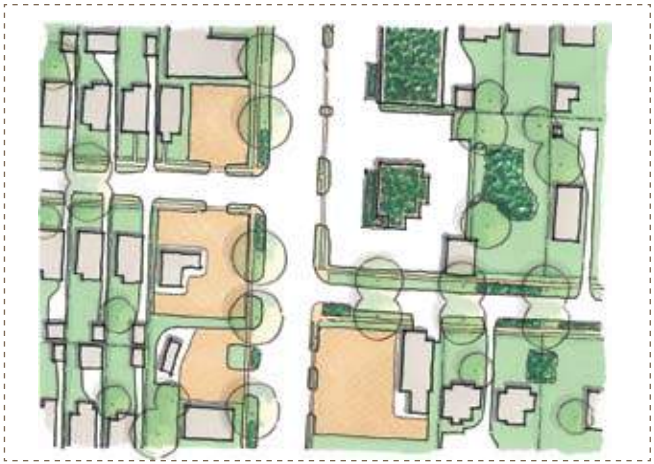
While final designs will be modified based on results of the pilot project in the basin, initial estimates indicate that green infrastructure in the 744-acre area could include as much as 330 curb inlet modifications, and 25 acres of rain gardens, bioswales, permeable pavement, and green roofs.

A capital budget of $40 million has been included in the plan for the remainder of green infrastructure construction in this 744-acre area. The proposed sole reliance on utilizing distributed green infrastructure to achieve combined sewer overflow control performance goals in an area of this size is unprecedented in both scale and scope at the national level.

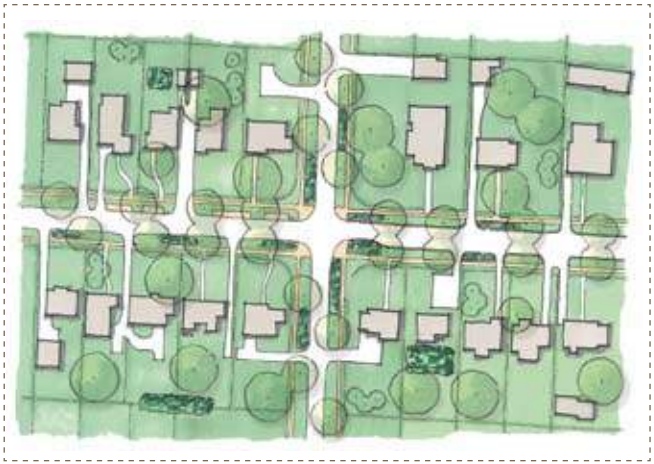
SYSTEM IMPROVEMENTS

Many of the improvements proposed in the Overflow Control Plan relate to improving the performance of the sanitary sewer system itself. The investment in these facilities will help the City in their daily duties of collecting and treating sewage, as well as help reduce overflows and system backups by pushing more flow through the system. Additionally, some areas of the system have extra capacity and can be modified to store flows within the system itself. This approach of maximizing the use of the City's existing investment is fundamental in the proposed Overflow Control Plan.

