ALTERNATIVES/OPTIONS REPORT

Regional Infiltration and Inflow Control Program
King County, Washington

March 1, 2005

King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Alternatives/Options Report

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Acronyms and Abbreviations

CSI	conveyance system improvement
E&P	Engineering and Planning (MWPAAC Subcommittee)
ESA	Endangered Species Act
ETT	Earth Tech Team
gpad	gallons per acre per day
IGA	intergovernmental agreement
I/I	infiltration/inflow
I/IP	infiltration/inflow policy
KCC	King County Code
Metro	Municipality of Metropolitan Seattle or King County Department of Metropolitan Services
MOUSE™	Modeling of Urban Sewers (software by DHI)
MWPAAC	Metropolitan Water Pollution Abatement Advisory Committee
NPV	net present value
PE	Professional Engineer
PIP	public involvement policy
RCW	Revised Code of Washington
RNA	Regional Needs Assessment
RWSP	Regional Wastewater Services Plan
SEPA	State Environmental Policy Act
SSES	Sewer System Evaluation Survey
WLRD	Water and Land Resources Division (King County)
WTD	Wastewater Treatment Division (King County)

Chapter 1

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 presence of I/I in the separated sewer system takes up needed capacity for conveying and treating wastewater generated by homes and businesses. The purpose of the I/I program is to reduce the amount of flow, thereby reducing the risk of sanitary sewer overflows and the costs of conveying and treating wastewater.

In 2000, the County's Wastewater Treatment Division, in cooperation with the local component agencies that it serves, launched an ambitious six-year $41-million I/I control study. The study includes efforts to identify sources of I/I, test the effectiveness of various I/I control technologies, examine the benefits and costs of I/I control, and prepare a regional plan for reducing I/I in local agency collection systems.

Development of a set of alternative approaches to controlling regional I/I marks a major milestone in the study. The following text summarizes these alternatives and the complex issues that affect I/I control in the region.

1.1 I/I Control Study

A comprehensive six-year I/I control study (summarized in Figure 1-1) began in 2000 and is scheduled to be completed at the end of 2005. The study consists of five steps; each step responds to a specific RWSP I/I control policy. The steps are as follows:

- Define current levels of I/I for each local agency tributary to the regional system.
- Select and construct pilot projects to demonstrate the cost-effectiveness of collection system rehabilitation projects.
- Develop model standards, procedures, and policies for use by local agencies to reduce I/I in their systems.
- Identify cost-effective options to remove up to 30 percent of I/I expected to occur in local agency systems during a 20-year peak flow condition.
- Develop a long-term regional I/I control program for review and approval by the County Council.

A few useful definitions…

Infiltration. Groundwater that seeps into sewers through holes, breaks, joint failures, defective connections, and other openings.

Inflow. Stormwater that rapidly flows into sewers via roof and foundation drains, catch basins, downspouts, manhole covers, and other sources.

Long-term I/I control. Policy, administrative, financial, and technical measures aimed at limiting future increases in I/I flow.

Direct I/I reduction. Sewer rehabilitation or replacement projects done to reduce I/I flows and alleviate immediate downstream capacity constraints in a basin.

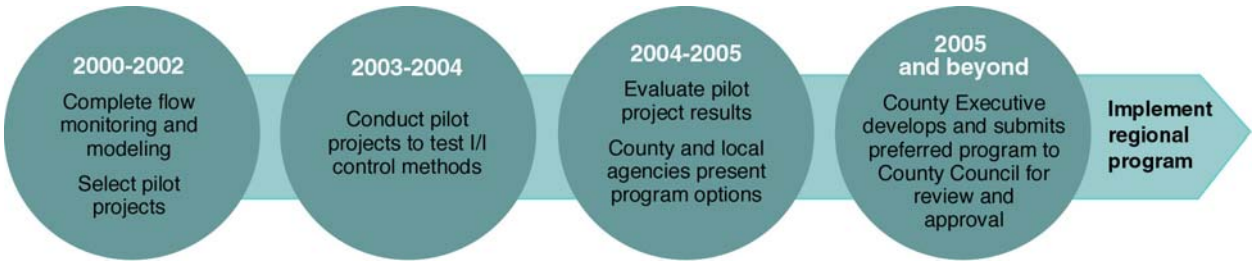

Figure 1-1. Regional Infiltration/Inflow Program Milestones

With the development of the I/I program alternatives described in this report, the first three components of the study are complete. The fourth component will be complete by April 2005 with the completion of a benefit-cost analysis and the *Regional Needs Assessment Report*. By December 31, 2005, the King County Executive will submit to the King County Council a plan for a long-term regional I/I control program. The program will identify target I/I levels for local systems. It also will identify long-term I/I control measures to meet these targets and to serve as cost-effective alternatives to planned conveyance and treatment projects. After Council approval of the program, implementation can begin.

The I/I study is unique in a number of ways. It is voluntary and primarily County-funded, even though most of the program focuses on local systems. Most important, planning and implementation are being done in partnership with the local agencies that contribute wastewater to the King County system.

1.2 Summary of Program Alternatives

The County considered a number of alternative approaches for an I/I control program and then narrowed the field to four (Table 1-1). The four alternatives described in Chapter 4 of this report provide a range of approaches from which to begin developing a recommended program. With the exception of Alternative 4, each alternative includes three core elements for I/I reduction:

(1) a distinct approach to defining the target level of I/I reduction,
(2) measures of cost-effectiveness for I/I reduction projects, and
(3) methods for funding I/I reduction projects.

The approach to defining the target I/I reduction level in each alternative serves as the driver for the other two elements. Several other program elements combine with these core elements to form complete program.

1.2.1 Alternative 1: Reduce Peak I/I by 30 Percent in the Regional Service Area from the Peak 20-Year Level

The 30-percent goal, established by policy in the RWSP, was based on information obtained from other jurisdictions around the country. It is not known if the goal is feasible in this region.

Under Alternative 1, cost-effective I/I reduction projects that meet a 1:1 benefit-to-cost ratio would be implemented as a priority. Projects with greater benefits than costs would accumulate savings that could be used for constructing additional I/I reduction projects. Once the cost-effective projects are implemented, additional I/I reduction projects (if needed) would be implemented until the 30-percent reduction goal is met. Projects would be funded through regional grants.

1.2.2 Alternative 2: Implement I/I Reduction Projects that Are Found to be Cost-Effective Based on a *Region-Wide* Evaluation

Alternative 2 responds to an RWSP policy that calls for rehabilitation of portions of the regional conveyance system to reduce I/I whenever the cost of rehabilitation is less than the cost of conveying and treating that flow.

Table 1-1. Summary of I/I Control Program Alternatives

	Target I/I Reduction Level	Cost-Effectiveness	Funding
Alt. 1	30 percent	Used to prioritize projects for implementation	County wastewater revenues
Alt. 2	Determined after cost-effective projects are implemented	Combined list of recommended I/I reduction projects must at least meet 1:1 benefit-to-cost ratio	County wastewater revenues, local agency funds, and/or direct payment by private property owners
Alt. 3	Determined after cost-effective projects are implemented	Each I/I reduction project must at least meet 1:1 benefit-to-cost ratio	Same as Alternative 2
Alt. 4	Based on an agreed-upon threshold	N/A	**I/I reduction:** Local agency funds and/or direct payment by private property owners **Monitoring and enforcement:** County wastewater revenues

Implementing this alternative should cost no more than constructing conveyance and treatment projects region-wide. All cost-effective I/I reduction projects with at least a 1:1 benefit-to-cost ratio would be implemented. I/I reduction projects would be funded through regional grants. Additionally, local agencies could contribute funds to bring an I/I reduction project up to the 1:1 benefit-to-cost ratio. This funding could be from the local agency or from a County low-interest loan. Projects with greater benefits than costs would accumulate savings that could be used for constructing additional I/I reduction projects. The percent of I/I reduction at peak flow across the entire regional wastewater system would be estimated based on the estimated cumulative reduction volumes of all proposed I/I reduction projects.

1.2.3 Alternative 3: Implement I/I Reduction Projects that Are Found to be Cost-Effective Based on a *Project-Specific* Evaluation

Alternative 3 also responds to the RWSP policy described in Alternative 2. It differs from and is less costly than Alternative 2 because each I/I reduction project would be evaluated for cost-effectiveness based on its own cost savings in comparison to the costs of conveying and treating wastewater flows with higher levels of I/I. Each I/I reduction project would need to at least meet the 1:1 benefit-to-cost ratio. Projects with greater benefits than costs would accumulate savings but would not fund other I/I reduction projects that are not cost-effective. The same methods as described in Alternative 2 would be used to estimate the I/I reduction level, and to fund I/I reduction projects.

1.2.4 Alternative 4: Set a Fixed Maximum I/I Threshold Expressed as Gallons per Acre per Day (gpad) at Peak Flow for Each Local Agency

Alternative 4 responds to an RWSP policy that calls for provision of incentives for local agencies to meet an established maximum allowable threshold of I/I during peak flow conditions. Under this alternative, the maximum threshold would be uniform for each agency that had initial I/I levels exceeding the threshold. Agencies with I/I levels lower than the maximum threshold would be required to maintain that I/I level with an agreed-upon allowance for pipe degradation over time. The maintenance of these lower-than-maximum levels would be required because the regional conveyance and treatment system is designed and constructed to convey existing and projected peak I/I flow quantities for those agencies, not the maximum amount allowed by a higher threshold.

Alternative 4 differs from the other three alternatives in that it relies more on regulating the local agencies and less on regional cooperation to reduce I/I levels. The I/I reduction percentage would be based on the percent of I/I reduction region-wide, assuming that each agency contributes either I/I equal to the established maximum threshold or an actual flow amount for those agencies with I/I levels under the threshold. Local agencies would be responsible for implementing I/I reduction projects, including funding the projects or making arrangements with private property owners. Extensive monitoring would be necessary to evaluate whether local agencies are meeting the established threshold. Incentives and/or penalties (such as a surcharge) could be required to attempt to achieve and maintain thresholds over time.

1.3 Issues Related to Program Development

In 2004, the E&P Subcommittee[1] continued to work toward reaching consensus on a number of complex issues related to the alternatives presented in this report. The subcommittee's consensus decisions guided the County in developing the alternatives and, along with input from program workshops, allowed local agencies to shape the parameters of a regional I/I control program. These and other issues will come into play during evaluation of the alternatives and preparation of the long-term regional I/I control plan. Issues include setting mandatory or voluntary provisions for local agency compliance, funding I/I projects, establishing target levels for I/I reduction, and defining roles and responsibilities.

1.3.1 Setting Voluntary or Mandatory I/I Provisions for Local Agency Compliance

The adopted RWSP requires that the establishment of a mandatory I/I threshold be considered for local agencies. Such a threshold would set a maximum allowable level of I/I that could enter the regional treatment and conveyance system during periods of peak flow. Currently, some contracts between the County and local agencies stipulate that flows above 1,100 gpad are subject to an additional charge, but because this contract provision has not been uniformly applied, it has not been enforced. Further, sewer pipes constructed prior to 1961 are exempt from this provision.[2]

An I/I threshold could serve as a useful tool for maintaining relatively low I/I levels in the regional system over time. However, setting a threshold value and putting it into practice would be complicated. Some agencies could be required to make significant repairs and upgrades to their systems to meet the threshold, while others may be operating below an established threshold. In addition, detailed monitoring to measure flows in relation to an established threshold could be costly.

Also under evaluation is whether to charge local agencies for not complying with adopted target levels for I/I reduction. Measures being considered are surcharges, incentives, and variable rates. Fundamental questions remain regarding whether these measures would have any positive impact on I/I levels in the regional system. Agencies may find it less expensive to pay a surcharge or higher rates in lieu of paying for I/I improvements. In addition, the revenue generated from surcharges or higher rates may not be enough to pay for I/I rehabilitation projects. As is the case with the I/I threshold issue, all of these measures would carry significant administrative and monitoring costs.

[1] The Engineering and Planning (E&P) Subcommittee is a subcommittee to the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC), a committee composed of representatives from the 34 local component agencies that contribute wastewater to the King County system..

[2] Sewer pipes built by the local agencies before 1961 represent the oldest parts of the system and are also often a source for high levels of I/I. An analysis will be conducted to determine whether flows in these pipes should be included in determining whether an agency is meeting the threshold.

Finally, the County and local agencies continue to discuss whether the standards, procedures, guidelines, and policies, when finalized, should be implemented as requirements region-wide or as a mix of standards and guidelines.[3] There is general agreement that standards, procedures, guidelines, and policies could be applied uniformly as requirements for I/I repair and rehabilitation projects paid for by County wastewater revenues. However, local agencies generally believe that some standards should be implemented as guidelines for I/I projects and other work that the agencies fund in their respective service areas.

1.3.2 Establishing Target Levels for I/I Control Program

RWSP policies set the overall target for peak I/I reduction in the service area as 30 percent below the 20-year peak level. Other options for setting target levels of I/I reduction were considered during development of alternatives. These options include setting I/I thresholds for local agencies, as discussed above, and using the cost-effectiveness of I/I reduction projects, either on a regional or project-specific basis, to determine the level of I/I reduction to undertake.

1.3.3 Funding I/I Reduction Projects

Four options are being considered for funding cost-effective I/I reduction projects: (1) the County pays all costs, (2) the County and local agencies share the costs, (3) private property owners fund all or part of the costs (for I/I repairs on private property), and (4) another project pays for part of the costs. The local agency contribution of funds could make an I/I project cost-effective for the County, while at the same time providing the agency with a system upgrade partially funded by the County. An I/I reduction project that is not cost-effective as a stand-alone project could become cost-effective if other funding sources pay for related project costs (for example, resurfacing the street). If such opportunities require a significant scheduling change, the I/I project's cost-effectiveness would need to be re-evaluated.

The County and local agencies are continuing to evaluate and discuss both policy and legal issues related to funding. A preliminary legal analysis suggests that all funding options, including publicly funding I/I repairs on private property are feasible. Results of a telephone survey conducted late 2004 with homeowners in the service area indicate that homeowners are split almost in half on a number of issues, including who should pay for sewer repairs on private property, who should pay for land repairs resulting from sewer work on private property, and whether fixing I/I problems should be mandatory.

1.3.4 Defining Roles and Responsibilities

Consideration of County and local agency interactions and formal relationships will be an integral part of the I/I control program. Discussions will continue about the nature and extent of inter-governmental agreements (IGAs) or service contract amendments related to implementation of an I/I control program and specific I/I projects.

[3] See "Basis for Program Alternatives" below for a discussion of standards, procedures, guidelines, and policies.

Pilot project results indicate that property owner participation increases with knowledge about I/I and its impacts on the costs of wastewater conveyance, treatment, and disposal. The County and local agencies generally agree that a public education and involvement program is a necessary and beneficial part of the I/I control program. The roles of the County and local agencies in such a program are still open. Several options are being considered. The County could act as the lead on all regional efforts, while local agencies could be responsible for public education efforts in their service areas. Or the County and local agencies could work cooperatively to develop and implement both regional and service-area-specific education and involvement programs. Or local agencies could take complete responsibility for all public education and involvement efforts.

The County and local agencies are considering the establishment of centralized program management that would organize and manage follow-through for agreed-upon action items and coordination and communication during program implementation. Program management would also encompass planning, analysis, and integration of I/I control measures and conveyance needs.

1.4 Basis for Program Alternatives

1.4.1 Flow Monitoring and Pilot Projects

Flow monitoring was conducted during the winter of 2001–2002 to identify sources and volumes of I/I in drainage basins throughout the separated sewer system.[4] On the basis of the flow monitoring data and a set of agreed-upon criteria, local agencies selected ten I/I pilot projects. The purposes of the projects were to determine if sources of I/I could be located and repaired and to gain a better understanding of the issues associated with implementing I/I reduction projects. Work on each pilot project consisted of identifying I/I sources through field investigations, designing and constructing rehabilitation improvements, and monitoring post-construction flows to determine the effectiveness of the rehabilitation. The projects were completed early in 2004.

The most important lesson learned from the pilot projects is that through monitoring, field investigation, and rehabilitation of sewer collection systems, it is possible to successfully identify, target, and reduce I/I—in large part because of strong collaboration between King County and local agencies at every step of the process. Rehabilitation technologies reduced I/I in eight of the ten pilot projects. The highest reductions occurred in projects that included rehabilitation of sewers on private property, indicating that significant reductions can be achieved where I/I originates on private property. Results also indicate that measurable reductions can be expected to occur only in areas with higher levels of I/I and only by focusing repairs on appropriate system components.

1.4.2 Draft Standards, Procedures, Guidelines, and Policies

RWSP policies require that the County, in coordination with component agencies, develop model conveyance system design standards, including inspection and enforcement standards, for use by

[4] Flow monitoring was also conducted in 2000-2001, but there was not enough rainfall to yield sufficient data.

local agencies to reduce I/I in their systems. In 2002, the County and local agencies drafted standards, procedures, guidelines, and policies and then applied them to the pilot projects to test how well they worked. In 2004, the County and the E&P Subcommittee revised the standards, procedures, guidelines, and policies to reflect lessons learned from the pilot projects.

The draft standards, procedures, guidelines, and policies address a wide range of topics, including connections to side sewers, pipeline and manhole leak inspections, system maintenance, and construction practices and materials for I/I control projects. They are intended (1) to guide the engineering and construction of future sewer system infrastructure (new and rehabilitated) to achieve long-term I/I control, and (2) to limit system degradation and I/I increases over time. The County and local agencies will continue to refine the standards, procedures, guidelines, and policies during implementation of the long-term I/I program.

1.4.3 Planning Assumptions

RWSP policies call for integration of I/I study results with planning for wastewater conveyance facilities. Since adoption of the RWSP, conveyance planning is now being conducted on a geographic basis by natural drainage basins. This approach allows for more detailed assessment of population growth, conveyance needs, and I/I control in each basin.

In spring 2004, the County and the E&P Subcommittee defined specific regional I/I control program planning assumptions. The planning assumptions include factors such as design flow criteria, population growth rates, water conservation, system degradation, septic conversion rates, new system I/I allowance, and unit costs and reduction effectiveness of different rehabilitation technologies.

The planning assumptions were used, in part, to project future I/I flow volumes, capacity demands, and I/I reduction rates for different repair techniques. Recently, the County used this information to complete a Regional Needs Assessment of its conveyance system. The assessment estimates through 2050 when conveyance facilities will need to be online to accommodate the 20-year peak flow.[5]

The Regional Needs Assessment and the regional I/I control program will form the framework for updating and modifying recommended conveyance system improvements. The I/I reduction rates in the planning assumptions will be applied to a the model to identify potential cost-effective I/I control projects that could reduce or eliminate the need for particular conveyance system capital projects. The model results, in addition to information in this alternatives/options report, will be used to develop a regional I/I control program.

1.4.4 Criteria for Benefit-Cost Analysis

Cost-effectiveness of I/I reduction will be determined through application of a benefit-to-cost ratio that compares the cost of I/I repair and rehabilitation projects to the cost of conveyance

[5] The 20-year peak flow design standard was mandated in RWSP policies and confirmed during development of the planning assumptions.

system improvement and treatment plant capacity projects. I/I reduction projects will be considered cost-effective if they meet two criteria, either on a regional or a project-specific basis:

- The I/I project must reduce, delay, or eliminate planned conveyance system improvements.
- King County's cost for the I/I reduction project must be less than the combined cost of treating I/I flows and the cost of the planned conveyance system improvement.

1.5 Next Steps

King County staff and the E&P Subcommittee will hold regular biweekly meetings, as needed, to discuss the topics discussed above and to move toward consensus on a preferred program alternative and its various program components. Meetings will take place from March through September 2005, when a final program recommendation will be developed.

The County is currently conducting a benefit-cost analysis, scheduled to be complete in the second quarter of 2005. From this analysis, a list of cost-effective I/I projects will be identified and their timing and locations will be determined. Once the list of cost-effective I/I projects and their associated cost savings from the existing Conveyance System Improvements budget are known, the County and local agencies can make informed decisions as they narrow in on a preferred program alternative.

By June 2005, a list of "least-cost" projects required to meet the RWSP's 30-percent regional I/I reduction goal will be prepared and presented to the E&P Subcommittee. The list will be derived from the same information and assumptions used for the cost-effectiveness analysis. The list of projects and associated costs necessary to reach a 30-percent reduction goal will inform decisions about the cost-effectiveness of achieving this I/I reduction goal.

By December 31, 2005, the King County Executive will submit to the King County Council a plan for a long-term Regional Inflow and Infiltration Control Program. The I/I program will be reviewed every other RWSP update cycle, or every 6 years.

Chapter 2

Direction and Process for Regional I/I Control Program

This chapter summarizes the background, goals, policies, and process for developing a regional infiltration/inflow (I/I) control program. It also provides an overview of I/I control program work completed to date. More detailed information on completed work, including supporting and background documents, is presented in the appendices.

2.1 Regional Wastewater Services Plan Direction: Goals and Policies

In 1999, King County adopted the Regional Wastewater Services Plan (RWSP) under Ordinance 13680. RWSP policies establish the framework and process for a regional I/I control program, as described below.

I/IP-1: King County is committed to controlling I/I within its regional conveyance system and shall rehabilitate portions of its regional conveyance system to reduce I/I whenever the cost of rehabilitation is less than the costs of conveying and treating that flow or when rehabilitation provides significant environmental benefits to water quantity, water quality, stream flows, wetlands, or habitat for species listed under the Endangered Species Act (ESA).

I/IP-2: King County shall work with component agencies to reduce I/I in local conveyance systems by the following:

1. By July 1, 2001, the King County Executive shall propose for County Council review and approval an initial list of pilot rehabilitation projects dealing with the most serious and readily identified I/I problem areas in local sewer systems.

2. By July 1, 2002, the King County Executive shall propose an additional list of pilot projects. The pilot rehabilitation projects shall be used to demonstrate the effectiveness of I/I controls in local sewer systems tributary to the regional system.

3. By December 31, 2002, the County, in coordination with component agencies, shall develop model local conveyance system design standards, including inspection and enforcement standards, for use by component agencies to reduce I/I within their systems.

4. By December 31, 2003 (now March 2005), the King County Executive shall submit to the County Council a report defining I/I levels in each of the local sewer systems, based on assessments of those systems, and identifying options and the associated cost of removing I/I

and preventing future increases. The options should be informed by the results of the pilot rehabilitation projects described in I/IP-2.1. The report shall present an analysis of options on cost-effectiveness and environmental costs and benefits, including, but not limited to those related to water quality, groundwater interception, stream flows and wetlands, and habitat of species listed under the ESA.

The report shall include information on public opinion, obtained through surveys and other appropriate methods, on the role of individual property owners in implementing solutions to reducing I/I, voluntary and mandatory property owner actions, willingness to pay for reducing I/I, and acceptable community options for reducing I/I.

5. No later than December 31, 2004 (now 2005[1]), utilizing the report described in I/IP-2.3, the King County Executive shall recommend target levels for I/I reduction in local collection systems and propose long-term measures to meet the targets. These measures shall include, but not be limited to, establishing new local conveyance system design standards, implementing an enforcement program, developing an incentive-based cost-sharing program, and establishing a surcharge program. The overall goal for peak I/I reduction in the service area should be 30 percent from the 20-year level identified in the report.

   The County shall pay 100 percent of the cost of the assessments and pilot projects.

I/IP-3: King County shall consider an I/I surcharge, no later than June 30, 2005 (now June 30, 2006[2]), on component agencies that do not meet the adopted target levels for I/I reduction in local collection systems. The I/I surcharge should be specifically designed to ensure the component agencies' compliance with the adopted target levels. King County shall pursue changes to component agency contracts if necessary or implement other strategies in order to levy an I/I surcharge.

2.2 Process for Regional I/I Control Program Development

The County and local agencies collaborated in developing the approach to a regional I/I control program. The County's collaborative approach included: (1) conducting nine workshops with the 34 local agencies that discharge sewage to the regional sewer system, and (2) conducting over seventy-five work sessions with the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) and one of its subcommittees, the Engineering and Planning (E&P) Subcommittee. This approach was and continues to be used to collaboratively develop an I/I control program.

[1] Because of lack of rainfall during the flow monitoring winter season of 2000–2001 and a corresponding lack of flow events, monitoring was continued during the 2001–2002 winter season. This additional monitoring delayed a regional I/I control program from the original RWSP schedule.

[2] Because of the 1-year delay that resulted from conducting flow monitoring in 2001–2002, the date for considering a surcharge was adjusted by a year in order to provide adequate time for the County Council to take action on the overall I/I program recommendation and then consider a surcharge.

As mentioned above, the County conducted nine County local agency workshops beginning in 2000 and continuing through 2003. The purpose of these workshops, which were attended by both policy makers and technical staff, was to review and reach agreement on key aspects of a regional I/I control program. The workshop topics are listed in Table 2-1.

Table 2-1. King County–Local Agency Workshop Topics

No.	Workshop Topic
1	Introduction, approach, and work plan for a regional I/I control program
2	Pilot project selection process and criteria; pilot project reimbursement and funding
3	Introduction to technical concepts
4	Financial concepts; alternatives for cost sharing
5	Modeling I/I flows
6	Design standards and rehabilitation techniques; contract management and language; private property I/I issues
7	Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) RWSP Subcommittee;[3] design standards, procedures, and policies
8	Pilot project selection
9	Pilot projects update, including sewer system evaluation survey (SSES) results; schedules

The County also collaborated with MWPAAC and the E&P Subcommittee to develop and recommend several specific regional I/I control program elements. These elements include the following:

- Design standards, policies, and procedures for I/I reduction projects
- Policies and intergovernmental agreements (IGAs) to guide I/I projects
- Criteria for benefits and costs of I/I projects
- Assumptions to model capital facility needs and identify I/I reduction projects
- Assumptions for cost-effectiveness analysis of I/I removal projects
- Issues related to I/I reduction on private property
- Issues related to financing I/I removal

In 2004, the E&P Subcommittee continued to work toward reaching consensus on a large number of complex issues related to the options presented in this report. The E&P

[3] Early in the process, MWPAAC's subcommittee was called the RWSP Subcommittee. This group was expanded to include other local agency representatives interested in I/I, and in 2003, the name was changed to the Engineering and Planning Subcommittee (E&P Subcommittee).

Subcommittee's consensus decisions guided the County and consultant team in developing this report and, along with input from the program workshops, allowed local agencies to shape the parameters of a regional I/I control program.

2.3 Work Completed to Date

This section provides an overview of the work completed to date. The information in this section draws from a number of documents, most of which are included as appendices. The documents contain detailed background information related to the completed flow monitoring, hydraulic modeling, regional sewer system assessment, and pilot rehabilitation projects; the development of draft regional standards, procedures, guidelines, and policies for I/I reduction projects; and the development of procedures for evaluating cost-effectiveness. These completed efforts established the framework, the technical information, and the tools that were used to develop this report. They will also be used to complete the cost-effectiveness analysis needed to identify specific I/I reduction projects, and to develop a regional I/I control program.

2.3.1 Flow Monitoring

In response to the RWSP directive (Policy I/IP-2.3) to assess I/I levels in existing local agency sewer systems, the County monitored wastewater flows throughout the service area during the 2000–2001 and 2001–2002 wet weather seasons. New hydrologic and hydraulic modeling software was obtained and used to identify the location and magnitude of I/I in each system. (For more detailed information on flow monitoring, see *Appendix B1*.)

For modeling purposes, 150 flow meters were used to divide the regional wastewater service area into 147 model basins.[4] These meters identified flow contributions from each model basin. The service area was further subdivided by the installation of an additional 650 flow meters in approximately 800 mini basins.[5] The mini-basin flows were used to identify levels of I/I and to assist in selecting appropriate locations for I/I removal projects.

Flow meters were installed during the rainy season of 2000–2001 to gauge flow levels from each local agency system. However, that winter brought an unseasonably low number of storms, resulting in insufficient wet-weather flow data. As a result, the flow meters were reinstalled during the wet weather season of 2001–2002. Several rainfall events during this season produced useful flow measurements that could be used to show I/I amounts.

Results of the 2001–2002 monitoring effort provided important geographic information about where the highest levels of I/I were in the region as well as an indication of how I/I enters the regional system. The geographic results show wide variation in I/I flow rates and volumes during storm events across the collection and conveyance system. I/I flow rates in the various mini basins range from a low of less than 1,100 gallons per acre per day (gpad) to a high of over

[4] Model basins were comprised of approximately 1,000 acres and 100,000 feet of pipe. The large-scale model basins were used to evaluate I/I flow rates throughout the regional service area.

[5] Mini basins were comprised of approximately 150 acres and 22,000 feet of pipe. Further subdividing the model basins into mini basins allowed I/I sources to be more accurately located, and identified areas more economically feasible to rehabilitate.

65,000 gpad. The monitoring data also yields information about how I/I is getting into local agency collection systems and then into the regional conveyance system based on how quickly I/I flows rise and fall in a particular mini basin during and after storm events.

