

Executive Summary

In December 1999, the King County Council approved the development of a Regional Infiltration and Inflow (I/I) Control Program as part of the Regional Wastewater Services Plan (RWSP). The purpose of controlling I/I is to reduce the amount of flow, thereby reducing the costs of conveying and treating wastewater. When excess I/I is present in separated sewer systems (those that are designed to carry only sewage), it takes up capacity that is needed for wastewater. In the regional system, as much as 75 percent of the flow in the conveyance system during storms (times of peak flow) is from I/I. Conveying these additional flows can drive the need for enlarging and replacing conveyance facilities (pipes and pump stations), even though this capacity is not needed all the time. If cost-effective methods for controlling I/I can be implemented, capital costs can be reduced by eliminating, delaying, or phasing conveyance system improvements.

Infiltration is subsurface flow, or groundwater, that seeps into sewers through holes, breaks, joint failures, defective connections, and other openings. Infiltration can occur throughout the year, but volumes are typically greater after large storms or prolonged wet weather periods.

Inflow is storm-related surface water that enters the sewer system via roof downspouts, yard and shallow foundation drains, catch basins, leaking manhole covers, and other sources.

In 2000, the County's Wastewater Treatment Division, in cooperation with the local component agencies that it serves, launched a 6-year, \$41 million I/I control study. The study included efforts to identify sources of I/I, test the effectiveness of various I/I control technologies, prepare a regional plan for reducing I/I in local agency collection systems, and develop I/I program alternatives. These efforts provided data for conducting the benefit/cost analysis.

Completing the benefit/cost analysis of I/I reduction projects marks a major milestone in the study. The following text describes how the benefit/cost analysis was performed and the results that were achieved.

1.1 What is the Benefit/Cost Analysis?

As part of its Regional Needs Assessment, the County developed a list of conveyance system improvement (CSI) projects. These projects will help accommodate the increasing wastewater flows brought about by growth. To make the most effective use its resources, the County evaluated whether it is cost effective to eliminate or delay projects on the CSI Project List by reducing the amount of I/I in the conveyance system. The benefit/cost analysis compared the estimated costs of constructing conveyance system improvement projects with the estimated costs of I/I reduction projects.

1.2 What Information was Used for the Benefit/Cost Analysis?

To conduct the benefit/cost analysis, information was needed that could be used to address:

- The anticipated effort and cost necessary to reach target levels of I/I reduction.
- The capacity and cost-savings effects of proposed I/I reduction on the regional conveyance system.
- The cost effectiveness of implementing I/I reduction projects compared with the costs of regional conveyance system improvements.

The County and local agencies worked together to obtain this information and to develop assumptions about I/I reduction. The benefit/cost analysis used the information collected and tools developed for the Regional I/I Control Program between 2000 and 2005, including:

- **Physical characteristics of local agency collection systems** – including the size, age, material and location of pipes; points of connection between local agency and regional conveyance systems; boundaries and acreage served; topography; and land use.
- **Rainfall data** – to help understand patterns in I/I flows after storms, as well as the relationship between measured rainfall and wastewater flows.
- **Flow monitoring** – to determine the geographic distribution of I/I throughout the local agency facilities tributary to the County’s collection system, to quantify I/I levels, and to subdivide the entire system of local agency sewer lines into geographic areas called mini-basins and model basins.
- **Hydrologic model** – to simulate the physical process of how rainfall ends up as I/I.
- **Hydraulic model** – to simulate the actual pipes that convey wastewater flows and I/I, and to evaluate how the system performs under existing and future demands.
- **Pilot projects** – to demonstrate the County’s success in finding and reducing I/I and to obtain “lessons learned” information.
- **Regional needs assessment** – to establish the extent of required capacity improvements and to estimate the costs associated with planning, design, and construction of conveyance system improvements.
- **Assumptions** – to establish target I/I reduction levels and to agree upon what I/I reduction levels could be achieved and the associated costs.
- **Techniques** – to develop a means of decreasing I/I by replacing or rehabilitating selected components of the sewer system (for example, disconnecting and re-routing downspouts that connect to the sewer system).
- **Alternatives** – to develop a recommended I/I program for defining a target level of I/I, to determine how cost-effectiveness is measured, and to address funding options.