Marlborough



76th & Troost



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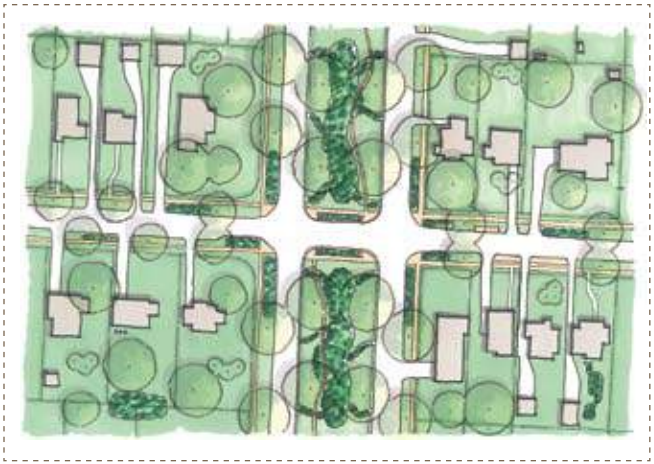
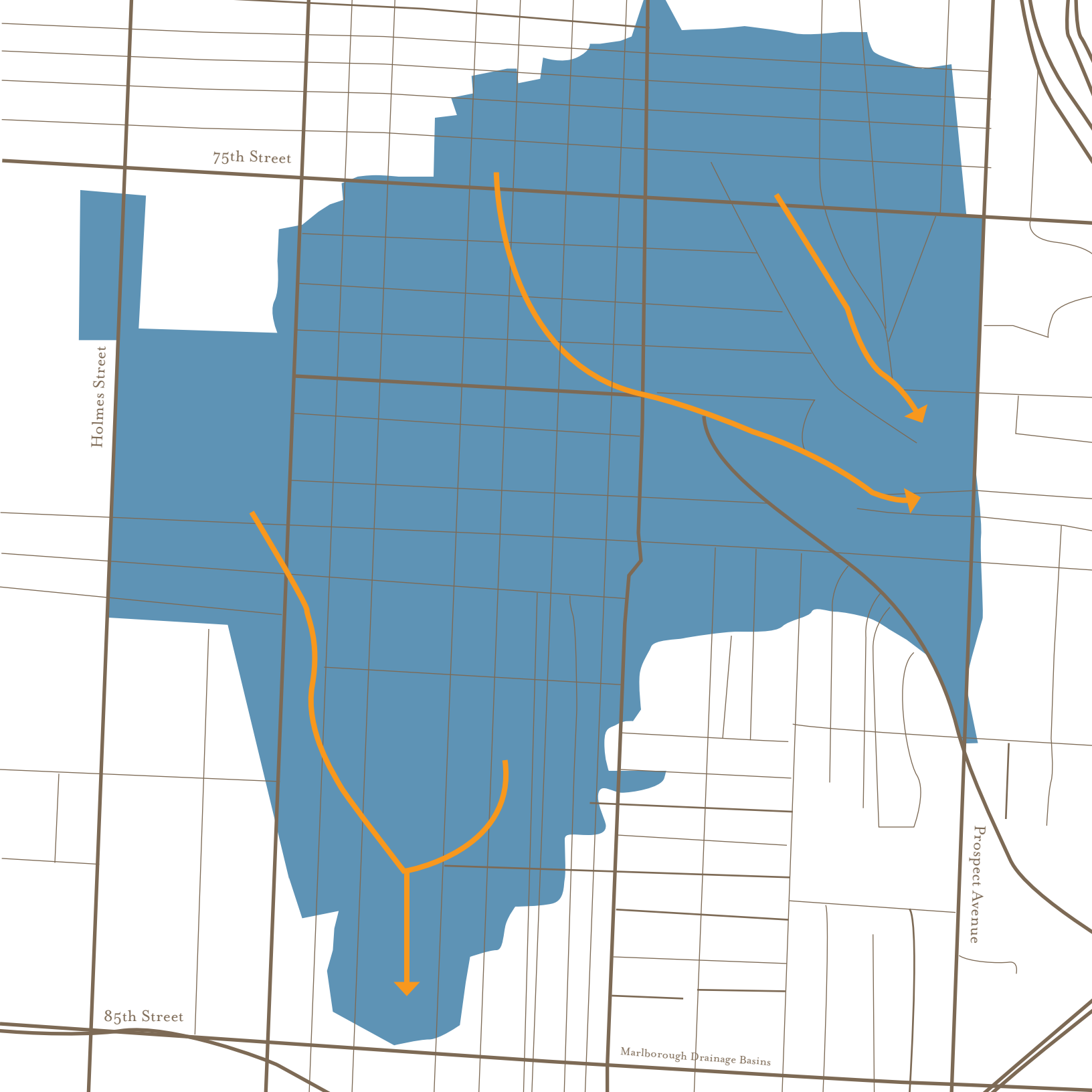


76th & The Paseo


75th Street
Holmes Street
Prospect Avenue
85th Street
Marlborough Drainage Basins

SEPARATION PROJECTS

In many areas of the combined sewer system, it is less costly to modify the existing system so that it functions as a separate sanitary and storm sewer system. These areas typically have a separate sanitary sewer system already functioning in the general area, which at some point connects to the combined sewer system. Separating the systems involves eliminating those interconnection points and providing new sewer lines that convey sewage only.