Rapid inflow of water that corresponds closely with a peak rainfall event comes mostly from private property, typically from the following sources:

- Downspout connections to the sanitary sewer system
- Cracked side-sewer pipes
- Foundation drains
- Sump pumps

Although not typical, rapid inflow sources can also occur from public portions of the system, including storm drain connections to the sanitary sewer and leaky manholes.

Slow infiltration of water into the collection system is another source of I/I. Slow infiltration typically comes from groundwater and results in higher I/I flows remaining in the system for several days after the conclusion of a storm event. Slow infiltration typically finds its way into the system via leaky manholes, sewer mains owned by the local agencies or the County, and laterals that can either be privately owned or owned by a local sewer agency, depending on the rules in place in the 34 separate agencies.

Once sufficient large storm flow monitoring data were collected, the results were compiled and used to calibrate the hydrologic and hydraulic flow models for each basin. This calibration process used measured rainfall, measured flow data, and basin-specific pipe and service area information. The calibrated basin models were used to simulate I/I flows that could occur in the regional system using a 60-year rainfall record. The results of this 60-year simulation were used to estimate the 20-year peak I/I flow from each model basin. This peak I/I flow was measured in gallons per acre per day and served as an indicator for the performance of each local agency's system.

Please see Chapter 3 of the *Regional Needs Assessment Report* for more detailed information on I/I flows in the existing system.

2.3.2 Regional System Modeling

The County developed a computerized regional flow hydraulic model for analyzing sewer flow data and for determining cost-effectiveness of I/I reduction projects. The model was calibrated to flow data collected during flow monitoring (described above). The model is being used to estimate the timing of conveyance upgrade projects based on projected 20-year recurrence interval projected peak flow rates. In order to make these projections, the model includes historical rainfall data, historical flow data, sewered growth projections, and population and employment projections. Forecasted probable I/I reduction rates were then applied to identify potential cost-effective I/I reduction projects that could reduce or eliminate the need for a particular conveyance system improvement capital project. I/I removal effectiveness information gathered from the I/I pilot projects (see *Appendix B3*) was used to forecast the probable I/I

reduction that could be realized from a particular I/I local system repair or replacement project. The model results, in addition to information in this report, will be used to develop a regional I/I control program.

2.3.3 Standards, Procedures, Guidelines, and Policies

In response to the RWSP directive to recommend new local conveyance system design standards (I/IP-2.2), the County and local agencies (via the E&P Subcommittee) collaboratively developed draft conveyance system design standards, procedures, guidelines, and policies during 2002. In 2004, the County and E&P Subcommittee revised the standards, procedures, guidelines, and policies to reflect lessons learned from the pilot projects.

The draft standards, procedures, guidelines, and policies include a wide range of program details that address physical components of the collection system as well as policy issues. They comprise a mix of standards, procedures, guidelines, and policies for the County and local agencies. Some of the subjects covered are as follows:

- Storm drainage connections to the sanitary sewer
- Smoke and dye testing for sewer system evaluation survey (SSES) investigations
- Pipeline and manhole leak inspections
- Allowable connections to side sewers
- Public funding for all phases of I/I mitigation work
- County and local agency roles in public education programs
- Methods of gaining access agreements to do work on private property.
- I/I program funding
- Public education

A summary of these draft standards, procedures, guidelines, and policies is presented in *Appendix A3*. The complete *Standards, Procedures, and Policies Final Draft* is included in *Appendix B2*.

The draft *Standards, Procedures, and Policies* are intended to guide the engineering and construction of future sewer system infrastructure to achieve long-term I/I control, and to limit system degradation and I/I increases over time. They remain a draft document because further revisions and refinement are anticipated as additional experience with I/I reduction projects is gained. Questions also remain between the County and local agencies regarding whether some items should be employed as guidelines or as standards. This subject is discussed in more detail later in Chapter 4.

2.3.4 Pilot Projects

The County and local agencies reached consensus in April 2002 on the selection of 10 local agency collection system rehabilitation and replacement pilot projects "to demonstrate the effectiveness of I/I controls in the local sewer systems tributary to the regional system" (RWSP policy I/IP-2.1). Pilot project selection was a collaborative effort with MWPAAC, and useful information was gathered during the process. The County was the sole source of funding for most of these pilot projects. In two cases, both the County and host local agencies provided funding.

The local agencies established criteria for selecting the pilot projects at a program workshop. These criteria are described in detail in the *Pilot Project Report* (see *Appendix B3*).

The local agencies and County selected 10 pilot projects among 12 total local agencies. (One manhole rehabilitation project was proposed by three local agencies.) The selected pilot projects are presented in Table 2-2 by local agency service area and by the type of pilot project. The location of the pilot projects are displayed in Figure 2-1.

The pilot projects were completed in late 2003 and early 2004, followed by post-rehabilitation flow monitoring and modeling. The results were compared to the 2001–2002 monitoring and modeling findings to assess the effectiveness of various I/I reduction technologies and approaches. The pilot projects produced valuable information about the use of different technologies and administrative methods to reduce I/I. A brief summary of key findings is included here. Detailed information is available in the *Pilot Project Report* (*Appendix B3*).

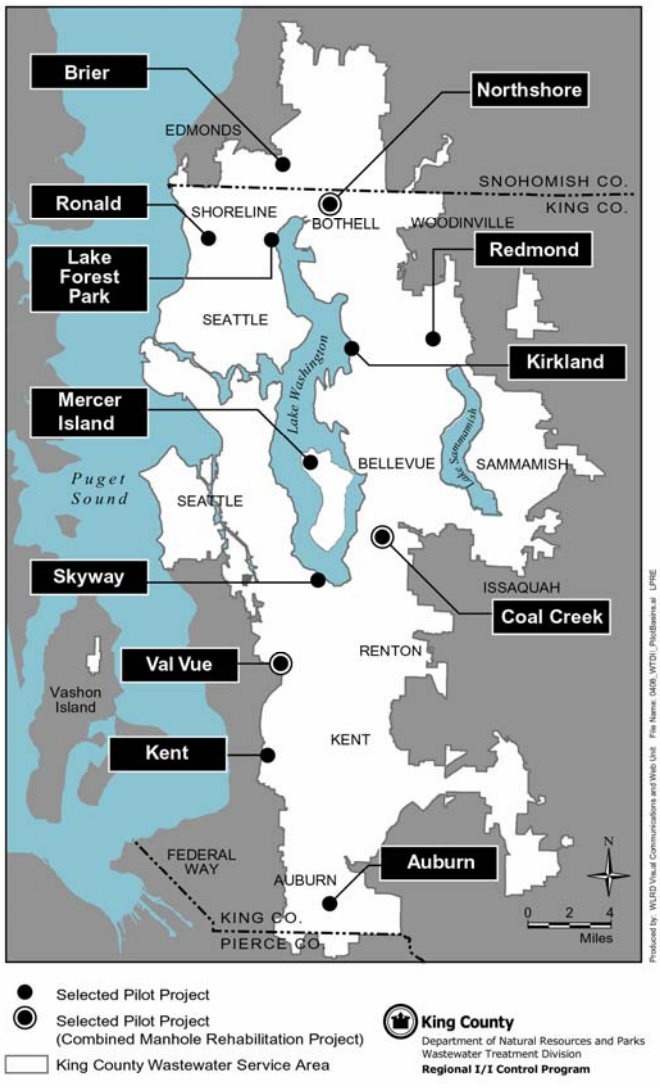

Figure 2-1. Pilot Project Location Map

Table 2-2. Pilot Projects

Local Agency Service Area	Type of Pilot Project
Auburn	Rehabilitate public manholes, sewer mains, and laterals; and private side sewers
Brier	Rehabilitate public manholes and sewer mains
Coal Creek/Northshore/Val Vue	Rehabilitate public manholes
Kent	Rehabilitate private laterals and side sewers
Kirkland	Rehabilitate public manholes, sewer mains, and laterals
Lake Forest Park	Rehabilitate public manholes and sewer mains
Mercer Island	Rehabilitate public sewer mains
Redmond	Rehabilitate public manholes, sewer mains, and laterals
Ronald	Rehabilitate private side sewers and some public laterals
Skyway	Rehabilitate and replace public manholes, sewer mains, and laterals; and private side sewers

Note: "Public" means owned by a local agency, and "private" means owned by property owners.

Key findings from the pilot projects are as follows:

- I/I reduction and control are achievable in areas where the source(s) of I/I can be identified and targeted by focusing repairs on the appropriate system components.
- Achieving significant I/I reduction is contingent on targeting large areas with high volumes of I/I for rehabilitation. In other words, measurable reductions in I/I can be expected only in those areas of the region with higher levels of I/I.
- Pipe bursting and cured-in-place pipe technologies are reliable for reducing I/I. Several other technologies were tested, but were relatively expensive or ineffective. This latter finding may be partially due to site conditions and not the technology alone. As an example, projects that focused on manhole and sewer main rehabilitation would not result in significant I/I reductions if the sources of I/I were primarily from private property.
- Based on lessons learned through the pilot projects, it is believed that where I/I originates on private property, significant reduction can be achieved.
- Coordination and communication between local agencies, contractors, and any other municipalities are essential.

The percent of I/I reduction and the percent of pilot basin improved for each pilot project are listed in Table 2-3. It is important to note that several pilot projects found "no measurable reduction." These projects were more focused on rehabilitation techniques and costs and therefore were not a real measure of percent of I/I reduction in all cases. For example, one pipe-bursting project that had been implemented in a residential area was also implemented in a high-density commercial area that happened to have small amounts of I/I. This was done to test for cost differences between residential and commercial areas. (See the *Pilot Project Report, Appendix B3* for more detail.)

Table 2-3. I/I Reduction Percentages for Pilot Projects

Pilot Basin	% I/I Reduction Achieved	% of Basin Improved
Auburn A	No measurable reduction	11%
Auburn B	No measurable reduction	19%
Brier	54%	23%
Coal Creek/Northshore/Val Vue (Manhole Project)		
Coal Creek	No measurable reduction	52%
Northshore	23%	64%
Val Vue	No measurable reduction	45%
Kent	78%	100%
Kirkland	28%	25%
Lake Forest Park	69%	35%
Mercer Island	37%	70%
Redmond	No measurable reduction	38%
Ronald	74%	72%
Skyway	87%	100%

It should be noted that no conclusions could be made regarding the cost-effectiveness of any of the I/I pilot projects. The purposes of the pilot projects were to see if I/I sources could be pinpointed and to test the applicability of rehabilitation technologies in field conditions. The pilot projects were not of a sufficient scale to identify whether any capital costs for conveyance systems or any costs for treatment could be reduced.

2.3.5 Regional I/I Control Program Assumptions

In spring 2004, the County and local agencies (via the E&P Subcommittee) used the results of the pilot projects and the experience of each local agency in working in their respective service areas to define specific regional I/I control program planning assumptions. The planning assumptions are meant to provide guidance for the modeling and cost-effectiveness analysis that will be used to compare specific I/I projects to related downstream conveyance system improvements. The planning assumptions include factors such as design flow criteria, population growth rates, water conservation, system degradation, septic conversion rates, new system I/I allowance, and unit costs and reduction effectiveness of different rehabilitation technologies. Other factors defined included the assumed discount rate, inflation rate, and O&M factors. Use of these assumptions should provide the greatest chance of identifying I/I projects that would be cost-effective if constructed and should also reduce the risk of identifying I/I projects that would not yield measurable I/ I reductions if constructed.

The planning assumptions will be used in a model designed to assess future facility needs including sizing and scheduling. The assumptions and model form the basis of the I/I reduction cost-effectiveness analysis. Goals for development of the planning assumptions were that they be

reasonable and realistic to avoid either under- or over-building and to meet the Growth Management Act requirement that the County regional conveyance system have the ability to convey wastewater flows from each local agency when those flows occur. It is anticipated that the County and local agencies will update and modify these initial planning assumptions over time as they gain experience and collect more information from future larger scale I/I rehabilitation projects. See *Appendix A4* for a detailed explanation of the planning assumptions.

2.3.6 Regional Needs Assessment Report

The *Regional Needs Assessment Report* provides a baseline description of the County's existing sewer system and outlines the conveyance improvements that would be necessary to convey 20-year peak flows. The report summarizes the monitoring, hydrologic, and hydraulic modeling that was completed to determine areas and volumes of I/I and to determine the resulting flows in the County's existing regional conveyance system. The following major elements are included in the *Regional Needs Assessment Report*:

- A description of the regional service area, the local agencies sending flow to the system, and the County's existing regional conveyance and treatment system.
- A summary of how the model was used to model system flows and capacity.
- A description of the I/I project rainfall and flow monitoring program that was used to collect data for input into the model.
- A discussion of the different types of fast-response and slow-response I/I components that make up total wet-weather 20-year design flows used to determine needed conveyance capacity.
- An explanation of how the rainfall and flow data were used to calibrate the model to determine flow volumes, including I/I, from wastewater service (mini and model) basins in the local agencies that contribute to the County's regional conveyance system.
- A description of how 20-year design flows, including I/I, were determined and then routed through the County's regional conveyance system to compare design flows with existing pipe hydraulic capacities.
- A listing of the characteristics and budgetary costs of County regional conveyance system improvement projects that would be needed to convey modeled 20-year design flows (without I/I reduction) in areas where the existing facilities are inadequate.

The *Regional Needs Assessment Report* and the I/I program (once approved by the County Council) are the framework for updating and modifying the recommended conveyance system improvements included in the RWSP.

2.4 Cost-effectiveness and Environmental Benefits

Policy I/IP-1 of the adopted RWSP directs the County to rehabilitate portions of the regional conveyance system to reduce I/I when the cost of I/I improvements is less than the cost of new conveyance and treatment facilities or when significant environmental benefits can be achieved.

2.4.1 Cost-effectiveness Analysis

To determine which I/I reduction projects are cost-effective, a computer model is being used to analyze capital facility and I/I reduction information. The analysis provides a means of estimating the ***costs of I/I reduction projects compared with the capital and operating costs of conveying and treating peak wastewater flows that include I/I***. See Chapter 6 for more detail.

A benefit-to-cost ratio will be calculated to determine cost-effectiveness for each I/I reduction project and to provide a ranking of the project compared to other I/I reduction projects. The benefit-to-cost ratio is based on the net present values (NPV)[6] of the costs and benefits for each project. The following formula shows how the benefit-to-cost ratio will be calculated for each I/I reduction project.

$$\frac{NPV(\textit{planned capital cost reductions, delays, \& eliminations}) + NPV(\textit{operating cost delays, reductions, \& eliminations})}{NPV(\textit{I/I project costs})}$$

This formula may be used in several ways. I/I project cost-effectiveness measures can be applied region-wide or on a project-specific basis. If applied region-wide, I/I projects that are less than or equal to the capital costs of conveyance system improvements ***in their entirety*** would be recommended. If applied on a project-specific basis, ***only I/I projects*** estimated to be less than or equal to the capital costs of capital conveyance system improvements would be recommended. The project-specific basis would result in the lowest ***combined costs*** for I/I projects and conveyance system improvements. See Chapter 4 for more detail.

2.4.2 Environmental Assessment

King County's Water and Land Resources Division (WLRD) conducted an assessment of the potential environmental benefits and/or impacts that may result from implementing a regional I/I

[6] Net present value is the amount that future sums of money are worth today after accounting for inflation and a specified rate of return.

program. WLRD's complete assessment is in *Appendix A5A*. The following text summarizes their findings.

The assessment considered the separate elements of I/I: stormwater inflow, stormwater infiltration, and base infiltration. Stormwater inflow responds most immediately to rainfall events. Its most common method of entry into the sanitary sewer system is via direct connections of downspouts and other stormwater collection features into sanitary sewer pipes. Stormwater infiltration responds to rainfall events over varying periods, ranging from immediately to delays of several hours. Common sources of stormwater infiltration are areas where cracked sewer service lines intersect intermittent subsurface flows of seasonally high groundwater. Base infiltration is the portion of the non-wastewater flow in sanitary sewer pipes that remains constant through time. Because base infiltration tends to come from deeper groundwater sources, it is difficult to quantify and is typically reported as an estimated volume.

The focus of an I/I program is to reduce flows during the wet season (stormwater inflow and infiltration). Stream flows and groundwater levels are typically high during the wet season. Where stormwater inflow and infiltration can be reintroduced into the landscape in a safely dispersed or infiltrated manner, environmental benefits may be achieved. However, the potential for erosion and localized flooding also exists. The type and scale of impacts depends highly on the volume of water reintroduced into the environment and the physical condition of the area that would receive the water. Therefore, it may be appropriate to perform a hydrologic assessment for each proposed I/I rehabilitation project that includes a downstream analysis and estimate of I/I volumes to be reintroduced into the local landscape and drainage system.

Chapter 3

Key Regional I/I Control Program Elements

The term "I/I control" refers broadly to all measures used to reduce levels of I/I in sanitary sewers. However, for development of a comprehensive I/I management program, two separate program elements need to be considered: direct I/I *reduction* and long-term I/I *control*. Reduction and control involve different approaches and strategies that work together to provide both near-term and ongoing elements of an effective I/I management program. These two approaches, discussed more thoroughly in this chapter, can be defined as follows:

Direct I/I reduction refers to sewer system rehabilitation or replacement projects that can be done in a targeted basin to reduce I/I flows and alleviate immediate downstream capacity constraints.

Long-term I/I control refers to policy, administrative, financial, and technical measures aimed at limiting future increases in I/I flow. Keeping the system in good repair minimizes future increases of I/I in the system. Long-term I/I control measures could include public education, design standards for new construction or rehabilitation, inspection and/or permitting requirements, new regulations or policies, and financial incentives.

In addition, this chapter discusses key legal and regulatory issues , including the ability to fund and implement I/I projects on public and private property, the ability to set and enforce long-term I/I control standards for collection agencies and private property owners, and issues relating to warranty and liability.

3.1 Direct I/I Reduction

Direct I/I reduction involves identifying sewer mini basins with high I/I volumes, and then reducing I/I by replacing or rehabilitating the whole mini basin or the portions of the system where specific sources of I/I have been identified within a mini basin. Mini basins are smaller sub-areas of a sewer model basin covering approximately 150 acres and containing about 22,000 linear feet of sewer pipe. Identifying I/I flow components for mini basins provides much more detail than the model basins, helping to more accurately identify where I/I flows are generated and how much rehabilitation investment may be required. Additionally, it would be more cost-effective to conduct I/I rehabilitation projects at the smaller mini basin level. This is because model basins are large and complex, averaging 1,000 acres and typically containing about 100,000 linear feet of sewer pipe. More discussion on basins and I/I quantification can be found in the *Regional Needs Assessment Report*.

I/I reduction techniques can include the use of one or more trenchless rehabilitation technologies such as cured-in-place lining or pipe-bursting sewer mains, side sewers, laterals, and/or manholes. Trenchless technologies are used whenever applicable because they are less invasive than excavating the existing pipe and replacing it with new pipe. Sometimes, however, excavation and replacement may be necessary.

3.1.1 Types of Projects to be Implemented

The capital conveyance facilities needed to accommodate future flows through 2050 in King County's regional sewer system were identified in a series of conveyance system improvement (CSI) reports.[1] These reports continue to be updated using the flow data collected as a part of this I/I program. The latest update is included in the *Regional Needs Assessment Report*, Chapter 4.

The CSI reports identify King County regional treatment plant upgrades and list necessary regional conveyance system pipe and pump station capacity improvement projects scheduled through 2050. The CSI reports also provide planning-level estimates of construction and project costs for each capacity improvement project.

To be cost-effective, an I/I reduction project, or set of projects, must be less costly (including capital and operations and maintenance) than projects that would otherwise be required to convey and treat the higher flows including I/I flows. (See the *Regional Needs Assessment Report* for more detailed information on how I/I flows in the existing system affect conveyance system needs.) In the King County regional sewer system, I/I reduction projects must meet two criteria to be considered cost-effective:

- The I/I reduction project must reduce, delay, or eliminate planned conveyance system improvements.
- King County's cost for this I/I reduction project must be less than the combined cost of treating I/I flows and the cost of the planned conveyance system improvement.

3.1.2 Program Funding

Several funding approaches and alternatives are being considered for both the reduction and long-term control components of a regional I/I control program. These approaches include County grants and/or loans to local agencies and/or private property owners and changes to rates or addition of surcharges. Other funding approaches include how rate revenues could be used to fund I/I control measures, how local agency contributions could impact projects, and how individual property owner payments or contributions could be incorporated into project funding.

For direct I/I reduction work, I/I projects must be cost-effective when compared with the costs of related conveyance and treatment system improvements. Funding of cost-effective I/I projects could be accomplished in four ways:

[1] http://dnr.metrokc.gov/wtd/csi/library.htm

County-funded—A cost-effective I/I project is funded by the County because it meets the two criteria described in Section 3.1.1 above.

County/local agency shared cost—The County and a local agency jointly fund an I/I reduction project to make it cost-effective for the County. If the planning-level cost estimates for a particular CSI project is used as the basis for determining cost-effectiveness, some I/I projects do not initially seem cost-effective because the projected cost for the I/I improvement exceeds the projected cost of the needed CSI project. However, because a local agency might receive incidental benefits from the I/I project, the agency may choose to contribute funds, thereby reducing King County's cost. The local agency contribution of funds could make the I/I project cost-effective for King County while at the same time providing the agency with a system upgrade that is partially funded by the County.

Private property owner participation—Private property owners participate in and fund rehabilitation projects for work on their property.

Funded as part of another project—An I/I reduction project that is not cost-effective as a stand-alone project could become cost-effective if other funding sources pay for related project costs (for example, resurfacing the street). This type of situation could occur when another agency's multipurpose project already includes funding for transportation, stormwater, and/or water improvement and an I/I improvement can coincide with that work to capture efficiencies and cost-savings.

Because multipurpose project funding depends on availability of other financing sources, construction timing for a multipurpose I/I reduction project can be different than the timing for a stand-alone project. A significant scheduling change would require re-evaluation of the cost-effectiveness of the I/I project.

Funding considerations that apply to both direct reduction efforts and long-term I/I control measures are discussed in further detail in Chapter 4. In 2005, the County and local agencies will discuss and develop decisions and agreements related to program and project funding.

3.2 Long-Term I/I Control

Long-term I/I control measures include policy, administrative, financial, and technical considerations that promote an ongoing program of review, maintenance, and repair of the collection and conveyance system. The objective of the program is to recover and maintain regional system capacity. Long-term I/I control measures would also help keep the system in good repair, which would minimize future increases of I/I in the system.

3.2.1 Policy Considerations

The County and local agencies are working together to shape key policy elements for consideration and adoption as part of the overall I/I control program. These policy measures would contribute to long-term I/I control in the region. The policy considerations include ways to

address private property I/I sources, inter-agency relationships and cooperation, and whether to establish specific I/I reduction goals and/or maximum I/I thresholds.

Private property I/I control—Based on information gathered from the pilot projects, it is believed that a significant amount of I/I may originate from privately owned components of the wastewater collection system. The I/I pilot projects demonstrated that considerable I/I reduction can be achieved in basins when these privately owned components are rehabilitated. Working on private property requires the cooperation of the property owner. The County and local agencies are continuing discussions about legal considerations and methods for funding improvements on private property over the long term.

Inter-agency relationships—Consideration of County and local agency interactions and formal relationships will be an integral part of any I/I control program alternative. The County and local agencies will continue their discussions about the nature and extent of inter-governmental agreements (IGAs) or service contract amendments related to implementation of an I/I control program and specific I/I projects that may be considered.

I/I Reduction Goals—The RWSP states that the overall goal for peak I/I reduction in the service area should be 30 percent from the 20-year peak level defined in the *Regional Needs Assessment Report.*[2] However, cost-effectiveness is also a significant I/I program goal. It may be determined through benefit-to-cost analyses that achieving 30-percent reduction is not cost-effective and that some other reduction goal may be more appropriate. The program alternatives, discussed in Chapter 4, address both the 30-percent goal and the cost-effectiveness measure.

Maximum Thresholds—Through continued discussions, the County and local agencies will consider whether or not a maximum I/I threshold for local agencies to meet should be incorporated into an I/I control program. Potential benefits and impacts of establishing an I/I threshold are discussed further in Chapter 4.

The County and local agencies will continue to discuss these policy considerations during development of a regional I/I control program in 2005.

3.2.2 Administrative Considerations

The County and local agencies are also evaluating ways to administer a regional I/I control program. Administrative considerations include the following:

Program management—Centralized program management would organize and manage follow-through for agreed-upon action items as well as coordination and communication during program implementation. Program management would also encompass planning, analysis, and integration of I/I control measures and conveyance needs.

Public education and involvement—Program alternatives must also include defining responsibilities for administration of public awareness approaches, including public

[2] King County Ordinance 13680, Section 7, I/I Policy 2.4 (I/I P-2.4).

education and involvement. Overall programmatic public awareness strategies should be considered as well as project-specific responsibilities and protocols. Project-specific public education and involvement decisions may be left to individual IGAs. Administration of the public involvement aspects of working on private property should also be considered.

Flow monitoring and ongoing system assessment—As part of a long-term I/I control program, ongoing or periodic system flow monitoring may be necessary to assess progress made at reducing I/I levels and meeting thresholds (if established). The frequency and scale of any flow monitoring efforts will need to be considered. For example, flow monitors could be placed at the agency level, model basin level, or mini basin level; data could be collected annually or less frequently. The monitoring choices made will result in levels of data collection with varied levels of associated cost.

Standards, procedures, guidelines, and policies—Currently in final draft form, a set of standards, procedures, guidelines, and policies were developed in partnership with the local agencies through the MWPAAC Engineering and Planning (E&P) Subcommittee. Development of a final version will be part of continued discussions between the County and local agencies in 2005 during development of a recommended program alternative. Key administrative considerations include implementation, compliance, future reviews, and uniformity of application.

3.2.3 Technical Considerations

With many of the program considerations described above, the following associated technical aspects need to be considered:

- Technical specifications or standards for design, construction, and inspection of new or rehabilitated sewers
- Methods and timing of monitoring and modeling sewer flows
- Technical criteria for flow monitoring, data management, and analysis
- Development of specific I/I reduction goals and thresholds if a policy decision is made to include them
- Decisions on planning assumptions to be used for modeling I/I in the sewer system and determining cost-effectiveness of I/I controls in relation to CSI improvements

The County and local agencies continue to work on these technical considerations.

3.3 Legal/Regulatory Foundation

One of the major policy considerations for a regional I/I control program will be how to manage I/I when it originates on private property. It is believed that I/I from private property constitutes a significant amount of the I/I entering the regional collection system. Four of the ten I/I pilot projects focused repairs on private property and achieved the highest levels of I/I reduction. By

contrast, I/I pilot projects that focused on repairs only on the public portion of the system achieved substantial reduction percentages but not as high as those that were located predominantly on private property. Therefore, the option of including I/I repairs on private property as one strategy in the overall I/I control program needs to be considered and explored. However, several legal questions must be addressed in order to consider inclusion of this strategy as a program option.

This section is not intended to provide the completed analyses or conclusions on these legal questions, but rather to introduce some of the key considerations and preliminary findings to inform further discussion and analysis. *Appendix A6* provides a listing of pertinent legal authorities related to this topic.

A primary question of the legality of spending public funds to make I/I repairs on private property is being explored and will continue to be analyzed and discussed in 2005 as the regional program options are developed. Preliminary research suggests that such expenditures would not constitute the unconstitutional gift of public funds under Article 8, Section 7, of the Washington State Constitution, provided that they have a public benefit outweighing the cost of other approaches to managing I/I and that any private benefit is incidental and not intended to be a gift.

These findings are based on the reasoning in the Supreme Court case *City of Tacoma v. Taxpayers of the City of Tacoma*.[3] This was an electrical utility case in which conservation expenditures on private property to achieve cost savings for the electrical utility were held not to be unconstitutional gifts of public funds. Concerns about the applicability of this case to a potential I/I program that uses public funds to make I/I repairs on private property will need to be analyzed and discussed more thoroughly as the program continues to be developed in 2005.

Additionally, Article 8, Section 10, of the State Constitution contains specific authority for the County to loan sewer utility revenues to private property owners to finance private property I/I repairs, provided that an "appropriate charge back" is made. Such a loan program is one alternative that could be implemented to deal with I/I originating on private property. However, initial research indicates that this constitutional provision would not pre-empt a program that directly funds the I/I repairs on private property without requiring the funds to be repaid. Again, more detailed discussion and analysis on this topic will occur in 2005.

Based on initial analysis it appears that King County and local agencies could consider three basic kinds of I/I programs affecting private property:

- Compliance program, based on existing ordinances and regulations
- Loan program, under the authority of Articles. 8, Section 10, of the Washington Constitution
- Publicly funded program, of the kind that has been judicially upheld in the *City of Tacoma* and other cases

[3] *City of Tacoma v. Taxpayers of the City of Tacoma,* 108 Wash. 2d. 679, 743 P.2d 793 (1987). (*City of Tacoma).*

Each would rely on a different combination of legal authorities, but they would not be mutually exclusive and could be used in combination with one another.

