CITY OF Springfield

HDR


# Integrated Planning Opportunities Alternatives Analysis – Sanitary Sewer Overflows

**Springfield, Missouri**

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# Introduction

*The City of Springfield (City), Greene County, and City Utilities of Springfield have developed an approach for integrated planning to best protect local environmental resources in an evolving regulatory landscape. The Integrated Plan (IP), titled "A Citizen Focused Approach," provides a holistic plan designed to prioritize investments based on the most effective solutions to address the most pressing problems that matter most to the community. Implementation of the IP includes a four-phased approach, which is designed to be iterative: 1) Assessment (What is the current status of the environment?), 2) Vision (Where do we want to be?), 3) Tactical (How will we get there?), and 4) Adaptive Management (What adjustments need to be made?).*

Identifying and prioritizing the most effective solutions using the Sustainable Return on Investment (SROI) approach is a critical component of the tactical phase. The SROI process is an economic analysis method for analyzing triple bottom-line (i.e., economic, social and environmental) outcomes of investments and policies. This approach provides a comparison between the general cost of a solution to the benefits achieved so that a more informed investment decision can be made.

The methodology for estimating the sustainability value of different opportunities, including social and environmental benefits and financial costs, entails projecting the value of impacts over a 25-year planning horizon and applying a discount rate to bring future values into today's dollars. A description of the financial costs and benefits along with the SROI results are provided below for I/I abatement and capacity improvements to the sewer system.

# Opportunity Description

The City has an efficient cleaning and maintenance program that minimizes dry weather sewer overflows caused by blockages, tree roots and grease. When storm water runoff and elevated groundwater enters the system, however, flows can exceed collection system capacity and discharge out of the system, known as a wet weather sanitary sewer overflow (SSO). Wet weather SSOs can be reduced by performing rehabilitation to eliminate the entry points of runoff and groundwater as well as replacing the system with larger pipes, pumps and storage facilities.

Success is often characterized by establishing a Level of Service (LOS) for the sewer system based on eliminating SSO up to a given frequency of rainfall. For example: a sewer system with a 5-year LOS will surcharge, on average, once every five years. This SROI analysis was performed on four levels of investment needed to achieve a system with a specific LOS. These include the 1-year, 2-year and 5-year LOS along with a LOS related to inflow and infiltration (I/I) control measures only. The vast majority of sanitary sewer overflows are caused by wet weather events. However, blockages (tree roots, FOG, etc.), power outages and vandalism can also lead to overflows during dry weather and the City has a maintenance program in place to address these issues.

Sanitary Sewer Overflow Reduction: I/I Control

Sanitary Sewer Overflow Reduction: 2 YR LOS

Sanitary Sewer Overflow Reduction: 1 YR LOS

Sanitary Sewer Overflow Reduction: 5 YR LOS

## Environmental and Social Benefits

SSO control measures can mitigate flood impacts to property and lower emissions from reduced energy use at the wastewater treatment plant, but the primary benefit is improved water quality. Water quality improvements were determined using a water quality index (WQI) approach. The WQI is a composite scoring system that evaluates the condition of a waterbody on a scale of 0 to 10 based on different community priorities and indicators. The economic value of a change in water quality is determined by the number of people that benefit and an individual's "willingness-to-pay" for that change. A one point change to the WQI is worth about $40 for a direct user and $14 for in indirect user.

HDR evaluated the change to the WQI in Springfield urban streams for the four different levels of SSO improvements. Each successive level of improvement results in a greater reduction in annual overflow volume. Overflow volumes previously modeled by the Overflow Control Plan (OCP) team were used to estimate reductions to bacteria, as measured by *E. coli*, and trash loading to Springfield urban streams for each of the SSO improvement opportunities (**Table 1**).