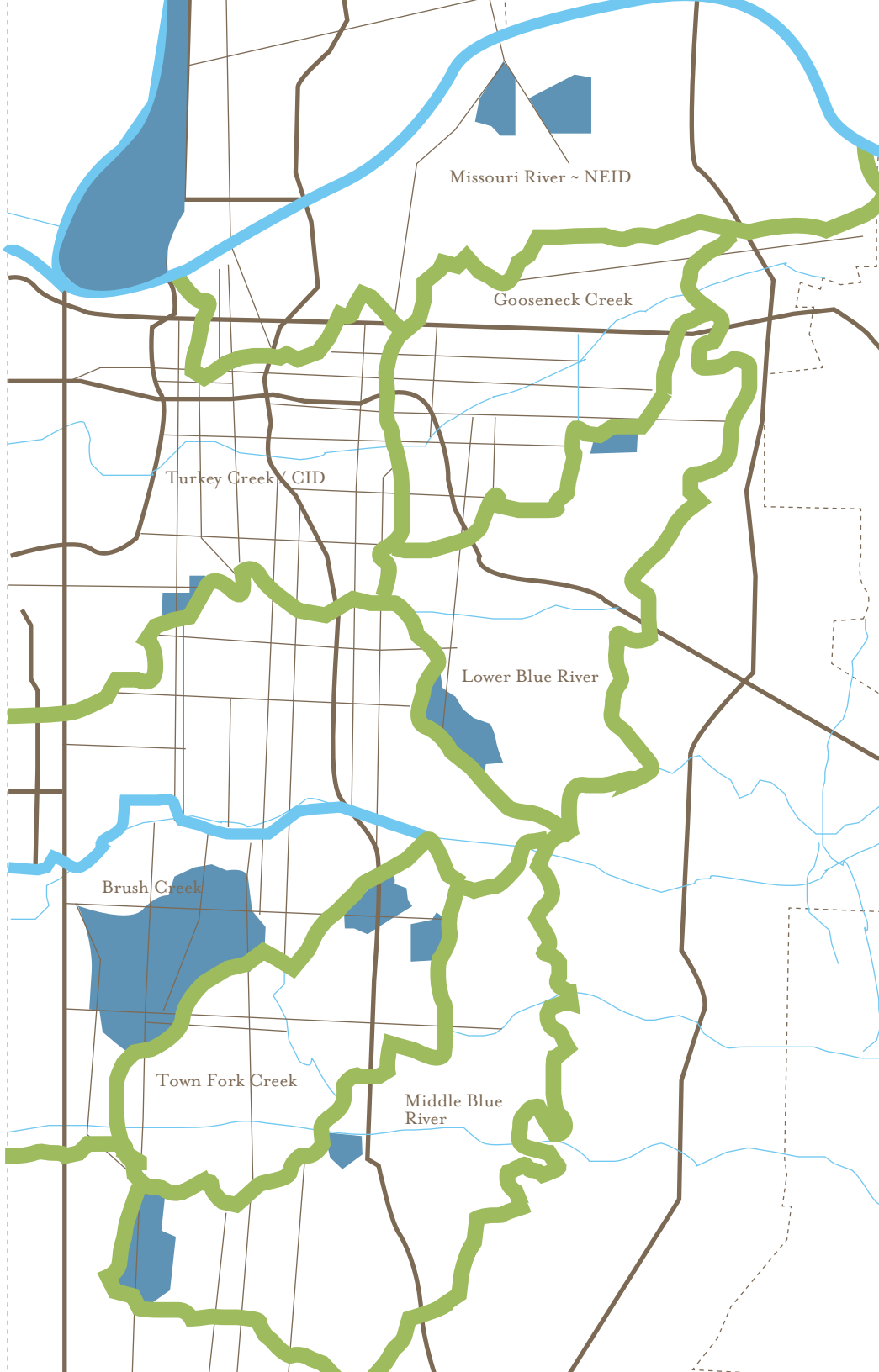
> "The proposed sole reliance on utilizing distributed green infrastructure to achieve combined sewer overflow control performance goals in an area of this size is unprecedented in both scale and scope at the national level."

While these separation projects may be small in scope, their proximity to neighborhoods makes them disruptive to the everyday life of citizens. The City will focus on minimizing disruption through the use of innovate design, construction and management techniques aimed at shortening construction times, limiting disruption, and coordinating with other planned improvements in the neighborhoods.

STORAGE PROJECTS

Despite all of the significant system repairs and improvements and green infrastructure projects proposed in this Overflow Control Plan, the potential still exists that these improvements may not be sufficient to reduce sewer overflows to levels required by EPA and MDNR. In that case, structural storage components will have to be relied upon to meet regulatory requirements. For that reason, this Overflow Control Plan includes contingency plans for the construction of structural storage facilities.

It is important to understand that the adaptive management approach used throughout this plan gives the City the opportunity to gauge the