3.3.1 Compliance Program

King County and most local agencies currently have legislation and regulations that to varying degrees assert authority over the initial construction standards, types of flows accepted, and condition of the sewer pipes that are tributary to their collection systems. King County Code (KCC) 28.84.050 and regulations issued under it assert the authority to (1) require planning and design standards that will limit I/I; (2) prohibit discharge of several kinds of private property and municipal drainage into the sewer system; and (3) limit the overall amount of non-wastewater flow into the system. The County could consider implementing an I/I program based on amending and enforcing its sewage disposal regulations. Such a compliance program could be improved by amending the regulations to address I/I more expressly as a defined problem. The enforcement provisions would have to be improved before a I/I compliance program could be implemented.

In most cases, the local agencies have the primary responsibility for regulating the connection of privately owned sewer system components to the local and regional system. Each agency has enacted code provisions that regulate private sewer system components and restrict discharges. While there is no uniform approach, there seems to be a consensus on certain key points:

- **Permits and inspections are generally required.** Most local agencies require permits and an inspection before private sewer system components are connected to the local sewer.
- **The property owner is responsible for maintaining and repairing the sewer system components they own.**
- **Excessive and hazardous discharges into the sewer system are prohibited.** Stormwater, surface water, groundwater, roof drains, downspouts, condensation from coolants, and a variety of other unwanted discharges are restricted from entering the sewer system.
- **Sanctions are available for violations.** These sanctions typically include levying fines and charging the property owner for the costs of inspection and repairs. Other codes authorize disconnection of water or sewer service.

Advantages:

- A compliance program could build on existing sewer codes.
- It would be less costly to the County and local agencies if property owners bore the cost of repairing the sewer system components they own.

Disadvantages:

- The program would not be voluntary.
- It could increase the administrative burden of an I/I program.

- Enforcement might be difficult. Entry onto private property for inspection, mandatory repair, or storm disconnections should be done with the property owner's consent.
- It may be difficult to gain cooperation from individual property owners to complete all needed repairs in a timely manner. This difficulty could limit the extent of repairs in a particular basin, which is not conducive to reaching targeted reduction percentages in order to eliminate a needed downstream conveyance improvement.

3.3.2 Loan Program

Article 8, Section 10, of the Washington Constitution and RCW 35.67.360 clearly authorize the County and the local agencies to undertake an I/I loan program. From a legal perspective, the most straightforward approach to conducting an I/I program for privately owned sewer system components would be to implement a loan program with "appropriate charge back" provisions.

Advantages:

- This program clearly would be authorized by the Washington Constitution and Washington State law.
- It could be a voluntary program.

Disadvantages:

- Administration could be complex. Repayment requirements could be hard to enforce. Repayment through fees might be difficult to administer.
- Compliance may be difficult because participation would still involve a cost for property owners to bear.
- Although a voluntary program, it would provide little motivation for property owners to take loans.
- Scattered timing and limited extent of repairs for those accepting loan funding in a particular basin would not be conducive to reaching targeted reduction percentages in order to eliminate a needed downstream conveyance improvement.

3.3.3 Direct Purchase Program

A direct purchase program would involve public funding of repairs on privately owned sewer system components. Public funding could come from King County and/or the local agencies. The County in partnership with the local agencies could either pay the cost of sewer repairs or perform the work themselves. This program would need to rely on the authority of the *City of Tacoma* case, and related cases, to avoid challenge as an illegal gift of public funds. Based on the decision in the *City of Tacoma* case, a successful cost-benefit analysis for the I/I program will be a prerequisite to designing a constitutional direct purchase program.

Advantages:

- This would be a voluntary program.
- Participation would likely be improved. The pilot projects show 90 percent voluntary participation.
- The administrative burden would be smaller.
- Funding would be reliable.
- The program would foster cooperation with the local agencies.
- It would assure that timing and extent of repairs in a particular basin would be conducive to reaching targeted reduction percentages in order to eliminate a needed downstream conveyance improvement.

Disadvantages:

- There are potential risk factors, including liability, potential implied warranty, and restoration expenses.
- This might be a more expensive program for the County.
- Additional time and staffing levels may be required to obtain Right of Entry agreements with homeowners in target basins.
- It could be subject to legal challenge as an unconstitutional gift of public funds.

3.3.4 Summary

In summary, preliminary findings indicate that an I/I program involving repair of privately owned sewer system components could potentially take three forms: compliance, loan, or directly funded. These three forms are not mutually exclusive and could be combined in various ways. The use of public funds for an I/I program on private property in a loan program is authorized by Article 8, Section 10, of the Washington Constitution. There is some legal authority that public funds may be used on private property in a direct purchase conservation program under carefully defined circumstances. Legal issues remain with respect to all three alternatives, but all have sufficient legal basis to warrant further consideration.

Chapter 4

Summary of Alternatives and Program Components

4.1 Introduction

The Regional Wastewater Services Plan (RWSP) Policy I/IP-2 directs that a report be prepared and submitted to the County Council identifying alternatives and options for I/I reduction and control. This *Alternatives/Options Report* addresses that directive.

To develop the program alternatives and program components discussed below, the County worked collaboratively with the 34 local agencies through numerous meetings with the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) and its Engineering and Planning (E&P) Subcommittee. Lessons learned from the pilot projects were also used in developing the alternatives and program components. This is consistent with RWSP Policy I/I-2.3, which requires that the *Alternatives/Options Report* be informed by the results of the pilot projects.

This chapter describes four I/I reduction and control program alternatives that represent a range of choices for future evaluation. They should be viewed as a starting point for further discussion and analyses as a program recommendation is developed in 2005. In addition to the four alternatives, this chapter presents other program components where discussions and analyses are still under way and program components where agreements about direction have been reached. While this chapter presents alternatives and discusses outstanding questions that exist, it does not present the approaches to various components of a regional I/I reduction and control program that were considered and dropped from further consideration. These approaches are discussed in *Appendix A8*.

4.2 Alternatives

To develop a recommended I/I reduction and control program, numerous I/I program approaches need evaluation. This report narrows these approaches into four alternatives. These four alternatives provide a range of I/I reduction and control approaches from which to begin developing a recommended program alternative.

All four alternatives include distinct approaches to addressing core program components. The components include *I/I reduction*, measures of *cost-effectiveness* for I/I reduction projects, and I/I reduction *funding* approaches. I/I reduction refers to the percentage of I/I removed from local agency wastewater collection systems and the regional wastewater conveyance and treatment

system. It is the concept originally presented in RWSP I/IP-2.4. The measure of cost-effectiveness proposed at this point of program development is a benefit-to-cost ratio that compares the cost of I/I repair and rehabilitation projects to the cost of conveyance system improvement (CSI) and treatment plant capacity projects. Cost-effectiveness exists when system-wide benefits (in terms of costs) from construction of I/I reduction projects are less than or equal to the capital and operating costs of conveying and treating I/I flows. The measure can be applied on either a region-wide or a project-specific basis. Future analyses will address the possibility that a local agency contributes funding to make an I/I reduction project cost-effective.

The alternatives below contain either a specific reduction goal or strategies for achieving I/I reduction for the least cost. Note that actual I/I reduction achieved through implementation of any alternative will likely vary from the reduction level projected at the outset. Therefore, it should be expected that the actual I/I reduction level achieved would be established after any alternative is implemented.

The four alternatives and their associated program drivers are described below.

4.2.1 Alternative 1

Driver: Reduce peak I/I by 30 percent in the regional service area from the peak 20-year level.

This alternative reflects RWSP Policy I/IP-2.4, which states "The overall goal for peak I/I reduction in the service area should be thirty percent from the peak twenty-year level identified in the report."

The 30-percent goal is based on information obtained from other jurisdictions around the country during the development of the RWSP. It is not known if the goal is feasible in this region. If Alternative 1 is implemented, cost-effective I/I reduction projects that meet a 1:1 benefit-to-cost ratio would be implemented as a priority. Projects with greater benefits than costs (greater than 1:1; for example, a benefit-to-cost ratio of 2:1 saves two times as much as the cost) would accumulate savings that could be used for constructing additional I/I reduction projects. Once the cost-effective projects are implemented, additional I/I reduction projects, if necessary, would be implemented until the 30-percent reduction goal is met. Cost-effective I/I reduction projects, as well as additional projects that are not cost-effective as may be necessary to achieve the 30-percent reduction goal, would be funded through regional grants

4.2.2 Alternative 2

Driver: Implement I/I reduction projects that are found to be cost-effective based on a *region-wide* evaluation.

This alternative reflects RWSP Policy I/IP-1, which states: "King County is committed to controlling I/I within its regional conveyance system and shall rehabilitate portions of its regional conveyance system to reduce I/I whenever the cost of rehabilitation is less than the

costs of conveying and treating that flow." Implementation of this alternative should cost no more than constructing CSI and treatment plant projects region-wide.

All cost-effective I/I reduction projects with at least a 1:1 benefit-to-cost ratio would be implemented. I/I reduction projects would be funded through regional grants for cost-effective projects. Additionally, local agencies could contribute to bring an I/I reduction project up to the 1:1 benefit-to-cost ratio. Such funding could be from the local agency or from a County low-interest loan. Projects with greater benefits than costs (greater than 1:1; for example, a benefit-to-cost ratio of 2:1 saves two times as much as the cost) accumulate savings that can be used for constructing additional I/I reduction projects. The percent of I/I reduction at peak flow across the entire regional sewer system would be estimated based on the estimated cumulative reduction volumes of all proposed I/I reduction projects.

4.2.3 Alternative 3

Driver: Implement I/I projects that are found to be cost-effective based on a *project-specific* evaluation.

This alternative reflects RWSP Policy I/IP-1, as described in Alternative 2 above. However, it is different, and less expensive, than Alternative 2 because each I/I reduction project would be evaluated for cost-effectiveness based on its own cost savings in comparison to the costs of conveying and treating wastewater flows with higher levels of I/I. Each I/I reduction project would need to meet the 1:1 benefit-to-cost ratio individually. The savings from I/I reduction projects with greater benefits than costs would not fund other I/I reduction projects that are not cost-effective. The methods for estimating and evaluating actual I/I and for funding I/I reduction projects are the same as in Alternative 2. Projects would be funded through regional grants, and local agencies could contribute funding to bring an I/I reduction project up to the 1:1 benefit-to-cost ratio. Such funding could be from the local agency or from a County low-interest loan to the agency.

4.2.4 Alternative 4

Driver: Set a fixed maximum I/I threshold expressed as gallons per acre per day (gpad) at peak flow for each local agency. The maximum threshold would be uniform for each agency that had initial I/I levels exceeding the threshold. However, agencies starting out with I/I levels lower than the maximum threshold, would need to maintain that I/I level with an agreed-upon allowance for pipe degradation over time.

This alternative, which reflects RWSP Policy I/IP-2.4, provides incentives for each agency to meet an established maximum allowable amount of I/I under peak flow conditions. Importantly, local agencies with I/I lower than the established maximum threshold would be required to remain at that lower I/I flow level, with agreed upon allowances for degradation over time. This is because the regional conveyance and treatment system is designed and constructed to convey existing and projected peak I/I flow quantities for those agencies, not the maximum amount allowed by a higher threshold.

Alternative 4 differs from the other three alternatives in that it relies more on regulating the local agencies and less on regional cooperation to reduce I/I levels. It establishes maximum gpad thresholds for each of the local agencies. Because regional system capacity analysis is based on existing I/I 20-year recurrence peak flow rates plus a 7-percent-per-decade flow degradation[1] (with a maximum of 28 percent to occur over 40 years[2]), agencies with I/I levels below the threshold must maintain their existing I/I flow level, including the allowance for degradation. The I/I reduction percentage is based on the percent of I/I reduction region-wide, assuming that each agency contributes either I/I equal to the established maximum threshold or an actual flow amount for those agencies with I/I levels under the threshold. The measure of cost-effectiveness is not applicable to this alternative because the local agencies would be responsible for implementing I/I reduction projects in order to meet the required threshold, including funding of I/I reduction projects or making arrangements with property owners to correct defective private sewer system components that are I/I sources.

Agreement would have to be reached with the local agencies on the level of the gpad thresholds to be established in order to implement this alternative. Extensive monitoring would be necessary to evaluate whether local agencies are meeting their established thresholds. Incentives and/or penalties (such as a surcharge) could be required to attempt to achieve and maintain thresholds over time.

4.3 Other Program Components

In addition to the alternatives discussed above, the County and local agencies (via the E&P Subcommittee) have identified six other program components for a regional I/I reduction and control program. These components include establishing an I/I threshold; inclusion of pre-1961 pipe systems; rates, implementing incentives, and surcharges; addressing private property issues; developing standards, guidelines, procedures, and policies for project investigation, design, construction, and inspection; and educating and involving the public. The following section describes each of these components and discusses outstanding issues currently being evaluated.

4.3.1 I/I Threshold

A peak-flow-period I/I threshold is a maximum allowable level of I/I that should enter the regional treatment and conveyance system during periods of peak flow (typically occurring during storm events). If established, local agencies would be required to meet the I/I threshold.

King County Code, Section 28.84.050 stipulates the sewage disposal rules and regulations for local agencies discharging to the metropolitan sewer system. Currently, Subsection 28.84.050 K.3 defines the flow allowance for groundwater infiltration and stormwater inflow as 3.06 cubic

[1] Degradation is the slow change in a sewer collection system that allows an increase in I/I flows. Degradation is due to cracks in the pipe, pulled joints, connections at manholes, construction damage, traffic damage to manholes, and so forth. For more detailed information, see *Appendix A7*.

[2] The maximum 28-percent degradation figure is a planning assumption. This assumption, like all other planning assumptions, is subject to modification as more experience is gained from I/I reduction projects.

feet per acre times the sewered area in acres. Flow volumes for any 30-minute period that exceed this flow allowance are considered excess flow. Per the contracts between the County and the local agencies, excess flow is subject to an additional charge.

When converted to an equivalent gallons per acre per day (gpad) of I/I, the allowable flow translates to 1,100 gpad. Regional monitoring and modeling indicate that this may be an unrealistically low limit. Whether or not it is realistic, the contract provision has not been enforced. Currently pipes constructed prior to 1961 are exempt from this provision. (The issue of pre-1961 pipes is discussed in Section 4.3.2.)

Establishing a peak-flow-period I/I threshold could be a useful tool for maintaining relatively low I/I levels in the regional system over time because it would provide local agencies with a flow standard to meet. The value of a threshold could be based on the I/I reduction goal ultimately established by the region. Considering the four program alternatives described above, an I/I threshold could be based on flow levels necessary to maintain a 30-percent reduction goal, or a goal established after implementing all identified cost-effective I/I rehabilitation projects, or some other agreed-upon reduction goal. While the potential benefits of an I/I threshold can be easily explained, setting a threshold value and putting it into practice would be more complicated. Currently, the amount of peak-flow-period I/I entering the regional system from specific basins in local agency systems varies from a low of about 1,100 gpad to a high of around 65,000 gpad. This means that the impact of implementing a threshold would not be the same for each agency. Some agencies could be required to make significant repairs and upgrades to their systems while others may actually be operating below an established threshold. This condition also presents an additional complication because the planned capacity of the regional conveyance and treatment system assumes that agencies that have low levels of I/I will maintain those levels (with some allowance for degradation) over time. Establishing a uniform threshold that allows some agencies to increase their I/I flows could actually reduce regional system conveyance and treatment capacity.

Setting and maintaining an I/I threshold is not without costs either. Detailed monitoring of flows within the system would be necessary to measure different agencies' flows in relation to an established threshold. Based on the experience gained in monitoring flows to develop this program, annual flow monitoring costs could be several million dollars per year or more depending on the level of monitoring required.

Discussions with MWPAAC members will continue to address questions about the potential benefits and impacts of establishing an I/I threshold, whether or not a uniform threshold should be established, and what the threshold value(s) should be.

4.3.2 Inclusion of Pre-1961 Pipe Systems in an I/I Program

The regional conveyance and collection system was originally established in 1961 when local agencies signed their contracts with the Municipality of Metropolitan Seattle (Metro) to send their wastewater to Metro's treatment plants. Those original contracts allowed additional fees to be charged for excessive stormwater or groundwater from facilities constructed after 1961. These contract provisions have the effect of exempting sewage collection pipes built before 1961 from

being subject to any standards or fees associated with groundwater or surface water (I/I) entering the system.

Because sewer pipes built before 1961 represent the oldest parts of the system, they are also often a source for high levels of I/I. A question for consideration is whether these older pipes should continue to be treated differently than the newer parts of the system.

Pre-1961 sewer collection pipes exist in nearly all local agency service areas. Given the nature of sewage collection systems, the older pipes exist as segments throughout a system. In other words, it is common for pipes built before and after 1961 to be connected together and wastewater to flow into and out of older and newer pipe as it makes its way through an agency's collection system to the County's regional conveyance and treatment system. Given this physical condition, it may appear that a simple approach to managing, and potentially regulating, I/I flows from local agency systems is to treat all the pipes that make up a system equally because they are all connected together. However, such an approach is not consistent with long-standing contract conditions between local agencies and the County.

The consideration of whether or not pre-1961 pipes should be treated the same as newer pipe relates directly to the potential for establishing a maximum I/I threshold and whether or not a surcharge penalty would be levied for exceedance of that threshold. Surcharge options, which are discussed in more detail in the next section, will need to include consideration of whether or not an exemption for pre-1961 pipe to a threshold and surcharge should be maintained. While maintaining this exemption would be consistent with current contract conditions, it would also pose logistical monitoring problems for isolating flows from newer pipes.

The pipes built prior to 1961 can be significant contributors to regional I/I flows. Therefore, any I/I rehabilitation program that is eventually implemented will include projects to pinpoint leaks in pre-1961 pipes and repair and/or replace those pipes as necessary. However, prior to making any conclusions about the costs or benefits of counting flows from pre-1961 pipe in a regional I/I threshold and surcharge requires further analyses to determine feasibility and to measure the potential costs and benefits.

The pipes that make up the sewer collection system are also being routinely repaired or altered. An additional issue to be considered for this program component is at what point do repairs and alterations to a pipe installed prior to 1961 change its condition to the point that it should be classified as a new pipe.

The County and MWPAAC will be addressing these issues as they work to develop an I/I program recommendation in 2005.

4.3.3 Rates, Incentives, and Surcharges

The RWSP I/IP-2.4 directs that an I/I program recommend target I/I levels and long-term measures to meet the targets: "These measures shall include, but not be limited to…developing an incentive based cost sharing program and establishing a surcharge program." The RWSP further directs that "King County shall consider an I/I surcharge, no later than June 30, 2005 (now 2006), on component agencies that do not meet the adopted target levels for I/I reduction in

local collection systems. The I/I surcharge should be specifically designed to ensure component agency compliance with the adopted target levels. King County shall pursue changes to component agency contracts if necessary or implement other strategies in order to level an I/I surcharge" (RWSP Policy I/IP-3).

While the overall objective of an I/I program would be the reduction of capital costs system-wide and the potential reduction in rates, options for ensuring compliance with I/I standards include whether or not surcharges, incentives, and variable rates should be established. Note that the options identified here are variations of the same thing: ways of charging for non-compliance with I/I reduction and control requirements. Descriptions and discussions of each option are as follows.

- ***Surcharges*** are an additional fee that could be charged to local agencies that discharged more I/I to the regional system than authorized. Essentially, they are local agency fees or penalties for exceeding a predetermined I/I threshold or for causing increased costs related to conveying and treating I/I.
- ***Incentives*** provide financial rewards, in the form of lower rates or rebates, to local agencies that operate at or below an I/I threshold. However, because the funding source for all wastewater treatment system functions is the County's wastewater rate charged to local agencies, funding for incentives would have to be reflected in the County's rate. The practical effect of an incentive program would be that additional fees would be charged to local agencies that exceed a predetermined I/I threshold, similar to a surcharge.
- ***Variable rates*** would establish different rates based on whether or not a local agency meets I/I reduction and control requirements. Variable rates provide both incentives and penalties, and are based on a local agency's I/I contribution. Agencies that have higher I/I levels pay higher rates; those with lower I/I levels pay lower rates. While this approach may provide a financial incentive to reduce I/I flows, it departs from the long-standing practice of charging uniform rates.

Fundamental questions remain between the County and local agencies regarding whether or not surcharges, incentives, or different rate structures would have any positive impact on I/I levels in the regional system. Agencies may find it less expensive to pay a surcharge or higher rates in lieu of paying for I/I improvements. In addition, the revenue generated from surcharges or higher rates may not be enough to pay for I/I rehabilitation projects. The local agencies have suggested that they be allowed to make investments in their own system in lieu of paying surcharges or variable rates.

As is the case with the I/I threshold issue, administration of a surcharge, incentive, or variable rate program would include significant administrative and monitoring costs that would likely be several million dollars per year or more. A portion of the administrative costs would need to cover site investigations to determine if I/I from some sites should actually remain in the wastewater system. An example is the stormwater collected at the County's solid waste transfer stations and directed to the sanitary sewer system. This is done to protect public health because the stormwater has the potential to be exposed to garbage as it travels across transfer station sites.

Questions about whether or not the revenues necessary to cover monitoring and administrative costs would be better spent on I/I repair and rehabilitation projects requires further examination and discussion. More detail about rates, incentives, and surcharges can be found in *Appendix A1*.

4.3.4 Private Property Issues

I/I flow monitoring, modeling, and pilot project data indicate that a significant amount of the total peak flow of I/I in the region is from private property sources.

The cost and potential disruption associated with reducing I/I from private property sources are considerable and affect the ability and willingness of property owners to undertake corrective actions. There are also constraints, including issues of legality and equity, that the County and local agencies must address if public funding is used to defray some or all of the cost of private sewer rehabilitation. For additional detail regarding these issues, see *Appendix A6*.

Inspection of private property to find sources of I/I rests primarily with local agencies that directly provide wastewater collection services to residents and businesses in the region. The local agencies typically have inspection and repair standards within their own regulations that they administer. These standards vary because they were developed independently by each agency.

4.3.5 Standards, Procedures, and Policies

Through numerous meetings, the local agencies and the County developed a working draft of *Standards, Procedures, and Policies* to be used in the pilot projects. They include a mix of standards, procedures, guidelines, and policies for the County and local agencies. Some of the subjects covered are as follows:

- Establishing proper construction practices and materials for I/I repair and rehabilitation projects
- Encouraging appropriate inspection and testing prior to acceptance of new or rehabilitated sections of sewer
- Developing inspection and repair standards for new and existing structures on private property
- Encouraging appropriate system maintenance
- Providing appropriate predesign, investigation of I/I conditions, inspection of construction, and enforcement of standards

These standards, procedures, guidelines, and policies were applied and tested on the pilot projects. From the lessons learned, a final draft version was developed. A more detailed description of the standards, procedures, guidelines, and policies is included in *Appendix A3*. The entire final draft document is included for reference in *Appendix B2*.

Potential benefits derived from requiring uniform standards and procedures for repair and rehabilitation work region-wide may include long-term reductions in I/I volumes and maintenance costs. However, there is not agreement about whether mandatory standards and procedures are necessary to realize these benefits. The County and local agencies continue to discuss whether they should be implemented as requirements region-wide or as a mix of standards and guidelines for the local agencies. There is general agreement that they could be applied uniformly as requirements for I/I repair and rehabilitation projects paid for by County wastewater revenues. However, the local agencies generally believe that they should be used mainly as guidelines for I/I projects and other work that the local agencies would be funding in their respective service areas.

4.3.6 Public Education and Involvement

The pilot projects implemented by the local agencies and the County indicate that property owner participation increases with knowledge about I/I and its impacts on the costs of wastewater conveyance, treatment, and disposal. Participation levels in the pilot projects were also likely influenced by the fact that private property owners benefited from free rehabilitation work on their property. Still, implementation of an I/I reduction and control program, especially one that includes private property and/or rate issues, necessitates some amount of public education and involvement.

The RWSP includes policies for obtaining public input in developing an I/I program (I/IP-2.3). Additionally, the Public Involvement Policies section of the RWSP states the following: “King County shall maintain public information/education programs and engage the public and component agencies of local sewer service in planning, designing and operating decisions that affect them” (PIP-7).

The County and local agencies generally agree that a public education and involvement program is a necessary and beneficial part of any I/I program that is developed and implemented. The role of the County and local agencies in such a program is still open at this time. Several options are still being considered. One option would have the County act as the lead on all regional efforts, while local agencies would be responsible for public education efforts in their service areas. Another approach is to have the County and local agencies work cooperatively to develop and implement both regional and service-area specific education and involvement programs. A third approach would have local agencies take complete responsibility for all public education and involvement efforts. Additional discussion of these options will likely take place later in 2005 as the recommended overall I/I reduction program begins to take shape.

4.4 Program Components with a Single Approach

Three identified program components have clear direction because they are governed by regulation and adopted policy or are based on information gathered through the I/I pilot projects.

They include the regional I/I control program assumptions, the regional I/I control program review period, and environmental review.

4.4.1 Regional I/I Control Program Assumptions

Regional I/I control program assumptions are divided into two categories:

- **Planning assumptions—**used to model future facility needs, including size and timing of new regional sewer system components
- **Reduction assumptions—**used to define I/I reduction project effectiveness, costs, and project design and construction factors

These assumptions are necessary for conducting a detailed cost-effectiveness analyses, which are currently under way and will be completed in the spring of 2005. The assumptions identified here are critical components of a regional I/I reduction and control program evaluation. The County and the E&P Subcommittee collaborated on formulating the assumptions, with the intention that the assumptions meet the following criteria:

- Be reasonable and realistic.
- Appropriately size regional conveyance system facilities and I/I improvements.
- Lead to facilities that meet the Growth Management Act requirement that the regional system be able to convey flows from each local agency concurrent with growth. King County has adopted the additional standard that facilities be sized and timed to provide sufficient capacity to accommodate 20-year peak-flow events.

Following completion of the pilot projects, the County and local agencies (via the E&P Subcommittee) used a collaborative process to discuss and agree on a set of assumptions for the I/I program. The assumptions are being used for conducting cost-effectiveness and I/I removal analyses. These assumptions have been incorporated into a model developed by the County. *The Regional Needs Assessment Report* contains a more detailed discussion of the model and its use in the development of a program recommendation in 2005.

Appendix A4 contains a detailed presentation of the assumptions. Each assumption is listed, and the agreed-to values are shown.

4.4.2 Regional I/I Control Program Review Period

The RWSP indicates that a long-term regional I/I control program necessitates some amount of tracking; specifically flow monitoring and program review. To be manageable and feasible, such monitoring and review (via modeling) need to gauge progress made in I/I reduction and need to occur at certain intervals.

The RWSP is currently expected to be updated every 3 years. The approach for reviewing the I/I program is to review it every other RWSP cycle, or every 6 years. A 6-year review period allows enough time for I/I project design, construction, and post-construction flow monitoring to occur.

4.4.3 Environmental Review

Each proposed I/I rehabilitation or repair project may have environmental impacts in its specific project area; especially if the project area includes streams, steep slopes, wetlands, or other sensitive areas. Therefore, each I/I project will be subject to project-specific environmental review procedures required by the State Environmental Policy Act (SEPA) and other applicable drainage and erosion control standards. Complete environmental review will consider the potential for environmental impacts during both wet (high-flow) and dry (low-flow) seasons. For further discussion and analysis of environmental review, see *Appendix A5*.

Chapter 5

Public Outreach Program

As part of the RWSP mandates, the I/I program has surveyed the general public each year to learn what residents know and understand about I/I in their communities; and in some cases specifically what residents learned about I/I as a result of having a pilot I/I reduction rehabilitation or replacement project constructed in their neighborhood. Local agencies and King County will use this information to develop materials to help explain what residents can do on their own properties to reduce private property I/I flows into their local systems. It is important that the local agencies are involved in this effort as some cities and agencies have very specific guidelines or ordinances on what can be done with downspouts and stormwater coming from private property.

5.1 Summary

In autumn 2000, King County conducted a small public opinion survey concerning water quality[1] that asked two I/I-related questions. Results from this survey and from four focus groups conducted by the I/I program consultant team in autumn 2001 showed that the average citizen has little or no knowledge about I/I issues. Accordingly, the I/I program should not be undertaken in 2002 but rather after completion of rehabilitation pilot projects in 2004. In the interim period, the County's program Web site contained general information about the I/I program and, in 2003, residents and businesses within I/I pilot rehabilitation project areas received project-specific information.

In autumn 2003 as a part of King County's water quality survey, residents were asked where their home down spouts connected.[2] Following completion of the pilot projects, a telephone survey of residents was conducted in November 2004. This telephone survey was the largest public opinion gathering effort completely focused on I/I. The purpose of this survey was to investigate homeowner opinion on possible solutions to the problem of clean water infiltration of the sewer system.

5.2 Results of 2000–2004 Surveys

2000-2001: With very few exceptions, participants in the 2000 telephone survey and the 2001 focus groups were initially unaware of any problems caused by I/I. Once informed, many expressed skepticism about the seriousness of problems and asked how anyone could be sure of something they could not see.