**Table 1. Estimated Annual Overflow Volumes and *E. coli* Loadings to the Wilson's Creek Watershed**

| Scenario | Annual Overflow Volume (MG)* | Reduction in *E. coli* Loading (%) | Reduction in Trash (%) |
|---|---|---|---|
| Existing | 103.4 | 0% | 0% |
| I/I Control | 58.6 | 15% | 2.2% |
| LOS 1 Yr | 23.0 | 27% | 3.9% |
| LOS 2 Yr | 10.0 | 31% | 4.5% |
| LOS 5 Yr | 0 | 35% | 5.0% |

*Overflow volumes were based on the Wilson's Creek watershed, which was used as a surrogate for Springfield urban streams.

Reductions in bacteria and trash loading will have a positive impact on different community priorities including waterbody aesthetics, primary and secondary contact recreation, and clean drinking water. It is estimated that SSO improvements will increase the WQI for Springfield urban streams anywhere from 0.070 point for I/I control to 0.162 point for a 5 year LOS (**Figure 1**).

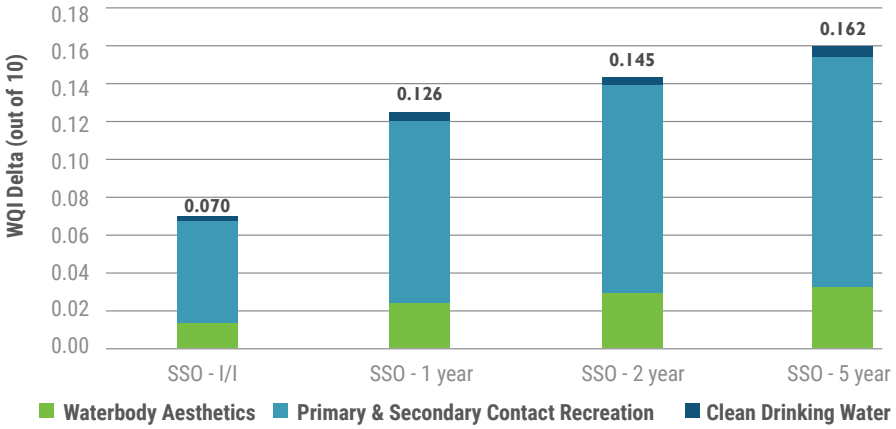


**Figure 1. Change to the Water Quality Index from SSO Reductions**

## Cost Considerations

The impact of improvements was based upon estimated values utilizing best available information and professional judgment. Capital costs for each level of service are the Total Present Worth Cost of Capacity Improvement Projects for each LOS from the City's OCP. Each LOS was based upon estimated reductions in I/I plus capacity related improvements. Capacity improvements include collection system and treatment improvements. Residual value was computed assuming a 60-year life span of the new system, which translates into 35 years of service life remaining at the end of the analytical period.

Annual costs include several categories of operation and maintenance costs savings. The largest savings occurs at the wastewater treatment plant and occurs because of a reduction in treatment volume. Per information provided by the City, a 30% reduction in I/I will result in an annual reduction of treated flows of 625 MG. This flow was multiplied by the weighted cost of treatment as provided by the City. Additional cost savings arise from implementation of improved water quality. These include:

- Potential Public Relations Cost Impacts: This category accounts for any reductions in public outreach costs and reduced time with customers and is monetized with staff wages. The inputs, which vary for each alternative, were determined in a workshop with the City.
- Potential TMDL Impairment Cost Impacts: This category relates to internal costs related to TMDL regulatory impacts, specifically attributed to administrative time and/or legal costs. The inputs, which vary for each alternative, were determined in a workshop with the City.
- Potential Regulatory Compliance Cost Impacts: The value of regulatory compliance involves using avoided permit violation costs as that value. The approach is a function of the number of days of reduced violations, and the permit violation costs on a daily basis. The inputs, which vary for each alternative, were determined in a workshop with the City.

A summary of capital and annual costs is presented below in **Table 2**.