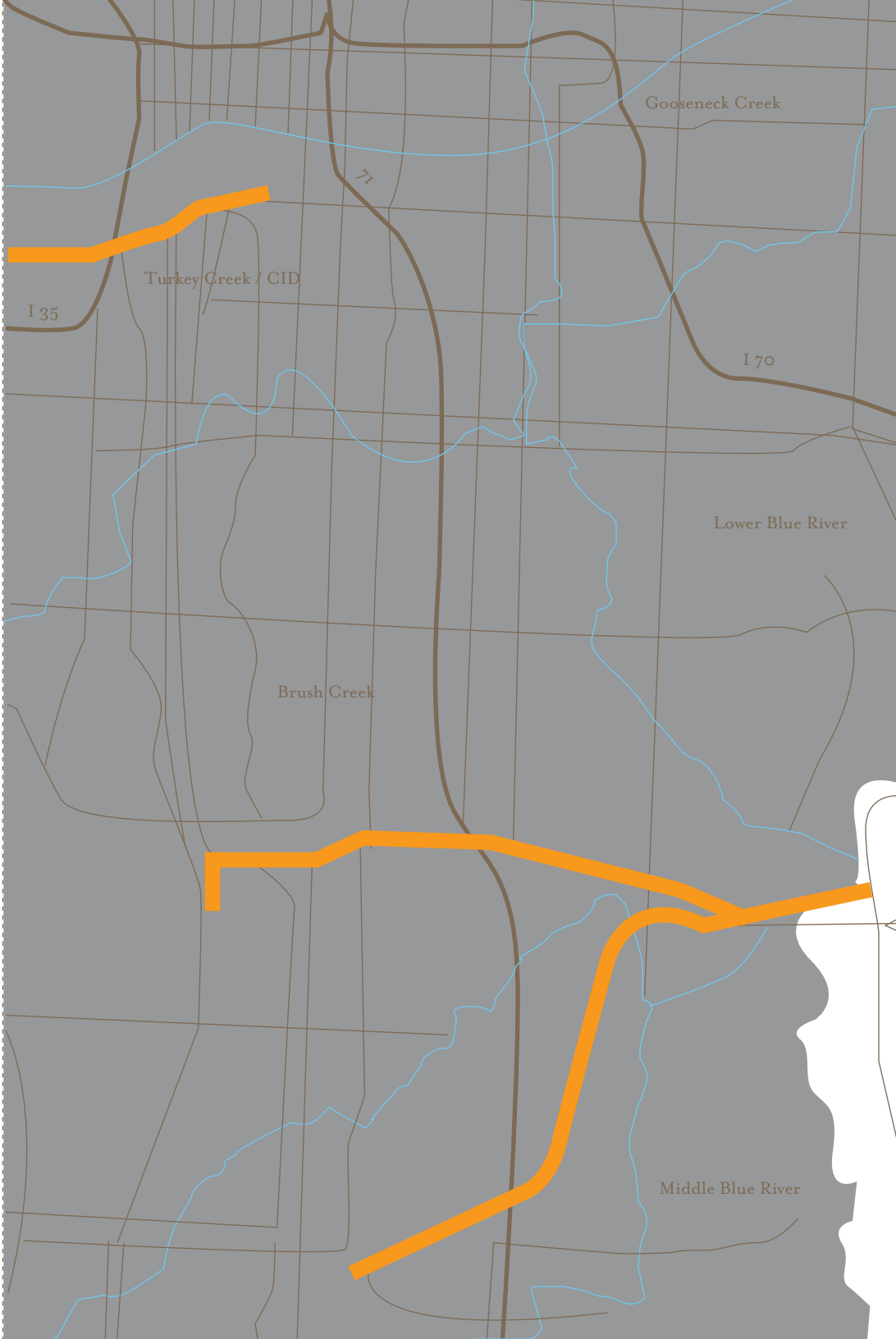


Separation Projects

effectiveness of the system repairs and improvements and green infrastructure projects as the program progresses. If those activities result in meeting the sewer overflow requirements in effect in the later years of this plan, then the need for structural storage facilities will be greatly diminished, if not eliminated. The intent of this Overflow Control Plan is to focus on all reasonable methods of reducing or eliminating the need for structural storage facilities, yet retain the option to construct some or all of those storage facilities if no other reasonable alternatives are available to meet regulatory requirements in effect in the later years of this plan.

The structural storage projects currently proposed as the contingency approach in the Overflow Control Program are comprised of deep tunnels used to store and convey sewer overflows during rain events until such time as the sewer system has capacity to accept those flows. Deep tunnel storage has been proven to be a cost effective method of storage on a per gallon basis. It is also less disruptive than many solutions because of its below ground proximity. The disadvantage of utilizing a tunnel system is that for the most part, the tunnels serve only one purpose, storing combined sewer overflows.

Throughout the Overflow Control Plan, the City will actively evaluate emerging technologies and other storage alternatives. Final evaluations will take into account social, economic, and environmental aspects of the proposed solutions as they pertain to meeting regulations and improving the economic vitality and quality of life in Kansas City.



Combined Sewer System Tunnels

Many cities in the United States have utilized deep tunnel storage solutions, including: Portland, Atlanta, Chicago, Detroit, Seattle and Milwaukee. In Kansas City's combined sewer area, three tunnels have been proposed. These tunnels are capable of storing 78 million gallons of combined sewer overflows. The tunnels are 16 to 26 feet in diameter, stretch 1.4 to 3.4 miles in length, and would be constructed in solid rock, deep below the surface.