[1] King County Department of Natural Resources, *Fall 2000 Public Survey.*
[2] King County Department of Natural Resources and Parks, *2003 Water Quality Survey.*

While most homeowners acknowledged their responsibility to fix anything within their property limits, they seemed unwilling to pay for the work unless they were mandated to do so or could visually see proof of the problems. Participants preferred easier inflow reduction steps to those that involved infiltration and pipe replacement. They also felt that the public system should be fixed before private property concerns were addressed.

All four focus groups agreed about the need to educate the public about I/I problems. They suggested that before the public could support an I/I reduction program, they would have to be educated about the actual cost of conveying and treating wastewater and stormwater, the conveyance and treatment capacity that wet weather I/I requires in the system, and methods of correcting the problem. The focus groups wanted positive messages and said the messages must be credible and understandable in order to have an effect on the public.

2003: Results showed that half (50%) of residents said they channel runoff from rain into their yards, 21% connect their down spouts directly to the sewer, and 13% discharge into the street. Most residents (61%) are likely to pay for repairing or replacing the sewer line that serves their property if it is faulty. Three respondents in four indicated that they were unaware of I/I entering local agency systems from private property sources.

2004: Between November 14 and 18, 2004, 400 telephone interviews were conducted with homeowners within the regional wastewater treatment area plus an additional 100 interviews within three pilot project areas: the City of Kent, Skyway Water and Sewer District, and Ronald Wastewater District. Full survey results and detailed findings comparing regional differences plus countywide and pilot area differences are in *Appendix A7*. The report highlights the following six points:

1. **Homeowners support spending on the program**

   A strong majority of residents in the wastewater service area (63%) and the pilot project areas (70%) support their sewer provider spending money on programs to reduce the amount of clean water that gets into sewer lines.

2. **A supermajority of homeowners say they are willing to pay an additional $1.00 per month to help reduce I/I.**

   Well over three-quarters (83%) of homeowners in the service area and three-quarters (76%) of homeowners in the pilot project areas say they would pay an additional $1.00 per month to help pay to reduce the amount of clean water going into the sewer lines.

3. **Homeowners are divided over who should pay for main line repairs, but a majority feel costs should be shared in some way.**

   Two-thirds (65%) of residents support sharing the costs of repairs across the service area. Residents are divided, however, on where the bulk of the share should fall. A third (35%) say costs should be shared equally across the service area, a third (30%) think customers in districts where the problems occur should pay more, and nearly a quarter (22%) think customers in the district where there is a problem should pay 100% of the costs.

4. **A majority of homeowners think the property owner should pay the total cost for side sewer repairs.**

   A majority (54%) of residents think property owners should pay the full cost of side sewer repairs. This is divided between a third (33%) who think residents should have access to low interest loans, while 21% think that property owners should find their own means to pay 100% of costs. Forty-two percent think these costs should be shared across the service area.

5. **Homeowners are divided over who should pay for land repairs resulting from side sewer work on private property, but homeowners agree that property owners should share some of the burden.**

   Residents are divided with a third (31%) saying that property owners should pay 100% and slightly more than a third (37%) saying the costs should be shared, either in the local sewer district (13%) or across the regional district (24%).

6. **Many homeowners think fixing I/I problems should be mandatory. Half of the homeowners think it should be the owner's decision whether or not to disconnect roof drains on private property.**

   Half (52%) of homeowners think property owners should be required to fix I/I in side sewers. At the same time, half (49%) think property owners should decide whether to disconnect their roof drains from the sewer system.

Local Survey: In early 2004, the Ronald Wastewater District conducted a survey of residents within its I/I reduction pilot project area. The survey focused on gathering opinions about all phases of the District's pilot project (planning through construction). The district received a 32% response rate from 264 mailings. More than 50% were satisfied or very satisfied that the District's public meetings conveyed the project description and were held at a convenient time and location. More than 73% were satisfied or very satisfied that the work was completed promptly, the contractor was responsive to them, and that they understood the type of work to be performed. And 84% thought that the disturbance level was reasonable during construction.

5.3 Pilot Project Public Information Efforts

In 2003, 10 pilot projects were done to evaluate the effectiveness of various I/I rehabilitation techniques and to document the effectiveness in reducing excessive I/I flows. Several pilot projects were done on private property. To help explain the I/I projects to residents and business owners, several outreach efforts were used.

In some areas meetings were held to provide information. Both photographs and videos were used to show residents the potential impacts from various I/I rehabilitation techniques. At the Ronald and Skyway open houses, district staff collected signed rights-of-entry for private properties. More than 2,500 households and businesses received by mail or hand-delivery project-specific notices with County and agency contact information regarding the work. More

detailed information was sent to more than 550 private property owners where rehabilitation work was undertaken.

The County expanded its program Web site to include highlights for each project and a direct link to local agency Web sites. During construction, several project information signs were installed in each pilot area. In addition to the local agency and County insignias, the signs included a 24-hour message number that immediately paged a County project manager. This instant contact provided residents with direct 24-hour access to project managers who could help answer questions, listen to concerns, or help with emergencies.

The experiences gained from the pilot project information effort demonstrates that direct communication with residents about I/I rehabilitation projects generates support and cooperation from residents. Direct public information efforts will need to be an important part of any recommended I/I program because a majority of I/I comes from private property.

Chapter 6

Next Steps

The previous chapters of this *Alternatives/Options Report* outline the program options and components for further analysis and discussion by King County and MWPAAC agencies in 2005. This report, along with the *Regional Needs Assessment Report*, were called for in RWSP Policy I/IP-2.3. The County and local agencies will use these reports as a basis for narrowing the options and program components presented here to one preferred program alternative that the Executive will submit to the King County Council by December 31, 2005. This chapter outlines the necessary next steps in the decision making process, including specific analyses, reviews, and meetings that must take place leading up to the selection of a preferred program alternative and its submittal to the Council in December 2005.

6.1 Regional Needs Assessment Report

The *Regional Needs Assessment Report* defines the levels of I/I within local agency collection systems and identifies the updated conveyance facility needs based on the recent flow monitoring conducted for the I/I program.

The *Regional Needs Assessment Report* is a product of several components, including flow-monitoring data that feeds into the MOUSE™ hydrologic and conveyance system hydraulics models to generate the future flow information and projected capacity needs for all portions of the regional conveyance system. Identification of the conveyance facility improvement needs, as well as their proposed timing, location, and estimated costs provide the basis for the I/I cost-effectiveness analysis that will follow.

The full *Regional Needs Assessment Report* is being submitted to Council along with this *Alternatives/Options Report.*

6.2 Cost-Effectiveness Analysis

Once future regional conveyance system capacity needs are identified and costs are estimated, a separate cost model will be used to estimate the costs of I/I reduction projects upstream of identified conveyance improvement projects. The cost model will use planning assumptions developed jointly by the County and local agencies, including assumed costs of specific I/I reduction methods, assumed reduction effectiveness percentages, contingency and other factors. The costs of conveyance system improvements will be compared with the estimated I/I reduction costs to arrive at the cost-effectiveness comparison on a project specific basis.

From this analysis, a list of cost-effective I/I projects will be identified along with their timing and locations. Once the list of cost-effective I/I projects and their associated cost savings from

the existing Conveyance System Improvements (CSI) budget are known, it will be possible for the County and local agencies to make informed decisions as they narrow in on a preferred program alternative. The cost-effectiveness analysis is being completed on a parallel track with the *Alternatives/Options Report* and will be complete in the second quarter of 2005. As the information from this analysis becomes available, it will be presented to the E&P Subcommittee for their review and input.

6.3 Financial Feasibility Analysis of a 30-Percent I/I Reduction Goal

The RWSP states that the overall goal for peak I/I reduction in the service area should be 30 percent from the peak 20-year level identified in the *Regional Needs Assessment Report.* By June 2005, a list of "least-cost" projects required to meet the 30-percent goal regionally will be prepared and presented to the E&P Subcommittee for their consideration. This list will be derived from the same information and assumptions used for the cost-effectiveness analysis and will include cost estimates, timing, location, and impacts to regional facilities of I/I reduction projects. The list of projects and associated costs necessary to reach a 30-percent reduction goal will be discussed with the E&P Subcommittee and will inform the decisions to be made about the cost-effectiveness of achieving the 30-percent I/I reduction goal.

6.4 Analysis of a Regulatory Approach: Thresholds, Surcharges, and Monitoring Requirements

Another potential program component discussed in this report is a regulatory approach, including possible maximum I/I thresholds or sewer surcharges. A regulatory component could be added to any program alternative, or a regulatory approach could be a central program driver (as described in Alternative 4). This potential program component must be analyzed further to determine how an appropriate surcharge would be structured. Any threshold level will need to be set and evaluated in terms of cost to local agencies and benefit to the regional system and future capacity needs. A threshold approach would require a monitoring and enforcement program. This monitoring and enforcement program would have an administrative structure and cost to the County and local agencies that would need to be further analyzed. The County will work with the E&P Subcommittee to develop and discuss possible threshold levels and analyze the associated costs and system impacts, while working toward consensus on whether to include a regulatory component in the overall long-term I/I control program.

6.5 Further Analysis of Private Property I/I Program Options

As discussed in Chapter 3 of this report, I/I flows originating on private property contribute a majority of I/I to the regional collection and treatment system. Thus, a long-term regional I/I control program must include approaches to rehabilitating I/I sources on private property. Three possible approaches could be pursued independently or in some combination. They include a regulatory program; a loan-based program; and a directly funded program in which the County or local agencies pay for I/I repairs on private property without requiring the property owner to pay back the agency.

A directly funded program could provide important advantages, allowing the County or local agencies to target I/I reduction in a particular basin upstream of a needed conveyance improvement project. By directly funding I/I projects, the participation of private property owners could be maximized, and most importantly, rehabilitation work could be done according to the schedule necessary to reduce I/I flows prior to the needed construction start date on a CSI project.

An analysis of all three approaches has been initiated; preliminary findings indicate they all could be feasible. Further analysis of the three possible approaches for reducing I/I flows from private property will continue in 2005. This further analysis will inform the County and local agencies as they jointly work toward a recommended program approach.

6.6 Immediate Next Steps

King County staff and the MWPAAC E&P Subcommittee will hold regular meetings as needed to discuss the topics outlined above and move toward consensus on a preferred program alternative and its various components. Meetings will take place from March through September 2005, when a final program recommendation will be developed. The Executive will submit the preferred program to the Council by December 31, 2005.

Glossary

Alternatives	Four identified, distinct I/I program approaches.
Assumptions	Factors that are used in the modeling efforts. They are divided into "planning assumptions" and "I/I reduction assumptions." Planning assumptions are used for determining regional facility needs and upgrades, while I/I reduction assumptions are used in identifying potential I/I reduction projects.
average wet-weather flow (AWWF)	The average flow between November 1 and April 30 on days when no rainfall has occurred on the previous day. Composed of the average base flow and the average infiltration/inflow (I/I).
base flow	Wastewater flow (not including inflow and infiltration) originating from residential, commercial, and industrial sources. Base flow can also refer to the portion of streamflow contributed by groundwater as opposed to runoff.
components	Specific elements that have been identified as parts of an I/I control program.
conveyance system	A system, consisting of trunks, interceptors, force mains, pump stations, and other facilities which move wastewater from one place to another.
cost effectiveness analysis	An analysis that is used to determine if an I/I reduction project provides more County regional facility benefits and cost savings than it costs to construct the I/I reduction project.
cured-in-place (CIP)	Process of curing a resin that has been saturated in a fabric. The fabric is typically formed within an existing structure and will provide a rigid lining when the resin has fully cured.
cured-in-place pipe (CIPP)	Cured-in-place liner cured within a host pipe.
degradation	Degradation is the slow change in a sewer collection system's condition that allows an increase in I/I flows. Degradation is due to cracks in the pipe, pulled joints, connections at manholes, construction damage, traffic damage to manholes, etc.
direct connections	Connections to the sewer system, usually located on private property, that allow rain and stormwater to flow into the sanitary sewer (for example, roof gutter drains, catch basins, sump pumps, and foundation drains).
Earth Tech Team (ETT)	A collection of firms, led by Earth Tech, that are providing consulting services to King County on the Regional I/I Control Program. The firms include Tetra Tech/KCM, HDR Engineering, Cosmopolitan Engineering Group, RoseWater Engineering, ADS Environmental Services, Financial Consulting Solutions Group, Shannon and Wilson, and Triangle Associates.

Endangered Species Act of 1973, as amended (ESA)	Federal statute that provides protection for species of fish, wildlife, and plants that are listed as threatened or endangered.
Engineering and Planning Subcommittee (E&P)	A subcommittee of MWPAAC that was assigned the role of working with County staff and the Earth Tech Team in developing the *Alternatives/Options Report* and various other I/I control program products.
fast response to rainfall	The water that quickly enters a wastewater conveyance system in response to rainfall. Typically this may be from pipe connections from storm sewers or combined sewers, catch basins, downspouts, and/or other surface runoff.
flow monitoring	A sewer flow project that measured flows in the region and in local agencies to better define the amount of peak flows related to I/I.
groundwater	Water that infiltrates into the earth and is stored in the soil and rock within the zone of saturation below the earth's surface. Groundwater is created by rain, which soaks into the ground and flows down until it is collected at a point where the ground is not permeable. Groundwater then usually flows laterally toward a river, lake, or ocean. It is often used for supplying wells and springs.
groundwater table	The upper limit in the soil of underlying material permanently saturated with water.
Growth Management Act (GMA)	A Washington state law (Chapter 36.70A RCW), guided by procedural criteria and adopted by the Washington State Department of Community Development, that provides a legal framework and guidance for the preparation of comprehensive plans, development regulations, and other land use planning for local governments.
hydrologic analysis	The study of the intensity and frequency of rainfall and the subsequent distribution and magnitude of flow into the wastewater conveyance system.
infiltration	The water that enters a wastewater conveyance system from the ground through means such as corroded or broken pipes, pipe joints, foundation drains, etc.
infiltration/inflow (I/I)	The total quantity of water from both infiltration and inflow without distinguishing the source.
I/I control	Measures that can be taken to address I/I concerns over an extended time period.
I/I reduction	A sewer system project that is constructed with the intent of reducing I/I in the sewer system.
inflow	The water discharged into a wastewater system from sources such as roof leaders, yard and area drains, foundation drains, cooling water discharges, drains from springs and swampy areas, manhole covers, cross connections from storm sewers and combined sewers, catch basins, surface runoff, and street wash waters.

lateral	The portion of the private sewer service pipe on public right-of-way. Where the sewer service pipe is on private property, it is called a side sewer. See also "side sewer".
local agencies	Municipalities (Cities) and water and sewer districts that provide local sewer service and receive wholesale wastewater services from King County.
manhole	A vertical shaft covered by a lid at ground level that provides access for maintenance of an underground pipe.
Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC)	MWPAAC advises the King County Council and Executive on matters related to water pollution abatement. It was created by state law and consists of representatives from the cities and sewer districts that operate sewer systems in King County. Most of these cities and sewer districts deliver their sewage to King County for treatment and disposal.
mini-basin	Drainage basins that were delineated as part of the 2000-2001 and 2001-2002 flow monitoring seasons. These basins were divided based on approximately 20,000 linear feet of sewer main within the basin.
mitigation	Avoidance of an adverse impact by not taking a certain action or parts of an action; minimizing adverse impacts by limiting the degree or magnitude of the action and its implementation; rectifying an adverse impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating an adverse impact over time by preservation and maintenance operations during the life of the action; compensating for adverse impacts by replacing or providing substitute resources or environments.
model	A computerized program that mimics the actual flow and conditions of the sewer system and that can be used to determine the cost effectiveness of I/I reduction projects.
options	Choices that are under consideration for each of the I/I control program components.
packer	An inflatable plug that is placed inside a pipe and expanded with air pressure.
peak flow	The highest base flow and infiltration/inflow expected to enter a wastewater system during wet weather at a given frequency that the treatment plant is designed to accommodate.
pilot basin	That portion of a mini-basin that was selected as a pilot project where rehabilitation work was actually performed for the pilot projects.
pilot project	Mini-basin that was selected as a demonstration rehabilitation project for the King County I/I Control Program.
pre-1961 pipe	Sewer system pipe that was in place prior to 1961. County/local agency contracts indicate that the County will accept flows from these pipes.

private property	Property owned by a private individual or entity that includes the side sewer and in some cases the lateral that connects the side sewer to the publicly owned sewer main.
rates, incentives, and surcharges	These are methods available for generating funding for I/I control program implementation and provide one approach for ensuring that local agencies address I/I concerns.
Regional Wastewater Services Plan (RWSP)	A capital improvement program adopted by the King County Council in December 1999 (through King County Ordinance Number 13680) to provide wastewater services to the County service area through 2030.
Revised Code of Washington (RCW)	A compilation of laws of the State of Washington published by the Statute Law Committee.
sanitary sewer	A pipeline that carries household, industrial, and commercial wastewater.
sewage	See wastewater.
sewer	A pipe that carries wastewater and/or stormwater runoff from the source to a treatment plant or receiving water. Sanitary sewers carry household, industrial, and commercial wastewater. Storm sewers carry runoff from rain or snow. Combined sewers are used for both purposes.
shoring	Props or posts of timber or other material in compression used for temporary support of excavations, formwork, or unsafe structures.
side sewer	The portion of the private sewer service pipe on private property. Where the sewer service pipe is on public right-of-way it is called a lateral. Also see “lateral”.
Side Sewer Evaluation Survey (SSES)	A technical and engineering evaluation of a sewer system that is intended to determine sewer system defects, and specifically for this I/I program to focus on I/I sources and volumes.
slow infiltration	Infiltration into a wastewater conveyance system that is characterized by a slow increase in flow during a rainfall event. This increased flow may take several days or weeks after a storm to decline.
sole source	Specifying a product that only one manufacturer provides.
Standards, Procedures, and Policies	These are a set of standards, guidelines, procedures and policies that are to be used or considered when planning, designing, and constructing I/I reduction projects. These were used in constructing the pilot projects and are included as a final draft appendix to this Report.
State Environmental Policy Act (SEPA)	A Washington state law (Chapter 43.21C RCW) that requires state agencies and local governments to consider environmental impacts when making decisions regarding certain activities, such as development proposals over a certain size, and comprehensive plans. As part of this process, environmental impacts are documented and opportunities for public comment are provided.

storm drain	A system of gutters, pipes, or ditches used to carry stormwater from surrounding lands to streams, lakes, or other receiving water. Also refers to the end of the pipe where the stormwater is discharged.
stormwater	The portion of precipitation that does not percolate into the ground or evaporate. Stormwater flows across the ground surface in channels or ditches, or flows within pipes.
surcharge	The process of filling a conveyance pipe as a means to control sanitary sewer overflows.
surface water	Any water, including fresh water and salt water, on the surface of the earth.
threshold	A realistic, enforceable limit on I/I for local agencies.
trenchless technology	Construction techniques that require little or no trenching to construct the improvements.
wastewater	The water and wastes from homes and businesses that enter pipes and are transported to treatment plants for treatment and disposal.
wetland	Land with saturated soils that are at least periodically inundated and that under normal conditions support vegetation suited to such environments. Wetlands include swamps, marshes, and bogs.

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Appendix A1

Rates, Incentives, and Surcharges Technical Paper

Appendix A1

Rates, Incentives, and Surcharges Technical Paper

A1.1 Sources of Funding

As noted in Chapter 3 of this report, there are two elements of an effective infiltration and inflow (I/I) program: direct I/I reduction and long-term I/I control. There are several different financial alternatives for each program component, and they include both regional and local agency financing as well as grants and other funding sources. For each type of funding source, there are also several different alternatives for determining what type of funding approach is used, how the funding is shared between King County and the local agencies, how the County rates are designed to affect local agencies regarding I/I related costs, and what administrative and operational procedures are necessary to implement different financial alternatives.

For direct I/I reduction projects, the primary financing source is County funding from Conveyance System Improvement (CSI) and treatment projects that are planned if no I/I program is implemented. To use funding that is otherwise used for CSI and treatment projects, a direct I/I reduction project must be cost effective (that is, it must have more benefits than costs). Cost effective I/I reduction projects are defined as those projects that reduce, delay, or eliminate CSI and treatment projects and that have more County savings from reducing, delaying or eliminating related CSI and treatment projects than the costs associated with the I/I reduction project. Other financing sources also include savings from reducing, delaying, or eliminating treatment plant improvements and from the reduced operating and maintenance costs to convey and treat lower flows.

When I/I reduction projects are not cost effective for the County, a local agency could contribute local funds to make a project cost effective for the County. Depending on the amount of a local contribution and its percentage of the total costs, such a contribution not only provides the

County with a cost effective I/I reduction project, but a local agency also benefits by funding an improvement to its system at less than the full project cost. In addition, as part of a multi-purpose project where a local agency or other jurisdiction already has funding for cost elements that are normally included as part of an I/I project (such as street resurfacing), this type of funding can be used to reduce the County's I/I project costs for non cost-effective projects and to help make a project cost effective.

For a long-term I/I control program component, the primary financing source is funds from the County's rates that are charged to the local agencies. Besides using funding directly from rates, other specific financing sources for I/I reduction projects or long-term I/I control program components could include state and federal grants and loans, County-specific bonds, local agency funds, and possibly, funding from private property owners.

A1.2 Financial Strategies

Although funds from County rates could be the primary source of financing, the County can use several financial approaches to implement direct I/I reduction projects and long-term I/I control programs and policies. Depending on what policy and program objectives are established for implementing various I/I program components, such as an I/I reduction goal or I/I threshold, different financial strategies could be used to help implement the I/I reduction goals through local agencies (for example, financial strategies that use either a proactive and incentive-based approach or a more enforcement and penalty-oriented approach). The status quo approach could also be continued. These financial strategies may or may not cause local agencies to reduce I/I flow or make I/I reduction investments. It should be noted that the financial strategies identified in this section will require the review of the County's Prosecuting Attorney's Office for their legality or for the requirements necessary to satisfy any legal issues that could be raised.

A1.2.1 Proactive

A proactive approach uses financial strategies that provide positive financial incentives to encourage local agencies to reduce I/I flows by making improvements through direct I/I reduction projects or through long-term control measures. Such positive incentives have the potential to lower a local agency's costs for reducing I/I to meet the I/I program goals and standards. These types of positive, proactive financial strategies include the following:

- County grants to local agencies for the full cost of I/I reduction projects that are cost effective
- Opportunities for local agencies to contribute their own funding, resulting in I/I reduction projects that are cost effective
- Loans from the County to local agencies for cost effective I/I reduction projects to help local agencies meet cash flow needs and reduce debt service costs
- Loans or grants to private property owners to repair I/I problems on private property

- A lower overall rate or rate credits, rebates, or discounts given to local agencies when local agencies meet specific I/I criteria for reducing or controlling I/I flows

A1.2.2 Enforcement

An enforcement and penalty-oriented approach uses financial strategies that are designed to charge or penalize local agencies if they do not meet specific I/I goals or standards, such as I/I thresholds or other agreed upon I/I standards. These types of enforcement-oriented financial strategies include the following:

- Impose a higher overall rate or rate surcharges and penalties on local agencies when they do not meet specific I/I criteria for reducing or controlling I/I flows
- Require local agency investments and funding in I/I control projects and measures to meet the I/I criteria without County financial assistance in lieu of paying higher rates or surcharges
- Require repairs and investments by private property owners if I/I repairs are needed, assuming that the County or local agencies have the legal authority to require such repairs

A1.2.3 Status Quo

There is also the choice to maintain a status quo approach in which local agencies continue to pay the same rate and must invest in I/I control using their own funds. Except for funding cost effective I/I reduction projects, the I/I program establishes no financial incentives or penalties for local agencies. Depending on the I/I policies and goals, the County and local agencies must assess whether such a financial strategy helps meet and sustain its long-term I/I policies and goals.

A1.3 Rate Issues and Options

The primary funding mechanism for the I/I program could be through the rates the County charges local agencies. Any debt funding for I/I projects or loans to local agencies must eventually be paid for through the rate that the County charges the local agencies for its wastewater-related services. Utility rates are generally designed to recover the cost of service, and there are several different types of cost sharing approaches that can be used to design rates and to create financial incentives and penalties for local agencies. How I/I costs and benefits are incorporated into the County's rate structure depends on the timing of I/I costs and benefits, how costs and benefits are shared between the County and local agencies, and what type of rate structure is used to reflect the County's financial strategies. The following discussion provides an overview of rate issues. Additional details need to be identified as specific cost effective I/I reduction projects and long-term control programs and costs are defined. There are several rate issues that the County and local agencies could consider to determine what financial strategies can be used to implement an I/I reduction program. Depending on the financial impact on a local agency, changes in the rate structure may or may not result in I/I reduction investments.

A1.3.1 Earlier Rates

One potential impact of implementing I/I reduction projects is that project funding is needed earlier than the planned CSI and treatment project schedule. As a result, when compared with the rates needed to support the planned CSI and treatment project schedule, the County's rates could be higher earlier in the schedule to meet the funding needs of the I/I projects, but could then result in smaller rate changes later in the schedule. It should also be noted that rate changes related to I/I costs are not the only reason why the County's rates change over time. Other non-I/I projects and program costs also affect overall rate changes in the future.

A1.3.2 Cost Sharing

Historically, the County (and Metro before it) levied a flat charge per equivalent residential unit (ERU) for all wastewater-related services (except for the one-time fee for new connections paid directly to the County). The ERU charge does not vary between local agencies based on the level of I/I flows or any other factor. This cost sharing rate structure has been called the "all for one and one for all" approach. The basic premise is that all local agencies are treated equally. This "collective" perspective assumes that I/I reduction benefits all local agencies equally because all local agencies benefit from the reduced, deferred, or eliminated capacity expansions contemplated in the CSI and treatment project plan and the Regional Wastewater Services Plan (RWSP). This perspective recognizes that I/I is more a regional than local problem and that surface water and groundwater flow between local agencies without regard to political boundaries. With this perspective, rates are based on the use of a regional average cost approach.

Two other types of cost sharing were introduced at an I/I program workshop. These two other approaches include a cost-driven approach ("those who cost the most should pay the most") and a benefit-driven approach ("those who benefit the most should pay the most"). The guiding principle for these two approaches is that for most utility systems, it costs more to serve some entities or customers than others.

Cost-driven

Recognizing this disparity, the cost-driven approach suggests that local agencies pay in proportion to the costs that they impose on the regional system. Both the amount of I/I and the cost of the I/I measures necessary to eliminate or mitigate I/I may vary considerably among the County's local agencies; or, more generally speaking, among the major drainage basins. Because some agencies contribute more to higher I/I program costs than others, this approach suggests that those causing higher I/I costs should pay more than those causing lesser costs.

A cost-driven approach can be based on several indices, and two potential measures that could be considered include I/I contribution and I/I reduction cost. Both of these measures could be used as a basis for a cost sharing structure. The difference between the two is subtle but significant:

- **I/I/Contribution.** Use of the actual I/I contribution as an index for distributing the cost-sharing burden could most closely match I/I program costs with those local agencies (or major basins) contributing I/I to the regional system. Each local agency's share of costs could be related to its relative contribution of I/I.
- **Cost of I/I Reduction.** This method focuses not on the degree of I/I contribution, but rather on the cost of reducing I/I in the local agencies' systems. That is, an I/I problem with an inexpensive solution (for example, raising and sealing a manhole periodically covered by surface flows) results in a lower cost share to a local agency than an I/I problem with an expensive solution (for example, removing and replacing a failed sewer main in a densely developed area with unstable soil). Using this method, the relative cost of reducing I/I from each local agency (or major basin) is more important than the degree of I/I contributed by the local agency (or major basin).

Benefit-driven

The benefit-driven approach recognizes that the benefits of many collective endeavors are not shared equally among all participants. Recognizing this benefit disparity, the benefit-driven approach suggests that local agencies pay in proportion to the benefit received from a collective undertaking. Some benefits are purely collective, while others may vary from local agency to local agency. Because some local agencies may receive greater benefits than others, a benefit-driven approach is based on the premise that those receiving greater benefits pay more than those receiving lesser benefits.

From a County-wide perspective, the main benefit of cost effective I/I reduction is that the region can potentially reduce its investments for the CSI and treatment projects because of reduced, deferred, or eliminated wastewater capacity expansion and the associated operation and maintenance costs. However, local agencies also experience agency-specific benefits from I/I reduction at the regional level, depending on the nature and intensity of an I/I program goals and standards. Local agencies could enjoy two types of benefits from an I/I program: direct and indirect.

- **Direct Benefits.** Local agencies could receive discrete, focused benefits from the County through an I/I reduction program. For example, local agencies in which the County rehabilitates or replaces facilities effectively receive free capital facilities repair and/or improvements.
- **Indirect Benefits.** Local agencies could experience indirect benefits from the County through an I/I reduction program. For example, if wastewater flows in a local agency diminish following a regional I/I rehabilitation program, the local agency could avoid other capital costs (for example, a pump station upgrade). Local agencies could also receive non-utility benefits when I/I reduction projects occur, such as street and right-of-way improvements. In other cases, improvements made in one local agency's system could also impact another local agency.