1.3 What is Cost Effectiveness and How was it Determined?

To evaluate cost effectiveness, a benefit/cost ratio was calculated for each of the planned conveyance system improvement projects:

$$\text{Benefit/Cost Ratio} = \frac{\text{(CSI Project Savings after I/I Reduction)}}{\text{(Cost of Proposed I/I Reduction Project)}}$$

A proposed I/I project was considered cost effective if the CSI savings resulting from the I/I reduction project were greater than the cost of the I/I reduction. All cost-effective projects had a benefit/cost ratio greater than 1.

A database analysis tool, the Benefit/Cost Analysis Tool, was specifically developed for the Regional I/I Control Program. It was used in association with the County's TABULA cost estimating software to compare reductions in capital costs (if any) to the cost of I/I rehabilitation. Inputs into these tools included information about the physical characteristics of the collection system, technique selected for reducing I/I, cost assumptions, results of hydraulic modeling, and information about upstream and downstream facilities.

Other factors that affected the cost effectiveness of a project included the level of confidence in the data and whether or not a threshold level of flow reduction was achieved.

1.4 What were the Results of the Benefit/Cost Analysis?

As shown in the table, nine I/I reduction projects were identified by the benefit/cost analysis as cost effective. For these projects:

- The estimated cost of implementing the I/I reduction projects is approximately \$73 million.
- The anticipated I/I reduction achievable is estimated at 22 million gallons per day (mgd), or approximately 5 percent of the I/I present in the entire regional service area.
- As a result of reducing I/I flows, it is estimated that the capital cost for nine impacted regional conveyance facility improvement projects could be reduced from approximately \$268 million to \$164 million, resulting in regional conveyance facility improvement savings of nearly \$104 million.
- The net overall savings realized from implementing the nine cost-effective I/I reduction projects is estimated at approximately \$31 million.

Project (Facility)	I/I Available (mgd) ¹	I/I Reduction (mgd) ¹	Benefit: Capital Facility Cost Reduction	Cost: I/I Rehab	B/C Ratio
South Renton Interceptor (RE*SRENTON.R18-16(9))	7.0	0.81	\$7,270,000	\$2,217,645	3.3
ULID 1 Contract 4 (RE*ULID 1-4.S-31(8))	5.5	1.08	\$2,410,000	\$999,123	2.4
Auburn 3 New Storage (Auburn3 Twin Tube Storage)	52.8	6.87	\$22,990,000	\$11,362,511	2.0
Issaquah 2 Trunk (RE*ISSAQ2.R17-40(3))	5.4	1.05	\$5,770,000	\$3,964,850	1.5
Bryn Mawr Storage (Bryn Mawr Tube Storage)	16.2	2.04	\$8,510,000	\$6,018,534	1.4
Lk Hills Trunk 3 rd Barrel Upgrade (WE*LKHILLST.ENTR(3))	10.8	2.20	\$14,438,000	\$11,307,052	1.3
Eastgate Storage and Trunk (Eastgate Tube Storage)	8.7	3.55	\$16,629,000	\$14,459,862	1.2
Wilburton PS / Factoria Trunk (RE*FACTOR.RO6-05(7))	10.4	2.39	\$12,058,000	\$10,550,378	1.1
Garrison Creek Trunk (RE*ULID 1-5.57I(10))	5.7	2.12	\$13,660,000	\$12,013,489	1.1

¹million gallons per day

1.5 What's in the Report?

The following chapters provide more information about the benefit/cost analysis. Chapter 2 provides background and introduction to the benefit/cost analysis. Chapter 3 describes the data sources that contributed to the benefit/cost analysis and how the information was used. Chapter 4 describes the benefit/cost analysis. Chapter 5 summarizes the results of the benefit/cost analysis.

The appendices, which are included on a CD, contain detailed information that supports the material presented in the chapters.