City of Portland Orgeon underground tunnel

SEPARATE SANITARY SEWER SYSTEM

Kansas City's separate sanitary sewer system is comprised of nine principal basins, covering 250 square miles of the City. The four separate sanitary sewer system basins north of the Missouri River are the Northern and Northwestern watersheds and the Line Creek/Rock Creek and Birmingham/Shoal Creek basins. The five separate sanitary sewer system basins south of the Missouri River are the Blue River North, Round Grove, Blue River Central, Blue River South, and Little Blue basins.

Under existing conditions, the collection systems and wastewater treatment plants have adequate capacity to convey and treat dry weather flows. During heavy rainfall, however, the amount of water infiltrating into the sewers exceeds the system's capacity.

In addition to the uncontrolled overflows from the separate sanitary sewer system, a constructed sanitary sewer overflow is present at the lower end of the Line Creek system. Since sanitary sewer overflow structures are not permitted, the plan addresses flows from this structure as an early priority.

Recommended strategies in the separate sanitary sewer system include reducing inflow and infiltration of stormwater by repairing the existing system where cost-effective. A combination of wet weather storage and treatment will also be provided to address inflow and infiltration determined to be too expensive to keep out of the system. Since work in the separate sanitary sewer system relates only to repair of the sanitary sewer system, green infrastructure is not included in the proposed plan.

In the separate sanitary sewer basins, a design storm having a duration of 24 hours and a depth that would be equaled or exceeded, on average, once every five years was utilized to develop the Overflow Control Plan. In Kansas City, that design storm would result in a rainfall depth of 4.68 inches.

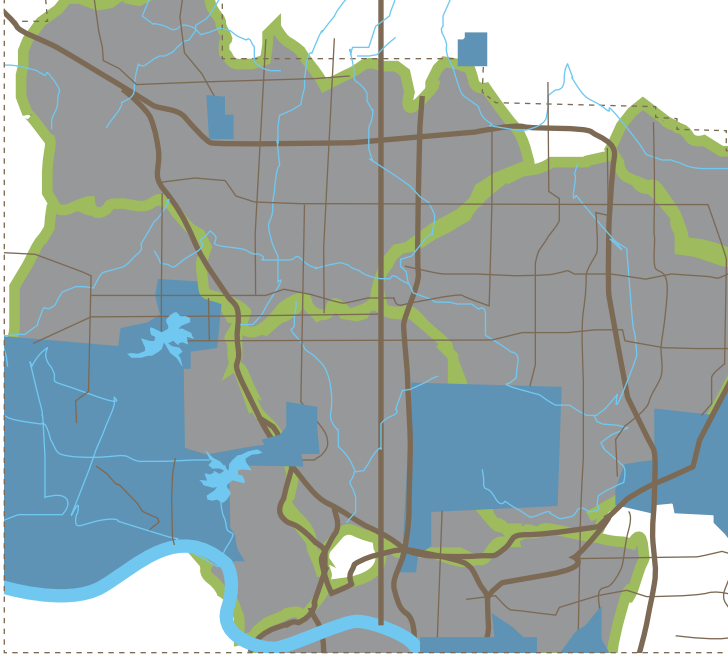
INFLOW/INFILTRATION REPAIR WORK

Many parts of the separate sanitary sewer system are in need of general repair and deferred maintenance. In addition to extending the life of the system, these repairs will help reduce the amount of rainwater inflow into the system. Inflow, however, is not the only problem. The age of the system and the construction techniques utilized at the time of construction create many challenges in keeping rainwater from entering the system below ground. To combat these issues, the Overflow Control Program proposes an aggressive infiltration reduction initiative focusing on lining existing pipes within the system to combat infiltration through pipe joints and connection points. While effective, the system itself is so large geographically that inflow and infiltration reduction efforts are only expected to partially reduce the amount of stormwater entering the system.