A benefit-driven approach accounts for these local agency-specific benefits when distributing costs to local agencies. Local agencies receiving direct and/or indirect benefits are expected to

pay a proportionately higher share of the cost for the regional program than local agencies receiving no direct or indirect local benefits. Rate structures consistent with the benefit-driven approach could begin with a common charge for the regional benefits received by each local agency, and then charges could be adjusted up or down for local agencies depending on the degree of local benefit received.

A1.3.3 Rate Design and Structure

Depending on whether a proactive or enforcement approach is used, rate structures can be designed to provide the incentives or penalties to reflect the cost sharing approach and financial strategies that the County and local agencies want to use to implement the I/I program. A wide variety of rate structures are used by wastewater utilities. Rates may vary by season, with local agencies paying more during high-flow periods (generally winter months) than during low-flow periods. Further, fixed rates may be complemented or replaced by charges that vary with volume, contribution to I/I flows, or other factors.

Figure A1-1 shows a continuum of potential rate structures, ranging from purely fixed and uniform to entirely variable. The far left end of the continuum represents a fully fixed, uniform structure as currently employed by the County. Further, an equivalent residential unit (ERU) is universally defined based solely on estimated or measured domestic flows. Under this current structure, an ERU count is the only quantitative index applied in rate setting. At the right end of the continuum is a rate structure that varies by time and by a more variable quantitative index of system capacity (for example, total flow, peak flow, relative I/I contribution, I/I costs or reduction benefits) with no fixed charges at all. Between these two extremes there are several potential rate structures that could combine fixed and variable features.

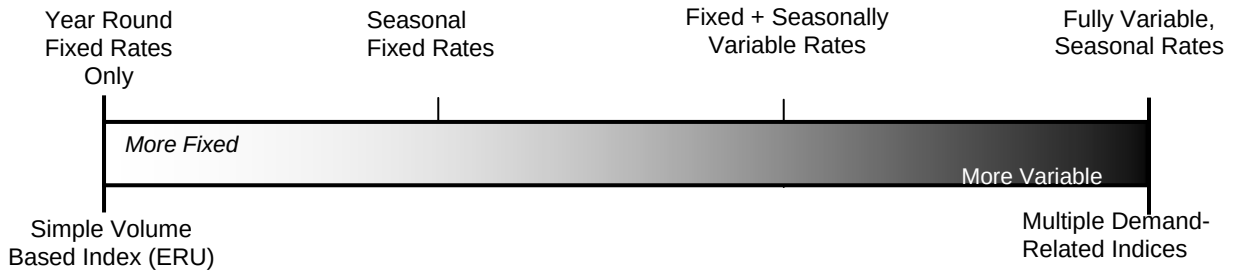

Figure A1-1. A Basic Rate Structure Continuum

As described above, the County and its local agencies have a variety of basic rate structures available to pay for an I/I control program. The previously discussed financial strategies identified several different rate options for providing incentives or penalties for local agencies to reduce I/I and meet the I/I program goals for reducing I/I. The following identifies and briefly describes a number of rate features and financial strategies that could be appropriate to facilitate I/I program cost sharing using either the collective, cost-driven, or benefit-driven approaches.

In the proactive and incentive-based approach, lower base rates, rate rebates, discounts, and loans were identified as positive incentives for local agencies.

- **Lower Base Rates.** Local agencies have different I/I flows, and to reward those local agencies that have done a better job of controlling and reducing I/I, a variable rate structure could be used that offers lower rates for those local agencies that have low I/I flows. The rate structure could have several steps that increase the base rate at certain I/I threshold levels.
- **Discounted Rates.** One means of varying rates while retaining a basically uniform structure is to offer discounts from the basic, uniform charge for local agencies that meet established I/I program standards. For example, all local agencies could pay a single fixed charge per ERU, but local agencies (or treatment regions or interceptor zones) with I/I contribution levels below an established threshold standard could receive a discount from their basic rate. Discount threshold standards could be based on a set, measurable I/I goal expressed in gallons per acre per day (gpad), while local agencies below the standard receive discounts. Discounts against basic rates could be applied alone or in combination with surcharges.
- **Rebates.** The County could also offer rebates (for example, funds paid to a local agency) that reward local agencies if they reduce I/I through localized programs.
- **Low-Interest Loans.** If a local agency needs to have County funding to support a local contribution or if a local agency wanted to reduce its debt service costs, one of the financial strategies is to have the County make funding available through a loan. If a local agency accepts a loan, the local agency pays the rate that all other agencies pay; plus, the local agency has an additional amount added to its rate to pay back the loan.

In the enforcement and penalty approach, the rate structure is designed to make local agencies with high I/I flows pay more than those with low I/I flows.

- **Surcharges.** As a corollary "stick" to the discount "carrot," surcharges could apply to local agencies (or treatment regions or interceptor zones) with I/I levels exceeding set threshold standards. Such surcharges could be added to the basic charges paid per ERU. As with rate discounts, surcharges could be based on either set I/I thresholds or relative I/I contributions. Surcharges added to base rates could be applied alone or in combination with rate discounts.
- **Higher Base Rates.** Local agencies have different I/I flows, and to encourage those local agencies that have not done a good job of controlling and reducing I/I, the County could use a variable rate structure that charges higher base rates for those local agencies that have high I/I flows. The rate structure could have several steps that increase the base rate at certain I/I threshold levels.

If the status quo approach is maintained, the County continues to charge a fixed rate. Such rates are based on the average cost of providing service and are most consistent with a collective cost sharing principle. In this approach, rates provide neither an incentive nor a penalty for how a local agency handles its I/I. To reduce local agency I/I, the County either:

1. Needs to have programs or specific contract provisions that allow the County to force local agencies to reduce their I/I. This is because the local agency would not have financial

incentives for reducing its I/I flow or financial penalties and higher costs if it takes no action to improve its I/I flow, or

2. The County just funds cost effective I/I reduction projects and there is no further program or contract action.

A1.4 Financial Administration and Reporting Issues

There are a number of financial administration and reporting issues that accompany the many different financial strategies and approaches. These issues vary with the approaches used to establish rates, provide financial incentives, share costs, and maintain accountability. Depending on additional County legal research, it is assumed that all the financial strategies are legally authorized for the County. If any of the alternative financial strategies or rate structure changes are implemented as part of the I/I control program, administrative changes can range from being very minimal for tracking local agency loan payments to being quite extensive for modifying the rate structure to account for I/I flows, costs, or benefits.

If rate surcharges, penalties, discounts, credits, and/or rebates, or variable rates are established, the County will be initiating a significant change in the way it establishes rates for local agencies. The current rate structure is based on a charge per ERU that is applied uniformly to all local agencies regardless of the cost of service or the actual flows conveyed and treated. A uniform rate structure does not distribute costs equitably if there are significant disparities in the costs and/or benefits to serve different local agencies. For an I/I control program, a uniform rate provides little financial incentive for local agencies to undertake local I/I control measures. Because a uniform rate spreads I/I conveyance and treatment costs for each local agency across the entire regional service area, such a rate does not generally provide an incentive to spend any local agency money on I/I control. Local agencies could be reluctant to spend time, energy, or funds on reducing I/I into the regional sewer system if I/I causes no adverse effects in the local area or no specific additional costs and/or if a local agency has different priorities for spending local agency funds. Even with a rate structure that includes incentives or penalties, a local agency might still be reluctant to make investments that could reduce its I/I flow sufficiently to lower its charges from the County.

To implement these other types of rates for I/I from what is presently being used, the County faces several challenges in determining an equitable rate structure, obtaining and analyzing data to support the desired rate structure, and developing administrative processes and systems to support the different billing and rate structures. As the complexity of the rate structure increases, so does the cost of implementing and maintaining a rate structure. The cost of monitoring, calibrating, computing, collecting, and administering complex rate structures can outweigh the equity that a more complex rate structure can offer. The revenue generated by more complex rate structures can also be less stable and harder to estimate, as well as be more difficult to explain to wholesale and retail customers. The key policy issue is whether or not a different basis from the uniform rate structure should be used to help implement an I/I control program and whether these different rate structures provide enough financial incentive or penalty to cause local agencies to reduce I/I.

Key issues that the County needs to address regarding any change in rate structure include the following:

- What is the basis for the difference in rates - I/I flows, I/I thresholds, I/I costs, I/I benefits, or other measures?
- If I/I costs or benefits are used as a basis for rate differences, how can the County determine the cost of service, what costs to include, and how I/I costs and benefits are allocated among local agencies for rate purposes?
- How can the County collect and monitor flow data that is used to support any rate differences? If formal I/I flow monitoring only occurs every other RWSP update (every 6 years), how often will the County and local agencies be able to change a local agency's rate based on its measured I/I flow? Is more frequent flow monitoring needed for rate purposes, and how much does such monitoring cost?
- What additional staffing and resources are needed on an ongoing basis to implement and maintain changes in the rate structure?

In any cost-driven cost sharing approach, the stability of the cost-sharing basis is an important concern. Cost-driven allocations can rely on factors at a fixed point in time (for example, relative I/I contributions as of December 31, 2003) or use a periodic measurement to adjust cost allocations (for example, annual peak flows). Rates may need to be set at a certain point in time with infrequent adjustments, because it is too difficult to change rates every time an I/I project is completed. Selection of a stable basis for sharing the cost of an I/I control program is an important practical point to be considered when evaluating this theoretical cost-driven cost sharing approach.

Because the County has not applied either cost-driven or benefit-driven approaches in its rate design, a thorough assessment of local agencies has not been done to identify both direct and indirect benefits. Such an assessment is necessary to properly develop benefit-driven rates. However, the value of direct benefits to local agencies through the I/I program is relatively easy to quantify, thereby making cost-sharing based on *direct* local agency benefits a possibility.

Besides new financial and administrative processes caused by changes in the County's rate structure, other changes in financial and administrative processes could also be needed to implement non-rate financial strategies. These other financial strategies include County grants, low-interest loans, local agency expenditures in lieu of surcharge payments, and any private and local agency contributions for I/I reduction projects. The issues associated with these financial strategies include the following:

- What terms, conditions, reimbursement documentation, and contract documentation are needed for either grants or loans to local agencies or private property owners? How can the County monitor payments?
- For low-interest loans to local agencies, who pays for any difference between the County's actual debt service costs and a local agency's debt service payments for a low-interest County loan? Are these payments separate or part of the local agency's rate?

- What type of criteria, terms, conditions, and documentation is needed by the County when local agencies agree to implement I/I reduction projects in lieu of paying a surcharge? How can the County monitor local agency compliance with these agreements?
- What type of timing commitments and agreements are needed from local agencies that agree to provide funding to make I/I reduction projects cost effective?
- What criteria can the County use to select which I/I reduction projects are implemented with local agency contributions?

A1.5 Options Considered and Included

Four options are considered for adopting and applying rates, incentives and surcharges. These four options are presented in Chapter 4 of this report for consideration in developing a final regional I/I control program plan.

Option: Surcharges or local agency investment in lieu of surcharges

Surcharges are charged to local agencies that discharge more I/I to the regional system than authorized. An additional approach to this option is to allow a local agency to invest in reducing I/I directly or through funds received back from the County. Surcharges are essentially local agency penalties for exceeding a pre-determined I/I threshold or for causing increased costs related to I/I. A surcharge can be implemented in a variety of ways:

- A fee added to a local agency's total charge for regional sewer service.
- An agreement with a local agency to fund specific I/I reduction projects within its jurisdiction in lieu of paying a surcharge to the County.

Option: Incentives

An incentive-based I/I reduction and control program provides financial rewards for local agencies that meet I/I reduction and control thresholds. The funding for such incentives comes from higher rates to all local agencies. Incentives include the following:

- A local agency with I/I less than or equal to the I/I reduction and control requirements receives a discount from its regional rate.
- Local agencies receive a rebate on their regional rate payment for meeting the I/I reduction and control requirements.

Option: Variable rates

A variable rate policy establishes different rates based on whether or not a local agency meets I/I reduction and control requirements. Variable rates provide both incentives and penalties, and are based on a local agency's I/I contribution. Those that have higher I/I levels pay higher rates, while those with lower I/I levels pay lower rates.

Option: No surcharge or incentive

The County continues with its current rate policy to treat all local agencies equally. Each local agency pays the same rate to have its wastewater conveyed and treated no matter how much I/I it contributes to the system.

Appendix A2

Private Property Issues

Appendix A2

Private Property Issues

A2.1 Overview

King County infiltration and inflow (I/I) flow monitoring, modeling, and pilot project data indicate that as much as 85 percent of the total peak flow of I/I in the region is classified as "fast response" or "rapid infiltration." A significant portion of I/I classified in these categories originates from: (a) defective private side sewers (that is, sewer pipes that serve residences and businesses and connect to publicly owned sewer mains) and/or (b) illicit connections on private property (such as downspouts or foundation drains routed to the sewer). Confirmation of I/I from private property sources requires that additional Sewer System Evaluation Survey (SSES) work be completed to identify specific private property rehabilitation requirements in each basin.

Side sewers are privately owned throughout the region, and the responsibility for maintenance and repair currently lies with individual property owners. In several local agencies, the laterals are also owned by the private property owner. The cost and potential disruption associated with reducing I/I from private property sources is significant and impacts the ability and willingness of property owners to undertake corrective actions.

The County and the local agencies also face constraints, including issues of legality and equity, which must be addressed if public funding is used to defray some of the cost of private sewer rehabilitation.

A2.2 Projected Private Property I/I

When fast response and/or rapid infiltration I/I components are present in a mini-basin, there is a strong probability that private property I/I sources are present. Fast response I/I is associated with direct connections of sources such as roof drains, downspouts, missing cleanout caps, yard drains, and driveway drains.

It is likely that the majority of fast response I/I sources stem from private property, where opportunities for illicit connections are most frequent and control is problematic. In addition, fast response I/I can originate from sources in the public portion of the system, such as submerged manhole lids or at the interconnection of storm drainage system mains with the sanitary sewer.

Rapid infiltration occurs as a result of the quick movement of surface water through shallow pervious materials to defective near-surface side sewers and/or to foundation drainage systems. Rapid infiltration is primarily associated with private property sources because the private portion of the sewer system is generally the shallowest portion, and because foundation drainage systems are often more conveniently discharged to the side sewer than to alternate surface water systems.

A2.3 Private Property I/I Components

Modeling of the basins tributary to the County regional conveyance and treatment system identified the total 20-year peak I/I flow present in each mini-basin. The four components of modeled I/I flows are shown in Table A2-1.

Table A2-1. Components and Origin of Modeled I/I Flows

Component	Origin	Ownership
Fast response	Direct connection of stormwater sources	Private/Public
Rapid infiltration	Leaking side sewers, leaking shallow sewer mains, sump pumps, foundation drains, manhole chimneys, and connected storm drains	Private/Public
Slow infiltration	Leaking deeper sewer mains, manholes, and deep laterals	Public
Base infiltration	Deep sewer mains and manhole bases	Public

A2.4 Modeled Private Property I/I Component Flows

Modeling was completed in 2003 and 2004 for approximately 800 mini-basins in the service area. Based on modeling results, approximately 85 percent of the total 20-year peak I/I flow for the region is either fast response (52 percent) or rapid infiltration (33 percent). This finding is a strong indication that a significant portion of the regional 20-year peak I/I flow originates from private property sources.

In 97 percent of the mini-basins, the majority of the 20-year peak I/I flow was a combination of fast response and rapid infiltration components. This finding suggests that there is a strong potential for the presence of private property I/I in most of the mini-basins throughout the region.

A2.5 I/I Pilot Projects on Private Property

Four of the ten pilot projects undertaken by the County in cooperation with local agencies during 2003 and 2004 included rehabilitation or replacement of side sewers on private property. The four pilot projects involving private property I/I were Auburn, Skyway, Kent, and Ronald. For more detailed information, see the *Pilot Project Report* in *Appendix B3*.

A2.5.1 Auburn Pilot Project Results

The Auburn pilot project included repair of 19 side sewers and 13 laterals (the portion of the side sewer in the public right-of-way), and replacement of approximately 2,200 linear feet (lf) of sewer main, replacement of 13 manholes, and placement of 9 manhole pans.

Because this pilot project included sewer main, manhole repairs, and an upstream pump station, the results do not clearly indicate how I/I could be reduced by rehabilitating private sewers alone. This pilot project was intended to provide important information about the effectiveness of pipe bursting for side sewers and laterals, as well as cost data.

A2.5.2 Skyway Pilot Project Results

The Skyway pilot project included repair of 163 side sewers and laterals and replacement of approximately 9,500 lf of sewer main and 36 manholes.

Because the complete system was replaced for this pilot project, the results do not clearly indicate how I/I could be reduced by rehabilitating private sewers alone. Again, this pilot project provided important information about the effectiveness of pipe bursting for service lines, as well as cost data.

A2.5.3 Kent Pilot Project Results

The Kent pilot project included rehabilitation of 154 side sewers and 134 laterals using both cured-in-place pipe (CIPP) and pipe bursting technology. In addition, two roof gutter drains to the sanitary sewer were removed.

The total 20-year peak I/I flow in the Kent pilot basin was:

- 12,900 gallons per acre per day (gpad) prior to pilot project completion
- 2,800 gpad after pilot project completion

Because the Kent pilot project focused on side sewers and laterals, conclusions can be drawn about I/I removal from private property.

A2.5.4 Ronald Pilot Project Results

The Ronald pilot project included rehabilitation of 208 side sewers and 53 laterals. All rehabilitation was accomplished using pipe bursting. In addition, 10 roof gutter drains to the sanitary sewer were removed.

The total 20-year peak I/I flow in the Ronald pilot basin was:

- 18,000 gpad prior to pilot project completion
- 4,600 gpad after pilot project completion

Because the Ronald pilot project focused on side sewers and laterals, conclusions can be drawn about I/I removal from private property.

A2.6 Private Property I/I Reduction Effectiveness

A 78-percent reduction in total 20-year peak I/I flow was achieved in the Kent pilot basin through rehabilitation of nearly 100 percent of the private property services. The total construction cost for this pilot project without tax was $993,000. This represents a cost per rehabilitated service of approximately $6,500.

A 74-percent reduction in total 20-year peak I/I flow was achieved in the Ronald pilot basin through rehabilitation of approximately 72 percent of the private property services. The total construction cost for this pilot project without tax was $990,000. This represents an estimated cost per rehabilitated service of approximately $4,800.

A2.7 I/I Effectiveness Assumptions for Options Analysis

The mini-basins were selected for pilot projects because of known problems and measured presence of a significant level of I/I. The two pilot projects that focused on rehabilitation of private sewers (Ronald and Kent) achieved total 20-year peak I/I flow reductions of 74 percent and 78 percent.

Recommendations for the amount of private sewer rehabilitation and the resulting I/I reduction levels to be used in the options analysis were presented to the local agencies via the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) Engineering and Planning (E&P) Subcommittee. The recommended values were based on the assumption that pilot project results represented achievable results throughout the region. The E&P Subcommittee reviewed the

recommendations and revised the assumptions based on perceived existing and anticipated system conditions encountered by the various agencies.

Table A2-2 lists the I/I reduction assumptions adopted by the E&P Subcommittee when developing and analyzing options for I/I reduction on private property.

Table A2-2. Effectiveness Assumptions

I/I Reduction Assumption	Adopted for Consideration
Percent of private sewer service rehabilitated per mini-basin	95% (45% side sewers only; 50% side sewers and laterals)
Percent reduction in total 20-year peak I/I flow level	60%
Minimum post-rehabilitation total 20-year peak I/I flow	3,500 gpad

A2.8 Pilot Projects Lessons Learned

In addition to providing I/I reduction performance and cost data, the pilot projects yielded other useful information. This information, termed "lessons learned," is important to consider when developing I/I reduction and control options. For more detailed information, see the *Pilot Project Report* in *Appendix B3*.

A2.8.1 Public Involvement and Communication

The success of the Ronald, Skyway and Kent pilot projects in addressing private property I/I was supported by an effective public communication approach. This included mailers, door hangers, and meetings with community groups and individual property owners. Right-of-entry agreements were obtained for approximately 95 percent of the relevant properties.

The private sewer rehabilitations, illicit connection disconnects, and surface restoration to pre-construction conditions were completed at no cost to the property owner and proved to be an incentive for increased private property owner participation. Additional lessons learned related to communication included: (a) effective scheduling is important to the property owner, along with communication of service disruption requirements and real-time updates on service restoration; and (b) it is important to manage the expectation of the property owner with regard to the nature of the work, the degree of disruption, and the amount of time that service will be lost.

A2.8.2 Technical Issues

The pilot projects on private property provided insight into a variety of technical issues:

- Closed circuit television (CCTV) inspection to detect I/I problems in side sewers and laterals is most effective when performed during the wet season, and preferably very shortly before rehabilitation work takes place.
- Smoke testing and dye testing are not fully effective in locating illicit connections. Property owner cooperation greatly enhances identification of clear water connections to the sewer system. Property owner cooperation can be encouraged through education on the I/I issue and its regional consequences.
- Elimination of illicit connections is not always cost effective, particularly if there is no appropriate location to discharge the redirected clear water flow.
- Where there is an illicit connection of a footing drain to the sanitary plumbing within the building footprint, it may not be cost effective to pursue disconnection.
- When rehabilitating a building service by pipe bursting, it is cost effective to address both the lateral and side sewer together, even if the side sewer is privately owned and the lateral is publicly owned. The combined approach eliminates the need for an intermediate access pit, which saves construction cost.
- The use of CIPP technology for rehabilitating smaller-diameter laterals and side sewers depends on the length of the building service, the number of bends and fittings, and the presence of plant roots in the line.
- The cost of surface restoration on private property may prove prohibitive if there are expensive surface features present above the access points necessary to rehabilitate the building service.

A2.8.3 Implementation Issues

Communication and coordination among all the impacted local agencies, the contractor, and the property owner is essential to the success of the work. It is imperative that the work on any individual property be completed with minimal disruption of service.

Use of qualified and experienced contractors is critical. *In situ* technologies employed to rehabilitate building services require specialized knowledge and experience. If the expertise of the contractor or his subcontractor is inadequate, quality and schedule problems can result.

A2.9 Draft Private Property Policies

The E&P Subcommittee discussed and established draft policies that focus on I/I reduction projects and support proposed standards, guidelines, and procedures. Several of these policies (from *Final Draft Standards, Procedures, and Policies*; see *Appendix B2*) relate directly to work on private property, including:

- **Policy #1** – "Public funding may be made available for all phases of I/I mitigation work on all privately owned property including residential, commercial, and industrial land uses. Funded work could include scope of work elements such as: permits, investigations, inspection and testing, any modifications to the side sewer connections and laterals, connections to public systems, restoration of disturbed areas (including landscaping, sidewalks, driveways, and right-of-way) and post-rehabilitation testing and enforcement. Environmentally infeasible and/or prohibitively expensive modifications would be considered for variances/waivers."
- **Policy #4** – "Both the Local Agency and King County will pass the necessary ordinances and develop the appropriate access agreements that allow each agency to gain access to private property, such as a right of easement or a construction and inspection easement. These agreements will allow certain actions related to I/I reduction and control such as conducting a side sewer and/or lateral inspection; construction rehabilitation; and conducting code enforcement activities."
- **Policy #6** – "If public funds support any portion of the I/I reduction work on privately owned property, then the Lead Agency would establish a process to manage and limit their liability. The potential site and in-ground liability issues should be a part of the I/I planning and design process, including an up-front agreement on when the jurisdiction's liability will begin and end. If King County is the Lead Agency, a liability beginning and ending point will be established with the Local Agency and the private property owner."
- **Policy #7** – "The Lead Agency would be responsible for ensuring that, for any I/I reduction project, the contract with the contractor includes appropriate bonding, licensing, insurance, and warranty provisions to ensure satisfactory completion of the project and warranty of the project for a sufficient amount of time (recommended minimum 12 months). For private property installation or rehabilitation, the Lead Agency would be responsible for ensuring the private property owner will have sufficient warranty."
- **Policy #8** – "If the consequence of I/I control work on a privately owned property or public system results in the diversion of storm water drainage, and there exists a public storm water management system, then the I/I work would involve meeting the provisions of the controlling jurisdiction's current "storm water drainage" ordinance. Jurisdictional approval must be obtained; infeasible and/or prohibitively expensive modifications would be considered for variances/waivers."
- **Policy #9** – "If the consequences of I/I control work on private residential property results in the diversion of storm water drainage (e.g. removal of illicit connections), and a public storm water management system does not exist, then the private property owner bears the responsibility for discharging the storm water drainage to an appropriate location.

Modifications that are deemed to be infeasible and/or prohibitively expensive (for the property owner) would be considered for variances/waivers."

- **Policy #10** - "The Lead Agency would establish a
  Choice 1 – "restoration to pre-construction condition"
  Choice 2 – "restoration to as near as possible to pre-construction condition"
  Choice 3 – "restoration to original grade only" standard for private property before initiating any I/I work (including landscaping, sidewalks, driveways, and rights-of-way)."

Additional, more general policies were discussed that apply to both public and private I/I reduction work. The topics covered included inspection, funding, and contractor qualifications.

A2.10 Private Property I/I Reduction Options

The following section defines the options identified for consideration when developing alternative approaches to I/I reduction. I/I reduction is defined as: *Measures implemented to reduce, delay, or eliminate planned improvements to the King County conveyance and treatment system.* The options included below are intended to provide a full range of choices for an I/I control program.

A2.10.1 Side Sewer and Lateral Ownership Issues

The ability of the lead agency to address I/I issues on private property is impacted by ownership of the building service. The building service is comprised of the side sewer (between the building and the right-of-way line) and the lateral (between the right-of-way line and the sewer main connection).

The 2004 private property survey[1] of local agencies revealed that for the 18 respondents, all side sewers were owned by the property owner. However, only 6 of the reporting agencies (33 percent) reported that laterals were also owned by the property owner. In the majority of the agencies reporting, the laterals were owned by the local agency. Responsibility for rehabilitation and longer-term maintenance of the building service was divided in some agencies and was entirely the responsibility of the property owner in other agencies.

Options for Side Sewer and Lateral Ownership

Table A2-3 lists the building service ownership options that the E&P Subcommittee adopted for consideration.

[1] This refers to a King County survey of the local agencies that was conducted in the spring of 2004. This survey focused on private property issues and how local agencies address private property sewer issues.

Table A2-3. Options for Service Ownership

Adopted for Consideration
Laterals – agency ownership of all
Laterals – private ownership of all
Side sewers and private mains – private ownership
Side sewers and laterals – variable ownership (existing situation)
Side sewers and laterals – consistent ownership among agencies

The E&P Subcommittee commented that agency ownership of side sewers is infeasible due to liability, maintenance issues, and cost implications and did not carry this option forward.

The E&P Subcommittee also noted that responsibility for maintenance is not contingent on ownership. For example, although many agencies own the lateral portion of the building service, the property owner remains responsible for blockages in the lateral when the blocking material originates on private property.

A2.10.2 Access and Right-of-Entry Issues

To address I/I issues on private property, the lead agency requires a means of establishing rights-of-entry to allow access for inspection, design, and construction.

The 2004 private property survey of the local agencies revealed that 12 of the 18 respondents had a means of establishing rights to examine private portions of the sewer system. These rights took a variety of forms, including:

- Project-specific agreements
- Long-term agreements
- Agency resolution or code
- Covenant associated with the land
- Access easements
- Informal agreement with or request to the property owner
- State law, right to inspect

Additional findings included:

- Existing property improvements can hinder access for inspection and rehabilitation.

- Where more than one property shares a single side sewer and/or lateral, access issues become more complex.
- Effective public education enhances the level of property owner cooperation related to access.

Options for Public Education on Access and Right-of-Entry

Table A2-4 shows the public education options that were presented to the E&P Subcommittee for consideration. The E&P Subcommittee agreed that these options are acceptable for this Report.

Table A2-4. Options for Public Education

Adopted for Consideration
The County creates regional I/I control program public awareness materials focused on private property access. Local agencies could modify the materials for their own use.
The lead agency for each I/I reduction project has prime responsibility for public education in the project area.

Options for Private Property Access (Right-of-Entry) Agreement

Table A2-5 shows the right-of-entry agreement options that the E&P Subcommittee adopted for consideration.

Table A2-5. Options for Private Property Access Agreement

Adopted for Consideration
Each local agency provides its own right-of-entry agreement
A regional I/I control program develops a right-of-entry agreement template for use by local agencies

Options for Private Property Access Legislation

Table A2-6 lists the options that were approved by the E&P Subcommittee for inclusion in this Report.

Table A2-6. Options for Private Property Access Legislation

Adopted for Consideration
The County creates a template for right-of-entry ordinance or resolution that local agencies could modify for use
The County passes a region-wide ordinance allowing right-of-entry by local agencies and/or the County for inspection, construction, and enforcement
Local agencies create right-of-entry ordinances or resolutions following guidelines developed by a regional I/I control program

The E&P Subcommittee suggested that the County and local agencies collaborate on any I/I reduction and control public awareness program. The E&P Subcommittee also questioned whether or not the County could legislate a region-wide ordinance.