**Table 2. Summary of Capital and Annual Costs ($2018, Millions)**

| Category | I/I Control | 1 YR LOS | 2 YR LOS | 5 YR LOS |
|---|---|---|---|---|
| Initial Capital Costs – Year 2018 ($M) | ($44.5) | ($382.4) | ($443.4) | ($529.3) |
| Residual Value of Initial Capital Cost – Year 2043 ($M) | $12.0 | $112.0 | $129.3 | $153.0 |
| Reduced Annual WWTP O&M Costs from SSO Reduction ($M) | $0.4 | $0.4 | $0.4 | $0.4 |
| Reduced Annual Public Relations Costs ($M) | $0.02 | $0.06 | $0.07 | $0.08 |
| Reduced Annual Impairment Costs ($M) | $0.06 | $0.06 | $0.06 | $0.06 |
| Reduced Annual Regulatory Compliance Costs ($M) | $0.1 | $0.3 | $0.3 | $0.3 |

## SROI Results

**Table 3** presents the costs and benefits of the four opportunities for SSO control improvements in present value form. From a cost perspective, I/I Control is significantly less costly than the other three that aim to reduce SSOs at different rain event frequencies. In comparison to I/I Control, which has a cost of $31.2 million in net capital and residual value, the costs increase from over $270 million to just over $375 million as LOS increases from 1 to 5 years. Other administrative and operating cost savings are small relative to the capital costs.

Water quality improvements provide the greatest social and environmental benefit with monetized values ranging from $5.4 million for SSO control to $12.7 million for a 5-year LOS. Other environmental and social benefits related to emissions reduction and reduced property impacts range from about $1.6 to $2.2 million. Although increasing levels of SSO control produce greater benefits, the improvements are not commensurate with the overall capital costs of these initiatives.

According to these results I/I Control provides the greatest benefits relative to costs, but is below the breakeven point with a benefit-cost ratio of 0.33. This means that for every dollar investment, approximately 33 cents of value is created. In comparison, the SSO Controls at any of the LOS levels have benefit cost-ratios of less than 0.1.

**Table 3. Summary of Present Value Costs of SSO Control ($2018, Millions)**

| Types of Benefits and Costs | I/I Control | 1 YR LOS | 2 YR LOS | 5 YR LOS |
|---|---|---|---|---|
| **Environmental** | | | | |
| Water Quality Impacts | $5.4 | $9.7 | $11.4 | $12.7 |
| GHG Emissions Reductions | $1.0 | $1.0 | $1.0 | $1.0 |
| **Social** | | | | |
| Air Pollution Impacts on Health | $0.3 | $0.3 | $0.3 | $0.3 |
| Property Value Benefits (Reduced Flooding) | $0.3 | $0.7 | $0.9 | $0.9 |
| **$ Costs** | | | | |
| Capital Expenditures (Less Residual Costs) | ($31.2) | ($271.3) | ($314.4) | ($375.1) |
| Total Annual Cost Savings | $9.7 | $13.4 | $14.3 | $14.7 |
| **Totals** | | | | |
| Financial Lifecycle Cost | ($21.5) | ($257.9) | ($300.1) | ($360.4) |
| Total Social, Environmental Benefits | $7.0 | $11.7 | $13.6 | $14.9 |
| Total Value - All Costs and Benefits | ($14.5) | ($246.2) | ($286.5) | ($345.5) |
| Benefit-Cost Ratio | 0.33 | 0.05 | 0.05 | 0.04 |

**Figure 2** provides the best estimate of value created relative to cost by accounting for several uncertainties that can raise or lower the perspective on total value. Taking into account these uncertainties, the benefit-cost ratio for I/I Control is estimated to range anywhere from about 0.2 to 0.6.


**Figure 2. Range of Potential Benefit Cost Ratios for SSO Control**

## Summary

The City faces significant potential investments to reduce SSOs into local streams during wet weather events. The estimated benefits from reduced overflows using I/I removal techniques are about $7 million over the 25 year study period, with corresponding costs at about $21.5 million. The results also indicate that SSO Control at higher Levels of Service simply do not generate sufficient levels of water quality improvements over I/I Control, to offset the significant costs of large capacity improvements to the sewer system.