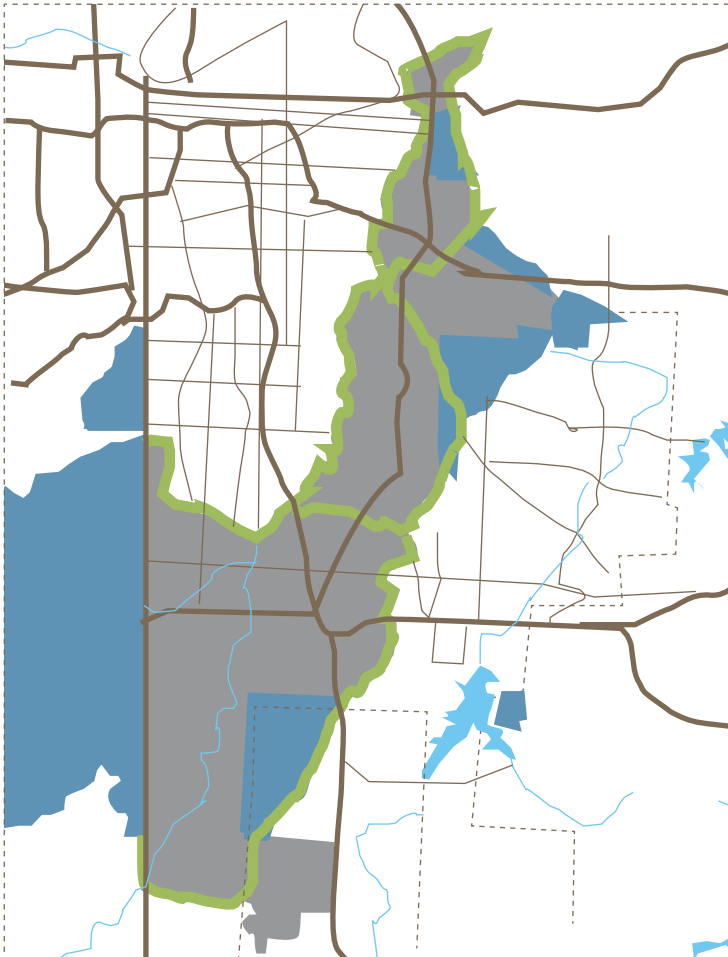
SYSTEM IMPROVEMENTS

Addressing overflows from the constructed sanitary sewer overflow located within the Line Creek/Rock Creek basin, just upstream from the Line Creek Pumping Station, is a priority to the City. The plan provides $43 million for construction of a 30 million gallon per day high rate treatment facility to be constructed near the Line Creek Pumping Station early in the program. This facility will allow the City to begin treating sewage overflows early in the program and will stay in service until final solutions are implemented.

Ultimately, it is anticipated that wet weather flows from the Line Creek/Rock Creek and Northwestern basins will be transported through a conveyance and storage tunnel to the Birmingham Wastewater Treatment Plant. The Plan also provides $45 million in funding for a high rate treatment facility to be added to the Birmingham plant to address peak wet weather inflows.



Northern Separate Sanitary Sewer
Service Area



Southern Separate Sanitary Sewer
Service Area

STORAGE PROJECTS

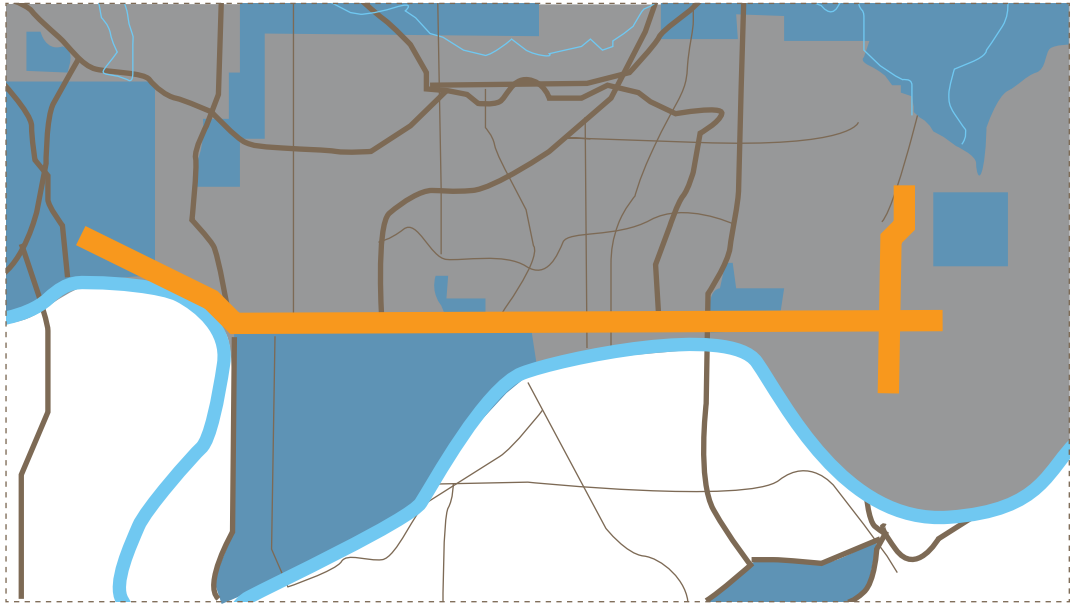
Two major structural storage projects are currently proposed in the separate sanitary sewer areas. Similar to the storage projects in the combined sewer area, through an adaptive management approach, the City will retain the flexibility to reduce the size or eliminate these storage projects depending on actual flow reductions achieved in early phase projects.