A2.10.3 Sewer System Evaluation Survey (SSES) Issues

The ability of the lead agency to identify sources of I/I on private property requires implementation of appropriate and effective SSES procedures. Completion of SSES procedures to detect private property I/I sources is best completed during wet weather when the soil moisture conditions are elevated and there may be higher groundwater.

Identification of specific private properties where I/I sources exist requires implementing SSES procedures that allow assessment of each service connection and each property. Assessment of service connections could be limited to observing the characteristics of service discharge at the sewer main, or could include inspecting the service pipe itself. Detecting illicit connections could require smoke or dye testing, interviewing property owners, and/or inspection of onsite drainage elements.

The 2004 private property survey of the local agencies revealed that 12 of the 18 respondents used one or more of the following SSES techniques to find I/I originating on private property:

- Wet weather flow monitoring
- CCTV inspection
- Dye testing
- Smoke testing
- Inspection of manholes for I/I
- Low pressure air testing

Options for SSES

Several options were presented to the E&P Subcommittee for consideration with regard to SSES procedures for the purpose of detecting I/I sources on private property. Table A2-7 lists the options based on E&P Subcommittee input.

Table A2-7. Options for SSES

	Adopted for Consideration
Defining appropriate SSES procedures for private property	• Local agencies adopt the uniform SSES procedures developed by a regional I/I control program • Each local agency independently establishes SSES procedures
Administering SSES implementation for private property	• Each local agency implements the required SSES procedures to detect private property I/I sources • The County implements the required SSES procedures to detect private property I/I sources • The required SSES procedures to detect private property I/I sources are incorporated into construction contracts for service pipe rehabilitation and illicit connection disconnects
Prioritizing the focus of SSES investigations	• Priorities are based on customer-reported service problems • Priorities are based on pipe material of private sewers • Priorities are based on age of private sewers • Characteristics are defined for private sewers that could be candidates for rehabilitation without the need for SSES. This option does not exclude appropriate SSES procedures to detect illicit connections.

The E&P Subcommittee noted that local agencies are willing to use uniform SSES procedures developed by a regional I/I control program only if the County funds rehabilitation work. The E&P Subcommittee favored having the option to include SSES in construction contracts, but said that the choice to do so needed to be made on a project-specific basis.

The E&P Subcommittee expressed concern about the potential for inconsistent results if SSES efforts were performed by both the local agency and the County, and questioned how any inconsistencies could be resolved. The E&P Subcommittee also noted that care is needed when exempting certain areas from an SSES based on private sewer characteristics, because illicit connections can still be present.

A2.10.4 Redirected Stormwater Drainage Issues

The ability of the lead agency to identify sources of I/I on private property is impacted by the need to appropriately redirect stormwater removed from the sanitary sewer system.

When illicit connections are detected, eliminating them requires that the stormwater removed (including foundation drainage) be redirected in a manner that does not result in local drainage problems. Redirected stormwater that is not picked up by a stormwater management system with adequate capacity can result in local property damage, standing water, or flooding. Many areas with illicit connections can have inadequate stormwater management systems in place as alternative points of discharge.

In some areas, redirection of stormwater currently discharging to the sanitary sewer system can impact water quantity and/or quality of downstream creeks, streams, or wetlands. This impact can be positive or negative and needs to be assessed when considering significant redirection of stormwater from an I/I reduction project.

Options for Redirected Stormwater Drainage

Several options for redirecting stormwater when eliminating or reducing I/I sources on private property were presented to the E&P Subcommittee for consideration. After discussion, the options listed in Table A2-8 were approved by the E&P Subcommittee for inclusion in this Report.

Table A2-8. Options for Redirected Stormwater Drainage

Adopted for Consideration
The local agency is responsible for properly redirecting stormwater when a stormwater management system exists, except where the redirection is deemed infeasible or prohibitively expensive.
The property owner is responsible for properly redirecting stormwater when a stormwater management system exists, except where redirection is deemed infeasible or prohibitively expensive.
The local agency is responsible for properly redirecting stormwater and for implementing a new stormwater management system to accept the redirected stormwater when a stormwater management system does not exist, except where implementation of a new stormwater management system and redirection is deemed infeasible or prohibitively expensive.
Stormwater from illicit connections is not redirected when an adequate stormwater management system does not exist.

The E&P Subcommittee noted that criteria need to be established to allow equitable determination of situations where redirection of stormwater is deemed infeasible or prohibitively expensive. If illicit connections are allowed to remain in place, consistent criteria need to be employed by all local agencies.

A2.10.5 Property Restoration Issues

Elimination of I/I sources on private property could require destruction of some privately-owned surface improvements. Responsibility for restoration of such privately owned improvements needs to be addressed.

The number and value of privately owned surface improvements varies from local agency to local agency and from property to property. Some neighborhoods and properties have simple landscaping features, while others include sidewalks, driveways, patios, decks, pools, fountains, exotic plantings, and outbuildings.

Restoring disrupted surface improvements significantly impacts the cost of rehabilitating a private sewer. The cost effectiveness of each private sewer rehabilitation effort is impacted by the associated property restoration costs. It is possible that rehabilitation of private sewers in neighborhoods with higher value properties could be less cost effective than in neighborhoods where fewer surface improvements are present on private property. This could impact the level of I/I reduction achievable in areas where higher value surface improvements are present. The degree to which the cost of restoration of private surface improvements is covered by publicly funded I/I reduction projects impacts the perceived cost effectiveness of those projects.

Options for Property Restoration

Several options were presented to the E&P Subcommittee for consideration with regard to restoration of private property when eliminating or reducing I/I sources on private property. After discussion, the options listed in Table A2-9 were approved by the E&P Subcommittee for inclusion in this Report.

Table A2-9. Options for Property Restoration

Adopted for Consideration
Restore private property as near as possible to pre-construction conditions.
In lieu of restoring private property, negotiate a fee settlement with the property owner based on the cost of restoring the property as near as possible to pre-construction conditions. Require the property owner to sign a waiver accepting the settlement as total compensation for damage to surface improvements.

The E&P Subcommittee noted that restoring private property to pre-construction conditions can never be completely accomplished. The E&P Subcommittee also noted that restoring to original grade without restoring surface improvements is not a viable option.

The E&P Subcommittee suggested that the settlement value be based on a “as near as possible to pre-construction conditions” approach when negotiating a fee settlement in lieu of restoration, and that it include execution of a waiver by the property owner accepting the settlement.

A2.11 Private Property I/I Control Options

This section describes options to consider when developing approaches to long-term I/I control. The options included below are intended to provide a full range of choices for an I/I control program.

A2.11.1 Public Awareness Issues

The ability of the County and the local agencies to control I/I in the long term is enhanced when the general public is aware of the problem and its consequences.

The pilot projects completed by the County and local agencies demonstrated that property owner participation increases with knowledge about I/I and its impacts on the costs of sewage conveyance, treatment, and disposal. The higher the level of understanding held by the general public regarding issues related to private property I/I contributions, the greater the motivation of individual property owners to participate in private property I/I control measures.

Options for Public Awareness

Table A2-10 lists the options presented to the E&P Subcommittee for raising public awareness about the need for reducing I/I sources on private property. After discussion, the E&P Subcommittee approved these options for inclusion in this Report.

Table A2-10. Options for Public Awareness

	Adopted for Consideration
Selecting types of public awareness tools	• General information mailers/bill stuffers, including multilingual information • Television/radio spots • Media releases • Web site • School outreach programs • Partnerships with schools, neighborhood groups, businesses, etc. • Community meetings where anticipated attendance merits • Community leader/stakeholder education
Creating public awareness materials	• The County and local agencies collaborate to create public awareness materials • The County and the local agency independently create public awareness materials
Implementing public awareness measures	• A local agency is the lead for an I/I control initiative, and the local agency is responsible for public education • The County is the lead for an I/I control initiative, and the County is responsible for public education

The E&P Subcommittee suggested that school outreach programs be added to the options for public awareness tools. The E&P Subcommittee also observed that in some areas, community meetings do not draw many people and the value of pursuing this approach needs to be evaluated. For the pilot projects, several public awareness tools were used; however, a large portion of the public was unaware of a project until it was underway.

The E&P Subcommittee suggested that the public education/outreach effort be scheduled as close as possible to the beginning of the project in order to be most effective. The E&P Subcommittee advised that public education materials include multilingual information summarizing the message and communicating options for obtaining a full translation.

The E&P Subcommittee suggested that options for creating public awareness materials include both a collaborative and an independent approach.

A2.11.2 Inspection Issues

The ability of local agencies to control I/I in the long term requires that private property be subject to inspection to determine the condition of private sewers and the presence of illicit connections.

Standardized inspection requirements and procedures are needed to ensure that new private sewer installations meet the specifications and guidelines established for I/I prevention. Periodic inspection following installation is needed to ensure that private sewer integrity is maintained and that subsequent illicit connections have not been made.

The number and length of private sewers in each local agency is great and the task of ongoing inspection is time consuming and costly. Methods are needed for prioritizing private sewer inspections. Higher priority could be assigned to inspection of properties where I/I sources are most likely to be encountered.

Options for Inspection

Options for inspection of sewers on private property were presented to the E&P Subcommittee. After discussion, the E&P Subcommittee approved the options listed in Table A2-11.

Table A2-11. Options for Inspection

	Adopted for Consideration
Inspection of new installations	• The local agency inspects new installations for compliance with I/I control requirements
Standardized inspection program for new installations	• A regional I/I control program implements a training program for local agencies to use • Local agencies certify the individuals who complete the inspection program • A regional I/I control program develops standard inspection forms for local agencies to use
Type and timing of inspections for existing installations	• A follow-up inspection is performed at a prescribed time after installation if the I/I threshold is exceeded in the basin • Periodic inspections are performed at prescribed intervals after installation if the I/I threshold is exceeded in the basin • One-time or periodic voluntary inspections are conducted at the request of property owners • One-time or periodic mandatory inspections are conducted • Inspection is performed at specific events; for example, upon sale of a property or when applying for a major permit
Funding of inspections	• County funded • Local agency funded • Property owner funded

The E&P Subcommittee noted that inspection of private sewers by the County duplicates local agency inspections and is not realistic. The E&P Subcommittee stated that an inspector training program administered by the County is a welcome resource for the local agencies and could be coordinated with the accreditation requirements for sewer system operators. Certification of inspectors could be granted by each local agency rather than the County. The E&P Subcommittee further noted that the use of forms and reporting requirements is ineffective because the forms are often misused and reports are often overlooked or ignored.

The E&P Subcommittee suggested that follow-up inspections not be required unless there is evidence that the I/I threshold in a particular basin is exceeded. The requirement for an event-triggered inspection, such as the sale of a property, could result in delay of the sale.

A2.11.3 Incentive Issues

Control of I/I on private property could be enhanced through incentives that motivate property owners to comply with program procedures.

Incentives may be positive or negative in nature and are generally financial or service based. When implementing the pilot projects, the provision of free rehabilitation of side sewers was an effective incentive to gain cooperation from most property owners.

Legal responsibility for private sewer integrity lies with the property owner. The general public good associated with private sewer rehabilitation could justify the use of public funds for providing incentives to property owners for cooperating with I/I control measures. The legality of using public funds to finance private sewer rehabilitation in Washington is being investigated. The options presented here are based on the assumption that legal means could be employed to allow use of public funds to support rehabilitation of private sewers.

The 2004 private property survey of all local agencies, with 18 responding, revealed that a few local agencies are currently employing incentives that promote property owner cooperation in dealing with problem private sewers. These incentives include:

- Imposition of penalties
- Imposition of liens on the property
- Availability of loans
- Use of the Local Improvement District (LID) process to fund repairs
- Use of the King County Housing Repair Program

Options for Incentives

Options for incentives to encourage property owner cooperation in I/I control measures were presented to the E&P Subcommittee for consideration. After discussion, the E&P Subcommittee approved the options listed in Table A2-12.

Table A2-12. Options for Incentives

	Adopted for Consideration
Positive incentive program	• Grant programs • Low-interest loan programs • No-interest loan programs • Private sewer programs (in which all property owners pay into a fund used to repair those private sewers having I/I sources)
Negative incentive program	• Penalties • Liens • Service disconnections
Funding	• County funding • Local agency funding • State funding • Federal funding • Property owner funding

A2.11.4 Legislation and Enforcement Issues

It is likely that measures employed to control I/I on private property are effective only when supported by appropriate legislation and enforcement programs.

Local agencies need the proper ordinances (for cities) and resolutions (for sewer districts) in place to support enforcement of I/I control measures. For some measures, new legislation could be required at the state level, such as use of public funds or imposition of event-driven inspection requirements.

Time and cost issues associated with effective enforcement of I/I control measures need to be budgeted and paid for, and resistance to I/I control measures from property owners needs to be dealt with. The political will to overcome this resistance is important to the success of any I/I control measures.

In the 2004 private property survey of local agencies, 16 agencies reported that they had adequate regulations in place to enforce permitting and inspection of private sewers and resolution of illicit connection issues. The same survey revealed that local agencies use several enforcement approaches for dealing with illicit connections. Similar to negative incentives, these include penalties, liens, fines, and disconnection of water service.

The 13 local agencies using these enforcement approaches indicated a fair to excellent success rate.

Options for Legislation and Enforcement

Several options were presented to the E&P Subcommittee for consideration with regard to legislation that supports I/I control measures. After discussion, the E&P Subcommittee approved the options listed in Table A2-13.

Table A2-13. Options for Legislation and Enforcement

	Adopted for Consideration
Legislation for I/I control	• Each local agency continues to use only its current ordinances/ resolutions • Each local agency uses its own ordinances/resolutions, including new ordinances/resolutions required to support adopted I/I control measures for private property • A regional I/I control program develops a template for local agencies to use in developing their own ordinances/resolutions • A regional I/I control program develops uniform regional ordinances/resolutions to be used by all local agencies
Enforcement of I/I control measures	• Local agencies enforce requirements for I/I control • Local agencies enforce requirements for I/I control using regional guidelines developed by a regional I/I control program • A regional enforcement approach is developed with uniform requirements to be used by all local agencies

The E&P Subcommittee noted that some local agencies do not look for illicit connections and currently have no ordinances/resolutions that prevent them. The E&P Subcommittee suggested that this "status quo" option be included.

A2.12 Funding of Private Property I/I Reduction and Control

A2.12.1 Cost Issues

The cost is significant for disconnecting illicit connections and repairing private sewers that are I/I sources.

In all the County jurisdictions, the portion of the sewer service line on private property (side sewer) is the responsibility of the property owner. In many County jurisdictions, the property owner's responsibility extends into the public right-of-way (lateral).

In order to conduct the cost effectiveness analysis for I/I projects, the E&P Subcommittee reached agreement on I/I reduction project cost estimates for different types of projects. The E&P Subcommittee requested that a cost estimate of $3,500 be used when rehabilitating each side sewer. The cost to rehabilitate each lateral is estimated at $3,900. In cases where the side sewer and the lateral are rehabilitated together, the cost is estimated at $6,800. These costs are currently the responsibility of the property owner if rehabilitation is required.

A2.12.2 Allocation of Cost

The property owner is typically motivated to rehabilitate the sewer service line only if the sewer deteriorates to the point that service is impacted. Sewer service lines that are I/I sources do not necessarily adversely impact the property owner. Such I/I sources do, however, significantly impact the available capacity of downstream conveyance and treatment systems that, in turn, impact the entire region.

The appropriate allocation of cost recovery when rehabilitating private sewers for I/I reduction and control purposes needs to be addressed. The question is whether or not the individual property owner bears the full cost of I/I reduction associated with disconnection of illicit connections or rehabilitation of the sewer service line, or if all or a portion of the cost is paid from regional funding sources for the collective benefit of the region.

If the property owner pays, there are issues related to potential economic hardship that could ultimately lead to delays in achieving I/I reduction and control goals.

A2.12.3 Legal Constraints

If a regional funding approach is deemed appropriate, there are legal issues to be understood and managed for funding work on private property. The legality of public funding for private property sewer improvements is being explored, and Chapter 3 of this Report includes a summary of the findings to-date. Some local agencies have moved in this direction to varying degrees.

A2.12.4 Funding Sources

If public funding on private property is deemed acceptable, the County or local agencies could be the source of funds. Public funding could take the form of grants or loans. Alternatively, local agencies could implement dedicated charges to their customer base, thus accumulating public funds for I/I reduction and control on private property.

If public funding on private property is deemed unacceptable, the funds could come from the property owners themselves.

A2.13 Options Considered and Included

- County/local agencies develop uniform inspection and repair standards for new and existing structures and local agencies implement
- Local agencies develop and administer their own inspection and repair standards for new and existing structures
- No new procedures developed for private property

Appendix A3

Standards, Procedures, and Policies

Appendix A3

Standards, Procedures, and Policies

This appendix presents standards, guidelines, procedures, and policies for future King County and local agency sewer system planning and design. These standards, guidelines, procedures, and policies were developed to focus on correcting the shortcomings in design, construction, inspection, and testing for sewer construction. Only those features of sewer systems associated with potential I/I sources are addressed. The standards, guidelines, procedures, and policies are intended to augment and emphasize individual local agency standards, which outline requirements for overall sewer system design, construction, and rehabilitation.

A3.1 Regional Wastewater Services Plan Direction

Thirty-four politically and administratively independent local agencies discharge wastewater from their systems to the County's regional sewer system. Flows within this large service area have increased to the point that in some cases, system capacity has been exceeded.

As part of I/I reduction efforts, the Regional Wastewater Services Plan (RWSP) directed the County, in coordination with component agencies, to *"develop model local conveyance systems' design standards, including inspection and enforcement standards, for use by component agencies to reduce I/I within their systems."* To meet target levels of I/I reduction in the future, the RWSP also directed the County Executive to propose long-term measures that *"include establishing new local conveyance systems design standards, implementing an enforcement program, developing an incentive based cost sharing program and establishing a surcharge program."*

A3.2 Development of Standards, Procedures, and Policies

The process of developing standards, guidelines, and procedures was a multi-year collaborative effort including the County, local agencies, and the Earth Tech Team. In the spring of 2001, the Earth Tech Team began development of alternative model engineering standards, procedures, and policies to comply with the requirements of the RWSP. The initial standards and policies were developed with the specific goal of maximizing I/I removal. Additional "alternatives" were included (for most of the standards, policies, and intergovernmental agreement clauses) in the original package to provide local agencies with a range of options.

The Earth Tech Team presented preliminary draft standards and policies to all local agencies in fall 2001 meetings, and requested that the local agencies provide comments, preferences, concerns, and issues. Discussion of these documents continued at a workshop held in January 2002. At the workshop it was decided that the Metropolitan Water Pollution Abatement Advisory Committee's (MWPAAC) Engineering and Planning (E&P) Subcommittee would further discuss and develop the draft standards and policies. The E&P Subcommittee met 15 times during the spring and summer of 2002 to review all the standards, procedures, guidelines, policies, and the intergovernmental agreement (IGA). A cooperative, consensus-based method of decision-making was utilized during these meetings.

The E&P Subcommittee reviewed and analyzed the draft standards and policies while considering cost, experience, and feasibility factors. In discussing the level of control to be included in the standards, the group determined that the approach to requiring new and/or different engineering techniques, procedures, and policies would be most successful if introduced to the region's local agencies in relatively small, incremental steps. The E&P Subcommittee made this decision based on financial and political realities. The standards, procedures, and policies that the E&P Subcommittee selected from the multiple choices, therefore, generally require the least amount of risk and strict requirements and the least financial impact for the local agencies. The group agreed that some alternatives should be considered voluntary guidelines instead of mandatory standards. The *Draft Standards, Procedures and Policies*, dated October 21, 2002, resulted from this effort.

The E&P Subcommittee also decided to apply these draft standards, guidelines, procedures, and policies to the pilot projects in order to test their effectiveness and corresponding impacts to staff time and local agency resources. Following implementation of the pilot projects, the standards, guidelines, procedures, and policies were revisited by the Earth Tech Team to incorporate the lessons learned during project design and implementation and to make recommendations for any proposed changes to the documents. The proposed changes were presented and reviewed with the E&P Subcommittee during the summer of 2004, and the *Final Draft Standards, Procedures, and Policies* (*Final Draft*) was prepared (refer to *Appendix B2*).

A3.3 Factors Contributing to I/I

Based on discussions with County staff, local agencies, and with individuals involved in regional I/I programs across the nation, it was determined that factors contributing to I/I in the local and regional wastewater systems include:

- Improper construction practices and materials
- Lack of adequate inspection and testing prior to acceptance of new and rehabilitated sewer sections
- Improper system maintenance
- Inadequate enforcement of existing ordinances

Infiltration and inflow are extraneous flows in separated sanitary sewer systems. Infiltration is groundwater that enters buried sewers and service connections by way of defective sewer main elements such as leaky connections of pipes to manholes, broken or separated pipe joints, root intrusion, cracked or crushed pipe, leaky rehabilitation improvements, and leaking sewer lines that are abandoned but still connected to the system (see Figure A3-1).

Inflow is surface water that enters the sanitary sewer system by direct connections from roof drains, area drains, catch basins, and unimproved surface drainage. Surface water also enters the system through manhole covers (see Figure A3-1). Groundwater sources connected to the system include foundation drains and sump pumps.

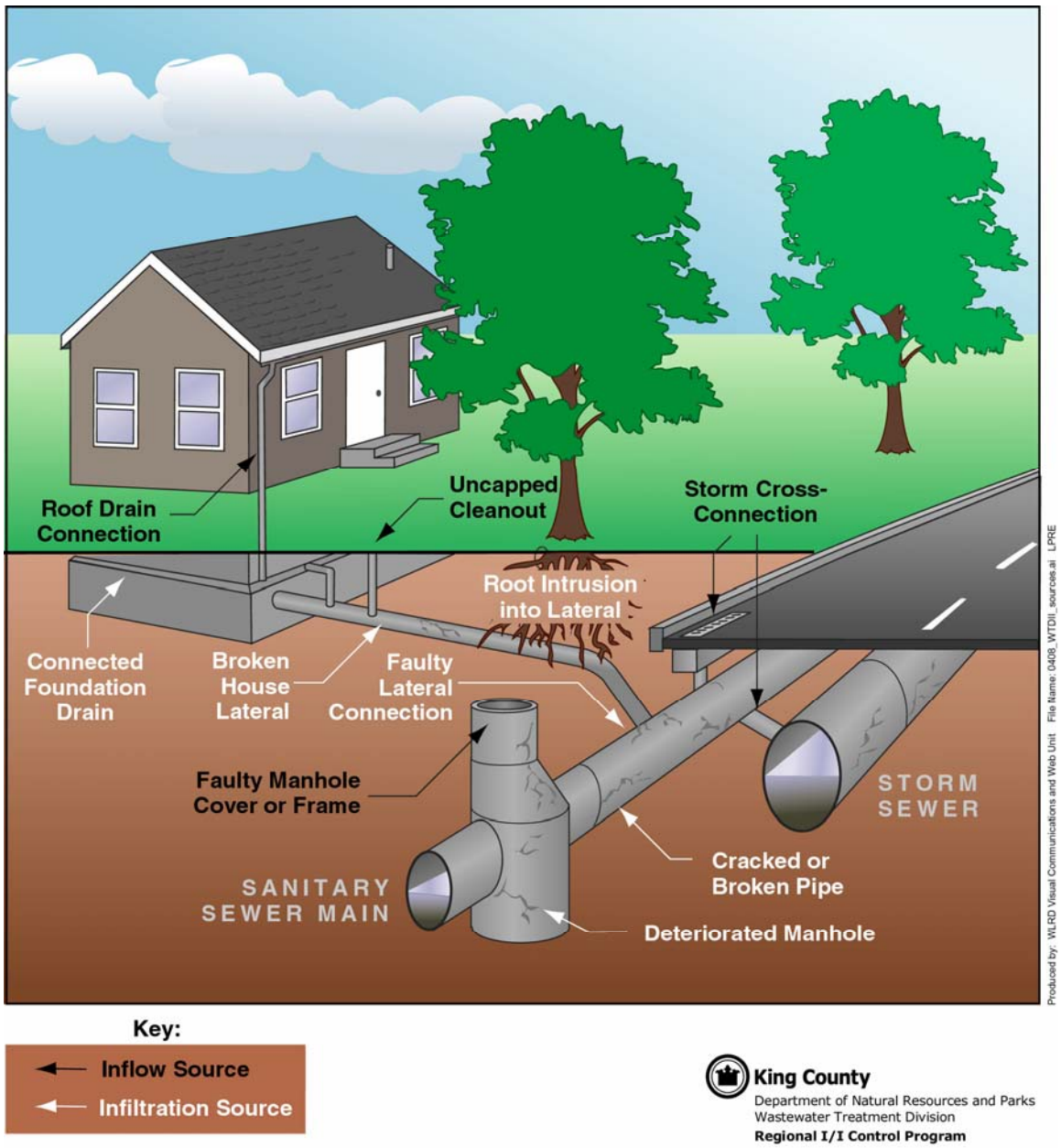

Figure A3-1. I/I Sources

Key factors that impair a sewer system's structural abilities, resulting in infiltration and/or inflow, are listed below.

- Improperly supported sewer mains, laterals, and side sewers are subject to vertical displacement over time, causing joints to open and pipeline trenches to settle, producing cracks or breaks in sections of the pipe.
- Groundwater flows into manholes constructed in wet ground if the exterior walls are not adequately sealed to make joints and connections watertight.

- Structural failure of sewer pipes allows groundwater to enter the system at the point of connection to manholes. Deep cuts and poor ground conditions often result in a larger than necessary excavation, leading to non-uniform support and unequal settlement. Inadequate support often causes failure of the pipe in shear at the manhole and provides a point of entry for groundwater.
- Pipeline failures often occur due to the installation of inappropriate materials. Materials must be appropriate for the existing ground conditions.
- I/I can occur at clean-outs, wyes, and tees if these are not properly plugged with a manufacturer's watertight plug, snugly fit, and firmly secured until services are installed and connected. Improperly connected service lines, unplugged wyes and tees, and broken plugs allow groundwater infiltration.
- Root systems of plants and trees seeking underground water supplies for nourishment will grow into a sewer through deteriorated, non-gasketed joints or other openings. Groundwater will follow the path of roots into the sewer. Root intrusion also impedes normal flow in the pipe, and can eventually stop the flow entirely.
- Manholes that are subject to inundation or located in the path of surface water flow can contribute significant quantities of inflow to the sanitary sewer system.

Future I/I can be reduced by recognizing past situations that have allowed extraneous flows to enter the system and by establishing standards or guidelines to prevent these deficiencies on future projects. Equally important is ensuring that standards and guidelines are followed during construction. Even when adequate standards are in place and used for sewer system design, inspection and testing during construction are needed to prevent system deficiencies that allow extraneous flows to enter the system.

A3.4 Engineering Standards and Procedures

This section summarizes the standards, guidelines, and procedures and describes how they are organized. For more detail, see *Appendix B2*.

A3.4.1 Organization of Standards and Guidelines

The standards and guidelines are divided into three major categories:

- **Planning Standards and Guidelines (PS)** – The planning standards and guidelines provide criteria to be followed during the planning phase of sewer projects and I/I investigations.
- **Public Facilities (PUB)** – The public facility standards and guidelines provide requirements for sanitary sewer systems owned, operated, and maintained by the County or a local agency. These systems include sewers to be constructed within public rights-of-way and developer extensions constructed within easements that eventually will be transferred to a local agency. Categories here include design and construction standards, testing standards, inspection standards, and warranty requirements.

- **Private Facilities (PRV)** – The private facility standards and guidelines provide requirements for privately owned sanitary sewers. They address the segments of sanitary side sewers and laterals belonging to the property owners being served. Categories include design and construction standards, testing standards, inspection standards, and warranty requirements.

Separate standards and procedures are provided for new construction and rehabilitation projects. New construction includes the addition of sanitary sewer infrastructure in areas that do not currently have sewer service, as well as replacement of existing systems. Rehabilitation projects include improvements to existing sanitary sewer systems, including collection mains, manholes, and side sewers. Rehabilitation techniques such as cured-in-place pipe, pipe bursting, slip-lining, and manhole liners fall into this category.

A3.4.2 Summary of Standards and Guidelines

Table A3-1 provides a summary and brief description of the *Final Draft* standards and guidelines. A total of 40 standards/guidelines were incorporated into the *Final Draft*, with 28 being accepted by the E&P Subcommittee as standards and 12 being accepted as guidelines.

Table A3-1. Summary of Standards and Guidelines

Standard/Guideline Number and Title	Standard/Guideline Description	Stan-dard	Guide-line	Rehab. Projects ONLY	Both New and Rehab. Projects
PS-1: Storm Drainage Connections to the Sanitary Sewer	Prohibits storm drainage connections to the sanitary sewer system unless approved by the County and the local agency.	√			√
PS-2: Design Capacity for Pipeline Rehabilitation Projects	Requires the pipeline system designer to consider any loss in hydraulic capacity on pipeline rehabilitation projects.	√		√	
PS-3: Visual Inspection of Manholes for Sewer System Evaluation Survey (SSES) Investigations	Outlines provisions for performing visual inspection of manholes for SSES investigations.		√	√	
PS-4: Closed Circuit Television (CCTV) Inspection of Sewers for SSES Investigation	Outlines provisions for performing CCTV inspection of sewers for SSES investigations.		√	√	
PS-5: Smoke Testing for SSES Investigations	Outlines provisions for performing smoke testing for SSES investigations.		√	√	
PS-6: Dye Testing for SSES Investigations	Outlines provisions for performing dye testing for SSES investigations.		√	√	

Standard/Guideline Number and Title	Standard/Guideline Description	Stan-dard	Guide-line	Rehab. Projects ONLY	Both New and Rehab. Projects
PS-7: Modeling and Engineering Analysis	Recommends basin modeling be performed to assess ongoing and future sewer planning efforts.		√		√
PUB-1: Connections to Existing System	Requires connections of new sewer piping to an existing sewer system at a manhole or to a sewer main via a tee. Also requires testing and inspection of the new piping before it is put into service.	√			√
PUB-2: Pipe Anchoring	Requires sewer mains on steep slopes to be designed by a Professional Engineer (PE) to ensure integrity of the system.	√			√
PUB-3: Manhole Location	Standard focuses on avoiding placement of manholes in locations subject to inflow sources. In those areas where it cannot be avoided, the standard requires the manhole to be watertight.	√			√
PUB-4: Manhole Size	Washington State Department of Transportation (WSDOT) / American Public Works Association (APWA) guidelines and manhole manufacturers' recommendations to be followed regarding the minimum distance between knockouts in manholes.	√			√
PUB-5: Manhole Joints	Manhole to be watertight from the casting down. Materials and construction to be in accordance with WSDOT/APWA guidelines.	√			√
PUB-6: Side Sewer Connection Location and Taps	Standard outline requirements for connection of side sewers to sewer mains.	√			√
PUB-7: Sewer System Design	Requires sewer system design to be performed by a PE applying appropriate standards and measures regarding pipe materials, bedding, and backfill.	√			√
PUB-8: Abandonment Requirements	Addresses abandonment requirements for manholes and sewer pipes.	√			√
PUB-9: Pipe Rehabilitation Methods	Addresses design and construction requirements for pipe bursting, cure-in-place pipe, slip lining, fold and form pipe, and spray-on linings.	√		√	

Standard/Guideline Number and Title	Standard/Guideline Description	Stan-dard	Guide-line	Rehab. Projects ONLY	Both New and Rehab. Projects
PUB-10: Manhole Rehabilitation	Includes design and construction requirements for manhole rehabilitation, including coatings, linings and chemical grouting.		√	√	
PUB-11: Spot Repairs	Outlines requirements for trenchless and dig-and-replace spot repairs on sewer mains.		√	√	
PUB-12: Manhole Leveling Rings	Outlines requirements for manhole materials and installation of leveling rings.	√			√
PUB-13: Manhole Lids/Inserts	Requires a manhole pan or gasketed, locking lid for manholes that are susceptible to inflow.	√		√	
PUB-14: Root Intrusion	Addresses root removal and correction of I/I problems at the point of root intrusion.	√		√	
PUB-15: Pipeline Leak Testing	Requires that new sewers pass an air or water test. There is also a provision that if the testing cannot be performed, the sewer needs to be CCTV-inspected for leakage during the wet season, but while still under warranty.	√			√
PUB-16: Manhole Leak Inspection	Requires visual inspection of manholes following substantial completion to verify the structure and connections are watertight.	√			√
PUB-17: CCTV Inspection	Requires a complete CCTV inspection of newly installed and rehabilitated sewer pipe.	√			√
PUB-18: Inspection of Pipe Installation and Backfill	Outlines inspection activities for pipe installation and backfilling operations.	√			√
PUB-19: Product-Specific Inspection	Requires verification that specified products and materials are being delivered to the job site, and that specified test reports are being provided.	√			√
PUB-20: Certification, Warranty, and Qualifications	Requires a minimum 1-year warranty. For rehabilitation products or systems without a proven track record, the product manufacturer must provide certification that the product will perform as specified.		√		√

Standard/Guideline Number and Title	Standard/Guideline Description	Stan-dard	Guide-line	Rehab. Projects ONLY	Both New and Rehab. Projects
PRV-1: Pipe Protection – Depth of Cover	Addresses depth of cover for side sewers, and strives to limit burial depths between 3 feet minimum and 15 feet maximum. The guideline requires following pipe manufacturers' recommendations for materials and installation when these conditions cannot be met.		√		√
PRV-2: Allowable Connections to Side Sewers	Prohibits new side sewers discharging to separated sewer systems to convey sources of clean water flow.	√			√
PRV-3: Pipe Zone Bedding and Trench Backfill	Outlines requirements for side sewer pipe installation and bedding requirements.		√		√
PRV-4: Pipe Materials	Addresses required design characteristics of pipe materials to be used for side sewers.		√		√
PRV-5: Inspection Wyes/Cleanouts	Requires installation of an inspection wyes/cleanout between 2 and 5 feet from the face of the building for new sewer installations.	√			√
PRV-6: Lateral and Side Sewer Rehabilitation Methods	Addresses design and construction requirements for pipe bursting, cured-in-place pipe, slip lining, and fold-and-form pipe for rehabilitation of side sewers.		√	√	
PRV-7: Spot Repairs	Standard outlines requirements for trenchless and dig-and-replace spot repairs on side sewers.	√		√	
PRV-8: Root Intrusion	Addresses root removal and correction of I/I problems at the point of root intrusion.	√		√	
PRV-9: Side Sewer/Lateral Leak Testing	Requires that new side sewers pass an air or water test.	√			√
PRV-10: Sanitary Side Sewer CCTV Requirements	Requires that side sewers be inspected before the trench is backfilled.	√			√
PRV-11: Product-Specific Inspection	Requires a CCTV inspection of the connection between the lateral and the main where the lateral/side sewer cannot be pressure tested.	√			√

Standard/Guideline Number and Title	Standard/Guideline Description	Stan-dard	Guide-line	Rehab. Projects ONLY	Both New and Rehab. Projects
PRV-12: Product-Specific Certification	Requires verification that specified products and materials are being delivered to the job site, and that specified test reports are being provided.	✓			✓
PRV-13: Bonding and Warranty Inspection	For rehabilitation products or systems without a proven track record, requires that the product manufacturer provide certification that the product will perform as specified.	✓			✓

A complete set of the standards and guidelines is included in the *Final Draft* (see *Appendix B2*). To summarize, each of the standards and guidelines consists of:

- **I/I Control Standard Title** – A brief name of the standard.
- **I/I Control Measure Description** – A description of why the standard is being proposed; that is, the type of I/I source being targeted.
- **Standard/Guideline** – This describes the standard/guideline in detail sufficient for engineers and local agency representatives to compare the intent with existing standards.
- **Potential Local Agency Impacts** – This indicates the potential impacts on the local agencies that adopt the standard. Impacts may include additional staffing requirements and impacts on agency procedures such as record keeping, inspections, maintenance, equipment, and other elements of daily operations. Elements of the standards that could add or reduces the cost of routine agency processes are listed. Due to the variability between agencies, no specific dollar amounts are presented.
- **Potential County Impacts** – This indicates the potential impacts on the County of adopting the standard. Impacts may include additional staffing requirements and impacts on County procedures such as record keeping, inspections, maintenance, equipment, and other elements of Department of Natural Resources staff daily operations. Elements of the standards that could add or reduce the cost of routine County processes are listed.
- **Potential Private Property/Ratepayer Impacts** – Many of the standards could impact private property owners or affect sewer rates. These impacts may include increased maintenance responsibilities for property owners, construction impacts, and cost increases or reductions.

A3.5 Standard Details

The standards and guidelines also included a set of standard details that outline specific requirements for the construction of manholes, sewer mains, and side sewers to help prevent I/I from entering a new sewer system. The details address only those features of sewer construction that impact I/I control, and are intended to augment current local agency standard details for sewer construction. The standard details are included in *Appendix B2*.

Similar to the standards and guidelines, the standard details were tested during the pilot project design and implementation, and later revisited by the Earth Tech Team and reviewed by the E&P Subcommittee for any final revisions. A summary of proposed changes to the working draft details and the E&P Subcommittee's recommendations and accepted changes are included in *Appendix B2*.

A3.6 Guide Specifications

The pilot project design included development of technical specifications detailing material, construction, and testing requirements for the various rehabilitation methods used. Rehabilitation included pipe bursting, installing cured-in-place pipe (CIPP), and various manhole rehabilitation methods. Implementing these technical specifications for the pilot projects provided an opportunity to assess how well certain requirements worked in practice, and allowed the specifications to be modified as appropriate. After implementing the pilot projects, the County and the Earth Tech Team debriefed the inspection team and several of the project contractors to discuss where changes to the specifications were needed. Modifications were then made to the technical specifications based on these lessons learned to form a set of guide specifications.

The guide specifications will be used as a starting point for any continuing rehabilitation work performed as part of a regional I/I control program, and include direction for tailoring the specifications to project needs. The guide specifications are also referenced in the standards and guidelines (specifically Guidelines PUB-9, PUB-10, and PRV-6) as the standard to be followed for rehabilitation work on sewer mains, laterals, and side sewers using pipe bursting, CIPP, folded/formed liners, and for manhole rehabilitation work. A copy of the guide specifications is included in *Appendix B2*.

A3.7 Summary of Policies that Support Standards and Procedures

Selecting effective engineering standards and procedures also includes establishing policies associated with the application of the standards. Policies are necessary to guide effective I/I removal projects.

This section presents a wide range of topics, many of which were first introduced by representatives of local agencies during County/local agency workshops. In broad terms, the policies address the issues of funding, public education, access to private property, inspection, permitting, liability, and stormwater drainage. While the policies include elements of the relationship between the County and the local agencies, their primary focus is on the relationship of the local agencies to their communities, contractors, and customers. The material presents conceptual foundations for regional consensus, consistency, and cooperation.

The number of policies included in the *Final Draft* was reduced to 15 from the original, MWPAAC-accepted working draft of 23 policies (October 21, 2002). This reduction was based on experience gained from the pilot projects and on combining similar policies where appropriate.

The policies were originally separated into two groups: (a) those addressing I/I reduction from private property sources, and (b) those addressing I/I reduction from public property sources. It was discovered during the pilot projects that such a division was unnecessary; thus, several policies were combined. The revised draft policies include policies that apply to both private and public sewer systems. The policy revisions are detailed in *Appendix B2*, which includes the original policies recommended by the E&P Subcommittee, lessons learned, and suggestions for combining policies from the Earth Tech Team, the revised policies proposed by the Earth Tech Team in 2004, and the comments and decisions made by the E&P Subcommittee for the *Final Draft* document.

Table A3-2 lists the *Final Draft* policies as approved by the E&P Subcommittee. These policies support the standards and procedures, are focused on actual I/I reduction projects, and do not include all policies to be considered for a regional I/I control program.

Table A3-2. Final Draft Policies

Policy #1, Public Funding for I/I Reduction Projects Public funding should be considered for all phases of I/I mitigation work on privately owned property. Funded work should include scope of work elements such as permits, investigation, inspection and testing, any modifications to the side sewer connections and laterals, connections to public systems, restoration of disturbed areas (including landscaping, sidewalks, driveways, and rights-of-way), and post-rehabilitation testing and enforcement. Environmentally infeasible and/or prohibitively expensive modifications should be considered for variances/waivers.
Policy #2, Public Awareness of I/I: Educational Materials The County, in conjunction with the local agencies, shall create and promote regional educational programs to introduce the general public to I/I as an issue, to explain the potential benefits from I/I mitigation efforts, and to inform the public of its responsibilities related to the I/I problem. Educational/informational materials shall be designed such that each local jurisdiction will be able to modify them to meet its local needs. Additionally, the County shall function as a central clearinghouse in responding to inquiries about a regional I/I control program.
Policy #3, Public Awareness of I/I: Responsibility for Community Unless otherwise specified or negotiated in the IGA, for each specific I/I reduction project being led by a local agency, the local agency shall be responsible for community education/involvement. Unless otherwise specified or negotiated in the IGA, if the County is the Lead Agency, the County shall be responsible for community education/involvement.

Policy #4, Access to Private Property for I/I Reduction and Control

The local agency shall pass the necessary ordinances/resolutions and develop the appropriate access agreements that allow each agency or its agents to gain access to private property, such as a right-of-entry or a construction and inspection easement. These agreements will allow certain actions related to I/I reduction and control, such as conducting a side sewer and/or lateral inspection, construction rehabilitation, or conducting code enforcement activities.

Policy #5, Inspection Training

To promote region-wide consistency, the County, in conjunction with the local agencies, shall provide training opportunities on an I/I control program to agency representatives. The training materials will include a checklist of guidelines for best practices and the adopted regional I/I control standards, procedures, and policies.

Policy #6, Limiting Liability

If public resources support any portion of the I/I reduction work on privately owned property, then the Lead Agency shall establish a process to manage and limit its liability. The potential site and in-ground liability issues shall be a part of the I/I planning and design process, including an up-front agreement on when the jurisdiction's liability will begin and end.

Policy #7, Bonding, Licensing, Insurance, and Warranty Provisions

The Lead Agency shall be responsible for ensuring that, for publicly funded I/I reduction projects, the construction contract includes appropriate bonding, licensing, insurance, and warranty provisions to ensure satisfactory completion of the project and warranty of the project for a sufficient amount of time (recommended minimum 12 months).

Policy #8, Stormwater Drainage Ordinances

Where I/I work on private or public property results in the diversion of stormwater drainage, and there exists a stormwater system, then the I/I work shall involve meeting the provisions of the controlling jurisdiction’s current stormwater drainage ordinances. Jurisdictional approval must be obtained.

Policy #9, Responsibility for Stormwater Drainage

Where I/I work on private property results in the diversion of stormwater and an adequate stormwater system does not exist, then the private property owner bears responsibility for discharging the stormwater drainage to an appropriate location.

Where I/I work on public property results in the diversion of stormwater and an adequate stormwater system does not exist, the local agency or associated agency bears the responsibility for discharging the stormwater drainage to an appropriate location.

Policy #10, Infeasible and/or Prohibitively Expensive Modifications

Where an I/I control project would result in the diversion of stormwater drainage, and the modifications required to properly discharge the stormwater are deemed to be infeasible and/or prohibitively expensive (for the property owner), consider giving the property owner choice of disconnection of illicit connection or surcharge.

Policy #11, Property Restoration The Lead Agency shall establish a standard for property restoration before initiating any I/I work (including landscaping, sidewalks, and driveways). Public property restoration is governed by local agency or associated agency codes or ordinances. Options can include: 1 – "Restoration as near as possible to pre-construction condition" 2 – "Basing value on restoration to as near as possible to pre-construction condition, make up front property owner payment with signed waiver"
Policy #12, Contractor Qualifications The Lead Agency shall develop in the bid specifications specific minimum experience requirements for contractors to ensure that the selected contractor has experience in the type of work to be performed.
Policy #13, Required Permits The local agency should obtain all feasible permits, including the State Environmental Policy Act (SEPA), Hydraulic Project Approval (HPA), 404, or other state or federally required permits. The contractor should obtain permits as detailed in the specifications, such as the building, road, utility, right-of-way use, and/or clearing and grading permits. The permits that the contractor is required to obtain should be listed in the bidding documents.
Policy #14, Cooperative Efforts For all permit needs, the jurisdictions including the County, the local agency, and the associated agency (if pertinent) will work cooperatively and collaboratively.
Policy #15, Revisions to Standards, Procedures, and Policies MWPAAC shall review and make recommendations on proposed revisions to regional I/I control program standards, procedures, and policies. MWPAAC shall recommend whether or not a revision should be adopted as part of a regional I/I control program.

A3.8 Intergovernmental Agreement (IGA)

This section provides a model for the necessary agreements between the County and a local agency to successfully manage an I/I reduction project. *Appendix B2* contains a detailed model/template IGA and a guidance table that indicates eligibility for I/I program funding.

The model/template IGA makes available standard clauses and choices of language that may or may not be included in an actual IGA. An IGA is intended to be an agreement between governments, specifically a particular local agency and the County, and not between the I/I reduction project manager and a contractor. Figure A3-2 shows both of these relationships.

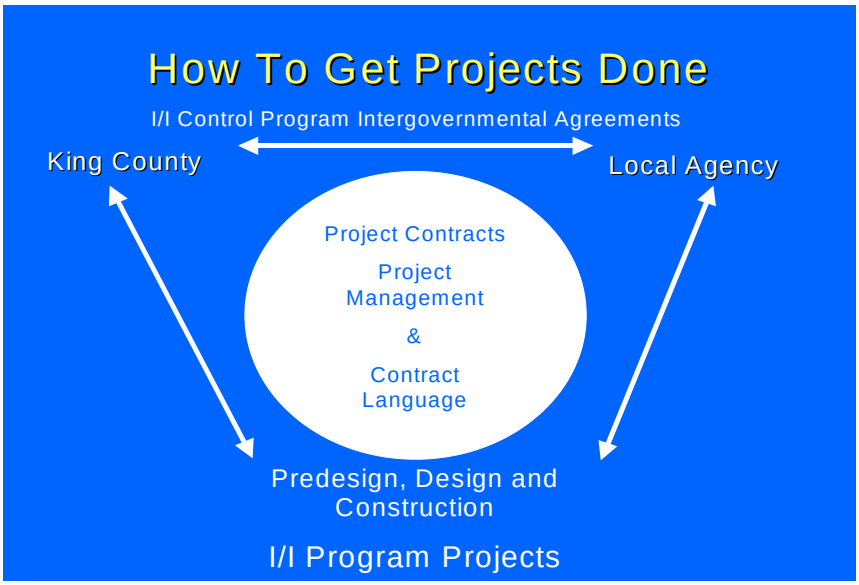

Figure A3-2. Intergovernmental Agreement Relationships

An intergovernmental agreement is necessary regardless of whether the I/I reduction project is managed and administered by the County or by a local agency; thus, the model/template IGA provides alternative language for both scenarios.

The IGA alternatives were originally evaluated by the E&P Subcommittee, and a working draft model/template IGA was drafted in 2002 based on those discussions and decisions. The analysis of alternatives for that working draft IGA was a complex undertaking, one that required local agency representatives (on the E&P Subcommittee) and the County to make choices related to implementing a regional I/I control program. Many of the language options raised fundamental questions about managing and administering I/I reduction projects within particular local agencies.

The working draft IGA was used during the pilot projects, with modifications made as necessary. Based on those modifications, the Earth Tech Team proposed revisions to the working draft model/template IGA. The E&P Subcommittee discussed the modifications and approved the *Final Draft* model/template IGA that appears in *Appendix B2*. Specific policies and terms of any IGA are, of course, open to discussion and decision by each local agency and the County.

It is worth noting that several items are not included in this IGA section because it is believed that they do not affect I/I reduction. These IGA topics include: (a) patents, (b) Americans with Disabilities Act, (c) legal relation (indemnification), (d) termination, (e) miscellaneous, (f) entire agreement section.

A3.9 Options Considered and Included

The preceding sections of this appendix focus on the process and specific standards, procedures, and policies that the E&P Subcommittee agreed to. In addition, some means of adopting the

standards, procedures, standard details, guide specifications, policies, and IGA and a protocol on their applications for public and private sewer construction projects is required to ensure consistent use by the County and local agencies on a regional basis.

Two options are considered for adopting and applying the standards, procedures, standard details, guide specifications, policies, and IGA. The following two sections describe these options along with recommendations of the E&P Subcommittee on their application; *Chapter 4* of this Report provides additional discussion.

Option: Standards and procedures for County-funded I/I projects; guidelines and standards for local agency I/I and non-I/I projects (E&P Subcommittee-approved)

This option is to use the standards, procedures, and standard details as required components of all County-funded I/I reduction projects. For all non-I/I sewer projects, the local agencies use all E&P Subcommittee agreed-to standards, guidelines, and procedures as requirements, while ones designated as guidelines are available for local agencies to consider on a non-I/I sewer project.

The guide specifications are still used when developing specifications for project bidding. The policies are used for all components of I/I reduction and control. The IGA in *Appendix B2* is intended to be a template or model for any specific I/I reduction project. Each project includes a negotiated IGA between a local agency and the County using the IGA model presented in the *Final Draft* (*Appendix B2*) as a model.

Option: Standards and procedures for both County-funded and local agency I/I projects; guidelines and standards for local agency non-I/I projects

This option is to use the standards, procedures, and standard details as required components of all County-funded I/I reduction projects and for all local agency non-I/I sewer projects.

The guide specifications are still used when developing specifications for project bidding. The policies are used for all components of I/I reduction and control. The IGA in *Appendix B2* is intended to be a template only or model for any specific I/I reduction project. Each project includes a negotiated IGA between a local agency and the County using the IGA model presented in the *Final Draft* (*Appendix B2*) as a model.

Appendix A4

Assumptions for Regional I/I Control Program

Appendix A4

Assumptions for Regional I/I Control Program

Both planning and I/I reduction assumptions were developed for I/I modeling and cost effectiveness analysis efforts. The planning assumptions are needed to determine capital conveyance and treatment facilities capacity improvements in the absence of any I/I reduction projects. Certain I/I reduction assumptions are needed to determine what I/I reduction projects are cost effective.

The E&P Subcommittee purposely wanted to be cautious in their assumptions and therefore selected an approach to assumptions that would not overestimate the capital facility and I/I reduction project benefits or underestimate the I/I reduction project costs.

The following sections of this appendix detail both the planning and I/I reduction assumptions followed by a summary table (Table A4-4) of chosen assumptions.

A4.1 I/I Planning Assumptions

Planning assumptions are necessary to extrapolate from existing conditions to maximum sewer system build-out. These assumptions are used to model future facility needs, including size and timing of new sewer system components. The assumptions and hydraulic modeling also provide a foundation for the I/I reduction cost effectiveness analysis. King County and the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) Engineering and Planning (E&P)

Subcommittee collaborated on formulating the planning assumptions, with the intention that the assumptions:

- Be reasonable and realistic
- Help avoid under-building of sewer facilities
- Help minimize or avoid over-building of sewer facilities
- Lead to facilities that meet the Growth Management Act requirement that the regional system be able to convey wastewater flows from each local agency without overflow when the 20-year flow events occur.

A4.1.1 Design Factors

The County and the Earth Tech Team elected to use the peak sanitary sewer flow that can be expected once every 20 years as the modeling flow for sizing capital facilities and costs. A "design storm" approach was considered but rejected because building a system based solely on the amount of rain from a 20-year storm does not take into account the antecedent moisture conditions. Antecedent moisture is the buildup of groundwater over time that affects total I/I during a particular storm event. For example, antecedent moisture conditions can lead to such high groundwater levels in this region that a rainfall event of 1.3 inches can result in a system flow equivalent to a rainfall event of 1.9 inches.

In March 2004 the County and local agencies, via the E&P Subcommittee, agreed on a design flow of 20-year peak flow plus a 5-percent safety factor. The 20-year peak flow is based on the statistical analysis of 60 years of peak rainfall data from Sea-Tac airport.

A4.1.2 Population Growth Rates

The I/I control program proposed for a maximum sewer system service area population is a straight line extrapolation of the most recent population data and projections from the Puget Sound Regional Council (PSRC). This "saturation" population is projected to occur by 2050. For a residential population, the approximate saturation population is 1,500,000; for commercial, it is 800,000; for industrial, it is 100,000.

In considering the population assumption, the County and E&P Subcommittee discussed several related issues such as urban growth boundaries, traffic zones, and densification.

The County and local agencies, via the E&P Subcommittee, agreed to use PSRC forecasts through 2030 and apply a straight line population projection through 2050.

A4.1.3 Water Conservation

The Regional Wastewater Services Plan (RWSP) anticipated the following consumption of water by different categories:

- Residential: 60 gallons per capita per day (gpcd)
- Commercial: 35 gallons per employee per day (gped)
- Industrial: 75 gped

Water conservation efforts in the region will reduce wastewater flows, so this reduction in flows should be accounted for in the modeling for capital facility needs. These conservation efforts led to lower water usage in the year 2000 than the RWSP forecasts, as evident in the actual water consumption in 2000:

- Residential: 56 gpcd in Seattle and 66 gpcd outside Seattle
- Commercial: 33 gped
- Industrial: 55 gped

The most recent consumption data (2003) shows additional reductions:

- Residential: 52.1 gpcd in Seattle and 62.4 gpcd outside Seattle
- Commercial: 32.4 gped in Seattle and 30 to 33 gped outside Seattle
- Industrial: not available

After discussion, the E&P Subcommittee and the County agreed to use a water conservation planning assumption of a 10-percent reduction in per day consumption by 2010, with no additional reduction thereafter. Water consumption projections are shown in Table A4-1.

Table A4-1. Projected Water Consumption

Type of Consumption	2000 Gallons-per-day Rate	2010 and Beyond
Residential (Seattle)	56	50
Residential (non-Seattle)	66	60
Commercial	33	30
Industrial	55	50

A4.1.4 Degradation

Degradation is the slow change in condition of the sewer collection system that allows an increase in I/I flows. Degradation is due to cracks in the pipe, pulled joints, connections at manholes, construction damage, and/or traffic damage to manholes, etc.

There is little data documenting how fast and how much degradation occurs in a collection system.

The RWSP assumes that I/I flow will increase by 30 percent from 1990 to 2020 due to degradation. For the revised flow predictions with the MOUSE™ (modeling of urban sewers) model, the Earth Tech Team assumed that degradation from 2000 would be 7 percent per decade, with a limit of 28 percent over a 40-year period. For example, if a specific basin has I/I in 2000 of 1,100 gallons per acre per day (gpad), after 10 years it will increase 7 percent to 1,177 gpad.

New sewer systems should degrade less than old systems; thus, degradation is a percentage of the existing I/I. Since a newer system has lower I/I than an older one with respect to flow, it has lower degradation. For example, a newer system may have 1,000 gpad of I/I while an older one may have 10,000 gpad of I/I. Seven percent of 1,000 gpad is 70 gpad, whereas 7 percent of 10,000 gpad is 700 gpad. Using a fixed percentage acknowledges that newer systems degrade less (on a total I/I basis) than older leakier systems.

The County and E&P Subcommittee agreed that no matter what degradation assumption is used to model facility needs, future system monitoring will continue, to ensure facilities are not built sooner than needed.

The County and E&P Subcommittee agreed on a planning assumption of 7 percent degradation per decade starting from 2000 up to 28 percent for existing pipe. For new construction, the degradation assumption of 7 percent per decade will start after the date of construction, with a maximum of 28 percent.

A4.1.5 Septic Conversion

The number and rate at which septic systems are converted to sewered areas impacts system flows and facility needs. As of 2000, approximately 43,000 houses in the regional wastewater service area were estimated to be on septic systems. These are located primarily in the northern, eastern, and southern edges of the County's service area.

The urban growth boundary restricts sewer services to developments within the urban growth area. As the urban growth area's population grows, land values rise. This leads to redevelopment of areas presently served by septic systems. Many of the parcels served by septic systems are larger lots that can be subdivided for further development and converted from septic to sewer.

Other information on the service area includes:

- Total developable parcels: 300,500
- Total sewered parcels: 246,500
- Vacant developable parcels: 11,000

The RWSP projected that 100 percent of the sewerable area will be converted from septic systems by 2020. Several local agency representatives were doubtful that 100-percent conversion would be possible by that date or even by 2030.

The County and E&P Subcommittee agreed on a planning assumption that 90 percent of the area with potential for sewerage as of 2000 will be sewered by 2030 and that 100 percent of this area will be sewered by 2050.

A4.1.6 New System I/I Allowance

Regardless of how well a collection system is constructed, I/I can leak into the system. Historically, an allowance of 1,100 gpad was included in the design flow for both the conveyance and treatment of sewage.

The amount of I/I leakage into the regional system from new sewer connections, sewer mains, manholes, and other facilities impacts system flows and facility needs. Flow monitoring during the wet seasons of 2001/2002 and 2002/2003 showed that the measured amount of peak hourly I/I found in new systems ranges from a low of 270 gpad to 11,200 gpad. Several new systems had less than 800 gpad of I/I.

In contrast, the RWSP assumed that new systems have I/I levels similar to existing systems in 1999 (the rates for those systems ranged from 1,600 gpad to 4,100 gpad). The average I/I for the overall existing system in 2004 was 3,600 gpad.

The County and E&P Subcommittee agreed on an assumption of 1,500 gpad for new system I/I, recognizing that 7-percent degradation per decade increase the I/I to approximately 2,000 gpad after 4 decades.

A4.1.7 Uncertainties Affecting Facility Sizing

Safety Factors

It is common practice and sound engineering judgment to add a contingency or safety factor for sizing facilities to handle unforeseen circumstances. For the regional sewer system, this applies to pipes, pump stations, and treatment plants. Adding a contingency factor allows the system to accommodate higher peak flows without overflows or other unwanted consequences.

Caution must be exercised when using uncertain factors. It is common to include "safety factors" in individual planning components; when these are combined, it can overstate the uncertainties. The increase for a 25-percent contingency factor in flow is roughly a 10-percent increase in cost.