The North Bank Tunnel is proposed as the primary solution to store sanitary sewer overflows from the entire northland. In addition to providing 42 million gallons of storage, this tunnel also provides conveyance capacity in an undersized portion of the system.

System Fact ~

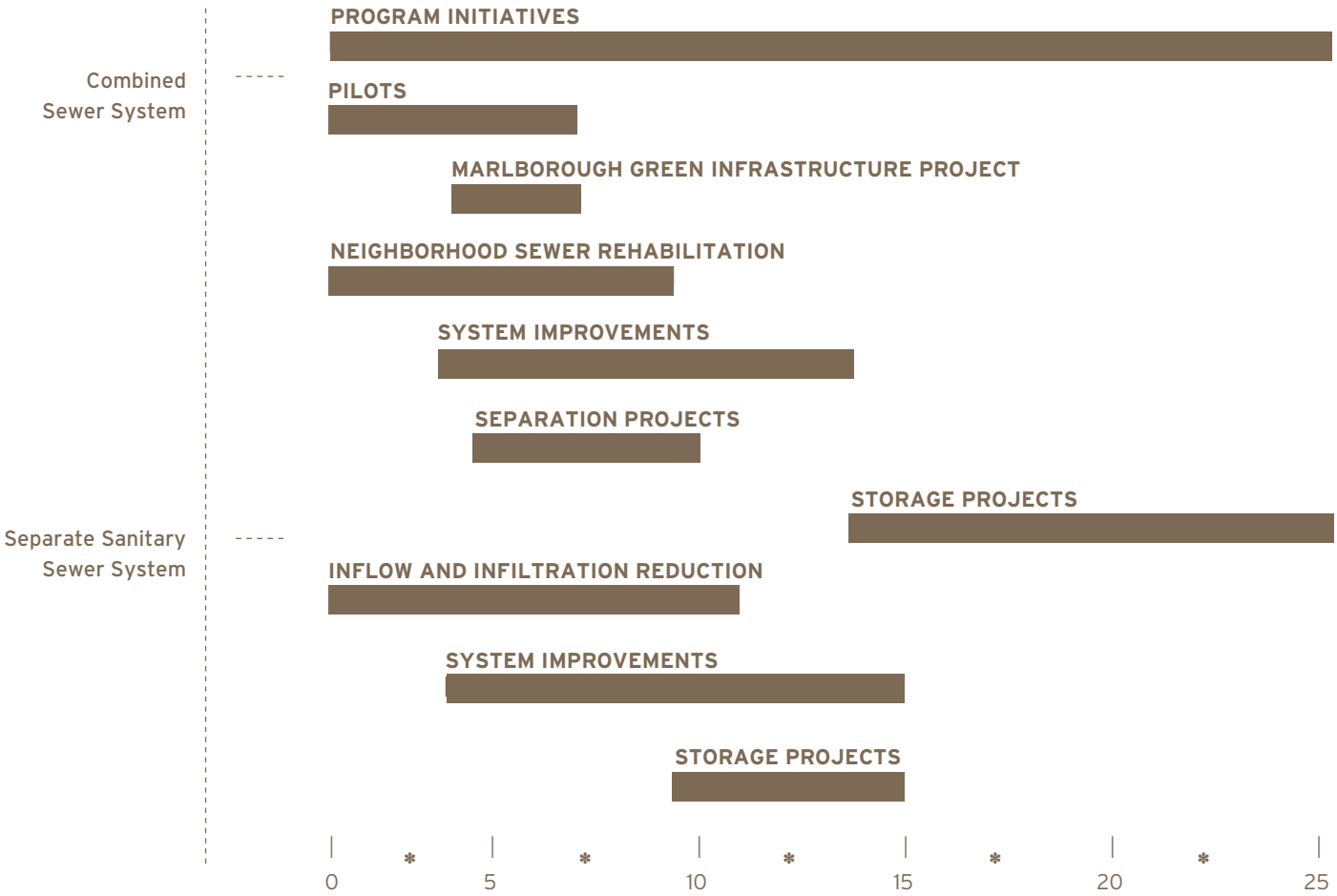
The proposed North Bank tunnel is 11 feet in diameter and stretches 11 miles in length.

South of the river, the plan proposes 68 million gallons of tank storage to hold excess inflow and infiltration from the Blue River South Basin and flows from Johnson County Wastewater. The adaptive management approach of the plan gives the City the flexibility to postpone final decisions on storage capacity until the results of ongoing technical and contractual discussions between Kansas City and Johnson County Wastewater are fully evaluated. The cost for addressing Johnson County Wastewater flows to the 87th Street Pumping Station will be recovered through either increased rates charged to Johnson County Wastewater or other funding agreements. Should Johnson County choose to manage the flows themselves, the proposed storage necessary will be reduced accordingly.



Northbank Tunnel

PROPOSED SCHEDULE



* City Review | Regulatory Review

25 year project timeline

PROPOSED PROJECT COSTS IN 2008 DOLLARS

Project Descriptions	Estimated Capital Cost ($Millions)	Project Type
PROGRAMMATIC ELEMENTS		
Blue River Watershed Management Plan	$2	Program Initiatives
Green Collar Jobs and Workforce Development	$5	Program Initiatives
Rain Gardens and Downspout Disconnects	$5	Program Initiatives
Public Education and Outreach	$12	Program Initiatives
Enhanced Monitoring and Modeling	$24	Program Initiatives
Subtotal, Programmatic Elements	**$48**	
COMBINED SEWER SYSTEM		
CID In-Line Storage	$2	System Improvements
Sewer Separation, 17th & Topping	$3	Separation Projects
Operable Gates in OK Creek Culvert	$4	System Improvements
Separation at Milwaukee/Chouteau Outfall	$5	Separation Projects
Sewer Separation, 47th & State Line	$5	Separation Projects
Sewer Separation, 55th & College	$6	Separation Projects
Forest Hill Consolidation Piping	$9	System Improvements
Sewer Separation, 31st & Broadway	$9	Separation Projects
Gooseneck Creek Improvements	$10	System Improvements
Separation & Consolidation, Gregory & Cleveland	$10	Separation Projects
Sewer Separation, 53rd & Waldron	$12	Separation Projects
Sewer Separation, 40th & Monroe	$17	Separation Projects
Sewer Separation, Downtown Airport	$17	Separation Projects
Turkey Creek Pumping Station & Force Main	$24	System Improvements
Sewer Separation, 84th & Brookside	$25	Separation Projects
Green Infrastructure Pilots and Partnerships	$28	Pilots and Partnerships
Distributed Storage, Outfalls 59 and 69	$40	Marlborough Green Infrastructure Project
Small System Improvement Projects	$41	System Improvements
High Rate Treatment at Blue River WWTP	$45	System Improvements

Project Descriptions	Estimated Capital Cost ($Millions)	Project Type
COMBINED SEWER SYSTEM		
High Rate Treatment at Westside WWTP	$61	System Improvements
Town Fork Tunnel	$122	Storage Projects
Neighborhood Sewers Rehabilitation	$122	Neighborhood Sewer Rehabilitation
150-mgd High Rate Treatment for Brush Creek	$129	System Improvements
Blue River WWTP Solids Handling	$159	System Improvements
OK Creek Tunnel & Pump Station	$183	Storage Projects
Brush Creek Tunnel, Pump Station & HRT	$304	Storage Projects
Subtotal, Combined Sewer System	**$1,394**	
SEPARATE SANITARY SEWER SYSTEM		
Shoal Creek Relief Sewers	less than $1	System Improvements
Round Grove Pumping Station Second Force Main	$2	System Improvements
Birmingham Force Main	$4	System Improvements
Round Grove Pumping Station & Relief Sewers	$11	System Improvements
Line/Rock Creek Relief Sewers	$13	System Improvements
Upgrade Birmingham Pump Station	$24	System Improvements
Line Creek Temporary High Rate Treatment	$42	System Improvements
Birmingham WWTP High Rate Treatment	$44	System Improvements
I/I Reduction (basins north of Mo. River)	$86	Inflow and Infiltration Reduction
I/I Reduction (basins south of Mo. River)	$86	Inflow and Infiltration Reduction
87th Street Pump Station Storage	$265	Storage Projects
North Bank Tunnel System and Pumping Station	$371	Storage Projects
Subtotal, Separate Sanitary Sewer System	$948	
TOTAL ESTIMATED COST	**$2,389**	

"Water is the vehicle of nature."

- Leonardo da Vinci

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CITY OF FOUNTAINS
HEART OF THE NATION
KANSAS CITY
MISSOURI

KCMO
WATER SERVICES DEPARTMENT

FROM OUR TEAM ~

Burns & McDonnell SINCE 1898

BNIM

MARC
Mid-America Regional Council

The Low Impact Development Center, Inc.

TETRA TECH, INC.

Conservation Design Forum

WE WOULD ALSO LIKE TO RECOGNIZE THE WORK THAT THE FOLLOWING ORGANIZATIONS HAVE CONTRIBUTED TO THIS PROJECT ~

Black & Veatch
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