The County and E&P Subcommittee agreed to use a safety factor of 25 percent of additional capacity when sizing facilities. Below are several factors that were considered in using the 25-percent safety factor.

Existing Peak Flow Estimates

An uncertainty that can affect facility sizing needs is the potential for inaccuracy in estimating existing peak flow from monitored data. Due to variances in rainfall monitoring, flow monitoring, and modeling, it is not always possible to predict peak flows with a high level of certainty. While models are calibrated using the best information and technology available, the peak flows that serve as the basis for facility sizing are estimates and are not perfectly accurate.

Potential for Sewering Outside Urban Growth Area

Sewers are required in urban growth areas and these areas are the source of wastewater system flows. However, sewers are needed, and built, outside urban growth area for environmental and/or public health reasons. This can lead to increased peak flows.

"Four to One" Policy for Development along Urban Growth Boundary

Chapter 3 of the County's *Comprehensive Plan* contains a "Four to One" development policy along the Urban Growth Boundary. This policy states that 1 acre of Rural Area land may be added to a city's Urban Growth Area in exchange for a dedication to the County of 4 acres of permanent open space. It is not known how this policy impacts peak flows.

Economic Changes

The local economy represents another possible impact on peak flows, since economic surges tend to bring new industries, companies, and population growth, all of which increase flows in the regional system.

Climatic Changes

Global climate change may impact the frequency and severity of rainstorms in the future. In light of this possibility, prudence suggests an uncertainty factor be applied for the design of facilities so they can handle peak flows.

A4.2 I/I Reduction Assumptions

To determine whether or not a proposed I/I project is cost effective compared to building a new capital facility, specific costs of I/I reduction must be delineated. To this end, the County and local agencies discussed and agreed on assumptions related to I/I reduction in the spring of 2004. The assumptions included costs of various I/I reduction techniques, the percent I/I removal of each technique, and the percent of a given basin that requires rehabilitation.

A4.2.1 I/I Reduction Costs

The pilot projects provided total and average costs for different categories of expenditures for rehabilitation of various system components. Using the pilot project figures, the Earth Tech Team and the County proposed cost assumptions for pipe bursting and cured-in-place pipe (CIPP) rehabilitation of sewer mains, manholes, laterals, and side sewers.

Local agency representatives thought these cost assumptions were low. The E&P Subcommittee and the County agreed by consensus on the following costs for I/I removal. These costs will be used in the cost effectiveness analysis.

- Sewer main rehabilitation: $110 per linear foot
- Direct disconnect: $3,000 each
- Manhole rehabilitation: $3,600 each
  (NOTE: consider life expectancy in cost effectiveness analysis)
- Lateral rehabilitation: $3,900 each
  (NOTE: based on 1 per lot; size-on-size)
- Side sewer rehabilitation: $3,500 each
- Lateral and side sewer rehab: $6,800 each

As I/I reduction project experience provides additional cost information, these figures will be revisited and revised if warranted.

A4.2.2 Percent Basin Rehabilitated and Percent Reduction

In addition to cost estimates for various I/I rehabilitation techniques, other assumptions are needed to develop cost estimates for I/I reduction projects for cost effectiveness analysis. These include:

- Percent of a basin to be rehabilitated, for example, the number of feet of sewer pipe (sewer main, lateral, or side sewer) or the number of manholes or direct disconnects in a given I/I project

- How much I/I would be removed by each technique

The County and the Earth Tech Team suggested assumptions for these variables to the E&P Subcommittee in the spring of 2004. The development and discussion of these elements was centered on the knowledge gained from the pilot projects. For example, while it may be likely that more than 4 percent of the houses in a model basin could be illicitly connected to the local agency's system, it is not always possible to identify these and, after they are identified, it is not always possible to disconnect them.

As with cost estimating, the E&P Subcommittee and County opted to approve conservative estimates when in doubt. This was intended to ensure that projects found to be cost effective in the first analysis would truly be cost effective.

Table A4-2 shows the percent basin rehabilitated and percent reduction assumptions agreed upon after discussion by the E&P Subcommittee.

Table A4-2. Percent Basin Rehabilitated and Percent I/I Reduction Assumptions

Technique	% Basin Rehabilitated – Final Assumption	% I/I Reduction – Final Assumption
Direct Disconnect (DD)[1]	4%	10%
Replace Everything + DD	95% Main 95% Manhole (MH) 95% Lateral/Side Sewer (Lat/SS) +4% DD	80%
Rehabilitate Public Portions of Basin + DD	50% Main 50% MH 50% Lat/SS +4% DD	40%
Private Property with Some Laterals + DD	50% Lat. & SS 45% SS only	60%

[1]This technique includes removal of roof gutter drains to the sanitary sewer system.

A4.2.3 Cost Estimating Factors

For the cost effectiveness analysis, estimates were needed for several other factors affecting project costs. These include construction cost factors such as utility conflicts, traffic control and dewatering as examples of costs listed in the County's Conveyance System Improvements (CSI) Program.

The County and the Earth Tech Team proposed these factors for the E&P Subcommittee's consideration. Table A4-3 shows the agreed upon cost estimating assumptions.

Table A4-3. Cost Estimating Assumptions

Cost Estimating Factors	Final Assumption
Allied Cost Factor	52% of estimated construction costs *(NOTE: May need to add mitigation costs for environmental or other concerns)*
Common Work Savings (For Total System Replacement)	Use 42% allied cost factor *(NOTE: May need to add mitigation costs for environmental or other concerns)*
Utility Conflicts	None (included in construction costs of pilot projects)
Traffic Control	None (if no traffic control needed): $0 Avg: $5/LF Main Heavy: $10/LF Main
Dewatering	Project-specific
Sales Tax	8.8% of construction estimate (or according to jurisdiction's tax rate)
Project Contingency	30% of construction estimate

A4.2.4 Financial Assumptions

To determine cost effectiveness, costs and benefits of I/I reduction projects must be compared with the costs of planned CSI and treatment plant projects. Because the proposed I/I reduction projects and the planned CSI and treatment plant projects occur over the next 50 years, the cost effectiveness analysis must account for the timing differences as well as the cost of the County's capital funding. Calculating the costs and benefits of an I/I removal project or capital improvement project involves predicting:

- The increase in the cost of goods and services over time, or the inflation rate; and
- The County's cost of capital, for example, bond rates, or the discount rate.

Using these two factors, the net present value of the costs and benefits can be calculated for each I/I reduction project and planned project. The net present value is the current value of the costs and benefits occurring in the future. The RWSP uses an inflation rate of 3 percent and a discount rate of 6 percent. NOTE: the importance of the discount and inflation figures lies not in the actual numerical level of each but in the difference between the two numbers.

Discount Rate

The discount rate used in the cost effectiveness analysis is the County's cost of capital based on the difference between the historical bond rates and inflation. The historical bond buyers' index

from 1980 to 2003 was 7.33 percent, though it has been below 6 percent since 1996. Over the same period the average difference between inflation and the bond rates was 3.15 percent. The E&P Subcommittee requested that the County present two separate cost effective analyses of I/I removal projects using discount rates of 6 percent and 5.5 percent.

Inflation Rate

Inflation is the increase in the cost of goods and services over time. The average inflation rate from 1984 to 2003 was 3.12 percent. The County and the E&P Subcommittee agreed to use a 3-percent inflation rate for the cost effectiveness analyses.

Operations and Maintenance Cost Savings

The E&P Subcommittee also reviewed the regional collection system, pump station, and treatment system operation and maintenance costs. These are needed because the cost effectiveness analysis will use operation and maintenance cost savings in the analysis in addition to the capital costs.

For the cost effectiveness analysis, it was agreed to use the same assumptions that were used in the RWSP with certain specific updated information related to operation and maintenance of: new pipes, new pump stations, new sewage storage facilities, and treatment plants.

The specific numbers are included in the summary Table A4-4 below.

Summary of I/I Program Assumptions

The final planning assumptions are listed in Table A4-4.

Table A4-4. Final Assumptions

Subject	Final Assumption
Design flow	• 20-year peak flow + 5%, based on Sea-Tac 60-year rainfall record (the additional 5% is the factor to accommodate the difference between the best fit curve and the third-highest 20-year flow)
Future Population	• Puget Sound Regional Council (PSRC) forecast through 2030; apply straight line projection through 2050
Water conservation (base flow projections)	• 10% reduction by 2010; no additional reduction thereafter
Degradation	• Existing pipe: 7% per decade starting from 2000 up to 28% • New construction: 7% per decade starting after date of construction, up to 28%
Septic conversion	• 90% of unsewered but sewerable area in 2000 sewered by 2030 • 100% sewered by 2050

Subject	Final Assumption
New system I/I allowance	• 1,500 gallons per acre per day (gpad)
Sizing of facilities	• 25% safety factor (when sizing facilities, a safety factor of 25% of additional capacity will be used)
I/I reduction costs	• Sewer main rehabilitation: $110 per linear foot • Direct disconnect: $3,000 each • Manhole rehabilitation: $3,600 each (NOTE: consider life expectancy in cost effectiveness analysis) • Lateral rehabilitation: $3,900 each (NOTE: based on 1 per lot; size-on-size) • Side sewer rehabilitation: $3,500 each • Lateral and side sewer rehab: $6,800 each
Percent basin rehabilitated	• Direct disconnect (DD): 4% • Replace everything + DD: 95% sewer main, 95% manhole, 95% lateral/side (Lat/SS) Sewer (Lat/SS) + 4% DD • Rehabilitate public portions of basin + DD: 50% sewer main, 50% manhole, 50% Lat/SS + 4% DD • Private property with some laterals + DD: 50% Lat/SS, 45% SS only
Percent I/I reduction	• Direct disconnect (DD) 10% • Replace everything + DD 80% • Rehabilitate public portions of basin + DD 40% • Private property with some laterals + DD 60%
Cost estimating factors	• Allied cost factor: 52% of estimated construction costs (NOTE: May need to add mitigation costs for environmental or other concerns) • Common work savings (for total system replacement): Use 42% allied cost factor *(NOTE: May need to add mitigation costs for environmental or other concerns)* • Utility conflicts: None (included in construction costs of pilot projects) • Traffic control: None (if no traffic control needed), Avg: $5/linear foot sewer main, Heavy: $10/linear foot sewer main • Dewatering: Project-specific • Sales tax: 8.8% of construction estimate (or according to jurisdiction's tax rate) • Project contingency: 30% of construction estimate

Subject	Final Assumption
Discount rate	• 6% and 5.5%
Inflation rate	• 3%
Operations and maintenance (O&M) analysis	Same methodology as the Regional Wastewater Service Plan (RWSP). Update the following numbers: • New pipes: $.15 per linear foot annually • New pump station: $4,104 *million gallons per day + $60,384 • New storage facility: $34,091 *million gallons + $4,546 • Treatment plant: $15,000 to $30,000 per million gallons per day of average annual flow reduction. Plant-specific. Covers energy and disinfection costs. * Reflected total O&M at the plants.

Appendix A5

Environmental Issues

Appendix A5

Environmental Issues

A5.1 Regional Wastewater Services Plan (RWSP) Environmental Policies

King County is committed to controlling infiltration and inflow (I/I) within its regional conveyance system. The Regional Wastewater Services Plan (RWSP) directs the County to rehabilitate portions of its regional conveyance system to reduce I/I whenever the cost of rehabilitation is less than the costs of conveying and treating that flow or when rehabilitation provides significant environmental benefits to water quantity, water quality, stream flows, wetlands or habitat for species listed under the Endangered Species Act (ESA) (Ordinance 13680 - I/IP-1).

In general, the County finds that the need for additional capacity in its sewer system is driven less by factors such as population growth and water conservation and more by the intrusion of water (I/I) into pipes through inappropriate connections to the sewer or cracks in the pipe. I/I affects the hydraulic peak flow that must be managed by pipelines and plants. The County is currently investigating various approaches to control I/I. However, because control alternatives are difficult to implement and numerous policy decisions need to be made prior to implementing I/I reduction, the County is not factoring reduced I/I into current planning (*2004 Annual Report*).

Under the provisions of the King County Charter and the Revised Code of Washington (RCW) 35.58.200, the RWSP (set forth in sections 1 and 4 through 15 of this ordinance) was adopted as a supplement to the comprehensive water pollution abatement plan for the County. The RWSP provides policy guidance for the wastewater system through 2030 (Ordinance 13860 – Section 3).

During early phases of RWSP development in 1995, the County conducted a planning-level cost-benefit analysis of various levels of I/I control. Results of the analysis indicated that I/I control

may be cost-effective at some levels. The County is addressing the uncertainties in these preliminary cost estimates and further analyzing the benefits of I/I control (*King County RWSP 2004 Update*).

A5.2 Relationship to Environment

Long-term operational impacts to the water quality of receiving water bodies include discharge from the treatment plants and combined sewer overflow (CSO) outfalls, conveyance system impacts, and I/I impacts. This section qualitatively describes the range of potential I/I program impacts to the environment.

A5.2.1 Water Quantity

Potential long-term water quantity impacts of unchecked I/I, depending on severity, include reducing summer base flows in streams and altering the hydroperiods of wetlands (hydroperiod refers to the depth, duration, frequency, and pattern of wetland inundation). Reducing I/I levels has the potential to increase small-scale, localized flooding because water would enter groundwater rather than the conveyance system. In turn, raised levels of groundwater have the potential to cause other hydrologic impacts such as scoured streambed channels, in-stream sedimentation, and loss of habitat. At the time of this writing, there is no known scientific information on the extent or severity of such potential impacts.

A5.2.2 Water Quality

The main water quality impact of I/I is the potential to increase the volume and frequency of CSO and sanitary sewer overflow (SSO) discharges in receiving waters. The principal pollutants present in CSOs and SSOs are microbial pathogens, oxygen-depleting substances, total suspended solids (TSS), toxics, nutrients, and floatables and trash (*EPA 2004 – Report to Congress*). These pollutants can contribute to water quality violations, impair the designated uses within the receiving waters, and reduce sediment quality near the outfalls.

SSOs are discharges of raw wastewater (as opposed to diluted wastewater from combined sewers) from municipal sanitary sewer systems. SSOs can release untreated sewage into basements, out of manholes, and onto city streets or into receiving waters. Overflows from the separate sanitary conveyance system occur occasionally, typically during extreme storm events, power outages, or system blockages. Minimizing the discharge of untreated wastewater is paramount to the mission of the Wastewater Treatment Division (WTD). Extensive resources are committed to maintaining the integrity of the system and preventing SSOs.

A5.2.3 Wetlands or Habitat for ESA Species

County policies for wetlands or habitat for ESA species include:

- Stream salmonid habitat assessments
- Proposal concerning compliance with the ESA 4(d) rule
- Review of its practices for compliance with the chinook 4(d) rule
- Preparation of a WTD Habitat Conservation Plan (HCP)
- Watershed Resource Inventory Area (WRIA) planning.

Stream habitat evaluation is a core element of several recently implemented regional programs. The County regularly conducts salmonid habitat and inventory assessments as part of its monitoring program. The information gathered in the assessments helps the County identify areas that require stream habitat restoration and preservation for the WRIA planning process, the Sammamish River Ecosystem Restoration Study, and other land use planning and Sensitive Area regulations.

In 2003, the planning effort turned to development of *Salmon Conservation Plans* (also termed *Habitat Plans*). These plans describe long-term habitat conservation and recovery actions in the Cedar River and Green/Duwamish River watersheds, taking an ecological approach but concentrating on the needs of ESA-listed species of chinook salmon and bull trout. Areas of initial work include modeling the two watersheds and their responses to management changes, analysis of historical conditions, and analysis of land use.

Many of the questions that need to be answered in regard to the WRIAs are identical to those that the County's WTD must address in various projects. Supporting the success of WRIA planning will ensure a sound framework for reasonable RWSP response to ESA requirements from the federal government.

Reducing I/I could impact wetlands or habitat for ESA species in some locations as a result of:

- Altering the hydroperiod for wetlands. This change could benefit or degrade wetlands depending on site-specific conditions. In turn, this could change wetland habitat and vegetation.
- Reducing stream stability and increasing erosion as a result of higher stream flows.

Hydrology is the primary factor influencing the type and location of wetlands. Protection of wetland plant and animal communities depends on controlling the wetland's hydroperiod, including the length and onset of drying in the summer (*Wetlands and Stormwater Management Guidelines, in Wetlands and Urbanization 1997*). Changing the hydroperiod in wetlands can reduce vegetation and animal (particularly, amphibian and fish) species' richness.

Reducing I/I levels has the potential to alter existing wetland hydroperiods, which may improve or degrade the values and functions of the wetlands. Improvements could occur as a result of decreasing the dry periods. In contrast, increased water flow to wetlands in winter and spring could lead to formation of channels that could increase water velocities (*Management of Freshwater Wetlands in the Central Puget Sound Basin, Chapter 13*).

A5.3 Regulatory Components

The following subsections provide an overview of State Environmental Policy Act (SEPA) compliance, permits, and approvals, and the ESA compliance actions that could be required for I/I projects. The exact requirements for a specific project need to be determined after the project is identified and a scope of work is established.

A5.3.1 SEPA Compliance

SEPA, among other things, requires all state and local governments within the state to:

- Utilize a systematic, interdisciplinary approach that ensures integrated use of natural and social sciences and the environmental design arts in planning and in decision-making that may have an impact on man's environment
- Ensure that environmental amenities and values are given appropriate consideration in decision-making along with economic and technical considerations…[1]

The policies and goals in SEPA supplement those in existing authorizations of all branches of state government, including state agencies, counties, cities, districts, and public corporations. Any governmental action may be conditioned or denied pursuant to SEPA.[2]

SEPA environmental review is required for any state or local agency project action, for example, agency decisions to license, fund, or undertake a specific project. I/I improvements are considered specific project actions.

SEPA rules direct agencies to:

- Consider environmental information (impacts, alternatives, and mitigation) before committing to a particular course of action[3]
- Identify and evaluate probable impacts, alternatives, and mitigation measures, emphasizing important environmental impacts and alternatives (including cumulative, short-term, long-term, direct and indirect) [3]
- Encourage public involvement in decisions[4]
- Prepare environmental documents that are concise, clear, and to the point[5]
- Integrate SEPA with existing agency planning and licensing procedures, so that the procedures run concurrently rather than consecutively[6]

[1] RCW 43.21C.030(2)(a) and (2)(b)
[2] RCW 43.21C.060
[3] WAC 197-11-030(2)(b) and (g)
[4] WAC 197-11-030(2)(f)
[5] WAC 197-11-030(2)(c)
[6] WAC 197-11-030(2)(e)

- Integrate SEPA with agency activities at the earliest possible time to ensure that planning and decisions reflect environmental values to avoid delays later in the process, and seek to resolve potential problems[7]

A5.3.2 Permits and Approvals

The number of permits and approvals is based on the extent of the project, the SEPA review process (if any), and the requirements of the local jurisdiction where the work is being performed. Because of the uniqueness of the regulatory authorities, their changing workloads, and their individual staff approaches as well as the ever-changing permitting requirements, early and continuing consultation with those agencies with jurisdiction over a particular project is highly recommended. In general, SEPA compliance is completed before permitting actions are initiated.

[7] WAC 197-11-055(2)

Appendix A5A

Potential Environmental Costs and Benefits of the King County Regional I/I Control Program

December 2004

King County

Water and Land Resources Division
Department of Natural Resources and Parks
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December 7, 2004

TO: Mark Buscher, Senior Project Administrator, Planning and Compliance Section, Wastewater Treatment Division

FM: Kelly Whiting, Hydrologist, Science and Monitoring - Scientific and Technical Support Section, Water and Land Resources Division

RE: Potential Environmental Costs and Benefits of the King County Regional I/I Control Program

The King County Regional I/I Control Program (I/I Program) includes the proposed rehabilitation of local agency wastewater collection and conveyance systems throughout the greater Metro service area. By ordinance (# 13680) the Wastewater Treatment Division is required to assess the potential environmental costs and benefits of the program. This report summarizes the findings of a general hydrologic assessment, performed by the Science Section of the Water and Land Resources Division. As I/I rehabilitation projects are identified, there may be opportunities for our Science Section to assist I/I Program staff in providing a more specific hydrologic assessment.

I/I Program – Flows of Interest

This report discusses Inflow and Infiltration flows (I/I flows) as three discrete flow components, stormwater inflow, stormwater infiltration, and base infiltration. In reality, it is often difficult to separate and quantify the individual I/I flow components from the gauged total wastewater flow hydrograph. All wastewater collection systems contain some level of stormwater inflow and infiltration, as well as base infiltration.

The goal of the I/I Program is to achieve a cost-effective reduction of I/I flows through the rehabilitation of existing wastewater collection and conveyance systems to reduce the amount of I/I flow entering the system. Detailed feasibility analyses have concluded that, in general, rehabilitation of laterals and side sewers will provide the most cost-effective reductions in I/I flows. These types of rehabilitation efforts are most likely to influence the I/I stormwater inflows and I/I stormwater infiltration components, as described below. In general, I/I base infiltration cannot be cost-effectively targeted for elimination from the system. However, where

I/I stormwater flows can be reintroduced into the landscape in a safely dispersed or infiltrated manner, environmental benefits may be achieved.

I/I Stormwater Inflow

The I/I stormwater inflows are the hydrologic component of the non-wastewater flow that responds most immediately to rainfall events. Stormwater inflow is most commonly found as direct connections of a stormwater collection system to the wastewater collection system. The I/I Program modeling project includes a fast responding (flow) component, or FRC. The FRC is comprised primarily of I/I stormwater inflows.

Where I/I stormwater inflows are most significant, the wastewater collection and conveyance system is essentially functioning as a high-flow stormwater partial bypass system for the existing natural and/or constructed drainage system, conveying storm flows directly to a treatment plant and away from the natural or established drainage system. The urban stream systems within the wastewater service area are generally not lacking storm flows. Therefore, it is generally true that there is minimal ecological benefit expected from an I/I program that targets the reduction of stormwater inflows to the wastewater collection system.

The reduction of I/I stormwater inflows will likely result in an increase in stormwater into the local environment, which may be comprised of a constructed or natural drainage system, a topographic or structural low point, or simply flow down-gradient across the landscape. In some cases, it may be possible to effectively disperse or infiltrate smaller stormwater flows back into the soils of the local landscape. However, in other cases the reintroduction of stormwater back into the environment may affect surface water hydrology in a similar manner as urban development. Most commonly these types of hydrologic alterations are described in terms of changed magnitude, frequency, and duration of storm flows. Other hydrologic attributes, such as rate of change and timing are less likely to be affected. Mitigation requirements, if any, would be determined by the local regulatory agency, or identified by design staff.

I/I Stormwater Infiltration

Simply defined, I/I stormwater infiltration is the hydrologic component of the non-wastewater I/I flow that responds to rainfall events, but which does not occur as the result of a direct connection with a stormwater collection system. Potential sources of I/I stormwater infiltration are numerous and could range in hydrologic response from nearly instantaneous to highly delayed and attenuated. Stormwater infiltration can occur when a cracked or leaking sewer service line intercepts intermittent subsurface flows or temporarily high groundwater. The I/I Program modeling project includes a slower responding (flow) component, or SRC. The SRC is comprised primarily of I/I stormwater infiltration.

As I/I stormwater infiltration is rainfall driven, these flows do contribute to the peak wastewater conveyance and treatment capacity needs. However, stormwater infiltration differs from direct stormwater connections in a couple ways. First, I/I stormwater infiltration tends to be more attenuated and often lack the large peak flow "spike" characteristic of direct stormwater inflows. Secondly, I/I stormwater infiltration may not require collection and conveyance, provided the

local landscape can accommodate periodic increases in subsurface water. Where these I/I flows can be safely eliminated from the wastewater system, the subsurface water would be available for environmental functions such as groundwater recharge, vegetative transpiration, and potentially stream flow enhancement.

The reduction of I/I stormwater infiltration may result in an increase in stormwater into the local environment, which may be comprised of a subsurface flowpath and storage, or possibly expressed to the surface and into a drainage system, a topographic or structural low point, or simply flow down-gradient across the landscape. In many cases, it should be feasible to passively retain the dispersed subsurface nature of these flows. However, in other cases the availability of more shallow subsurface water may be a concern for adjacent slopes or structures.

I/I Base Infiltration

To generate estimates of total I/I flow, it is necessary to quantify a base infiltration (BI) hydrologic component. As defined for the I/I program, BI is the portion of the non-wastewater I/I flow that remains constant through time and is assumed to come from deeper groundwater sources. This differs from the active groundwater component in the Hydrologic Simulation Program – FORTRAN (HSPF) or the baseflow component of the MOUSE RDII hydrologic model, in that BI is assumed to have little or no inter- or intra-annual variability. Figure 1 shows graphically the hydrograph separation of BI from total wastewater flow for a typical dry day (no stormwater inflow or infiltration).

Base infiltration in the wastewater system is difficult to quantify with much degree of certainty. The methodology for estimating BI uses hydrograph separation techniques that are based on an assumed level of night-time sewage generation. The methods have been refined using empirical relationships between the average and minimum flows from the given service area.. The

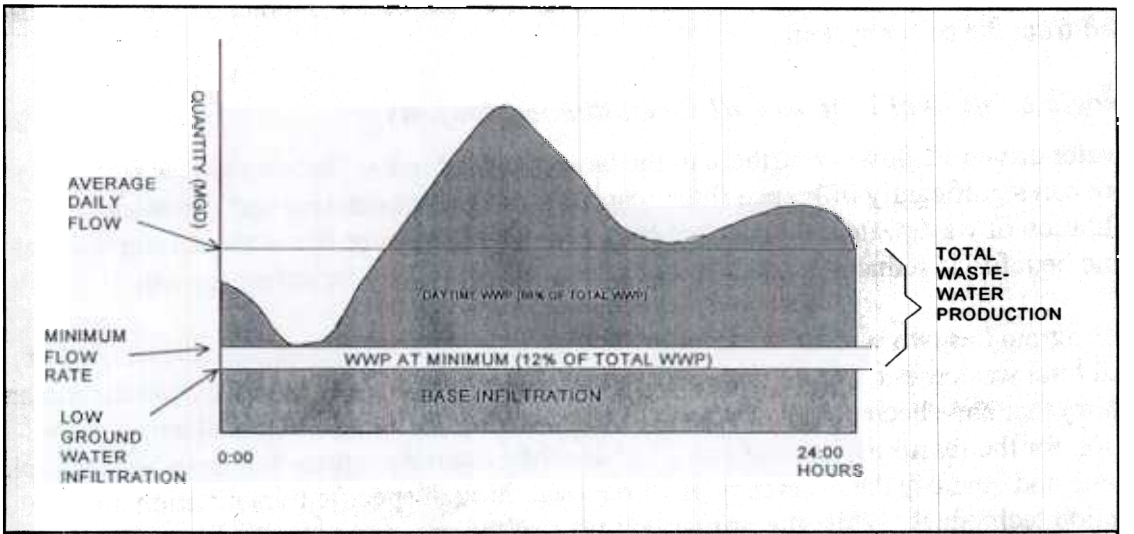

Figure 1 Relationship of Base Infiltration and Wastewater Production on Typical Dry Day

uncertainty in BI estimates are increased when the method is applied to a-typical hydrographs, such as occur downstream of fill and draw pump stations, sewer service basins with "three-shift" patterns, and unusual commercial sewer flows. Base infiltration is also assumed to remain constant across time although it was calculated from a single "dry-day" period from a specific year. It may be possible to improve the reliability of BI estimates with a more specific analysis plan, perhaps one that incorporates water usage into the estimate of night-time sewage generation. Given that BI control is not a primary program objective due to lack of cost-effectiveness, further analysis may not be warranted.

Where base infiltration is greatest in magnitude, the wastewater collection system is, in some manner, intercepting a continuous source of flow from the environment. This could be a surface water source (e.g., at a stream crossing), or involve the interception of relatively shallow groundwater. In the future, it may be possible to compare elevations of the local wastewater collection systems to local groundwater levels, but the data is not available at this time because it is cost prohibitive to collect it . Such an analysis could help focus the search for sources of base infiltration in the wastewater system.

Base infiltration is assumed to occur at all times. During periods of low stream flow, including severe low flow events (natural or otherwise), BI in the wastewater collection system may contribute to the severity of low flow conditions in the natural drainage system. Reducing base infiltration into the wastewater collection and conveyance through rehabilitation of the system may provide ecological benefit through the increased availability of groundwater to the natural drainage system but the extent of the benefit would be difficult to quantify. The low stream flow benefits of BI reduction would depend on the fate of the removed flows. Some of the removed flows may end up realized as stream flow but portions of the flow would be subject to other hydrologic abstractions including evapo-transpiration, capillary activity, and/or migration to deeper groundwater. Estimations of the phenomena would require local information on soils, geology, plant cover, groundwater, and their discrete and collective interaction with the I/I flows excluded from the sewer system.

Hydrologic Analysis of Proposed I/I Rehabilitation Projects

Stormwater driven I/I flows contribute to the largest peak flows in the wastewater system and therefore can significantly influence future capacity needs for treatment and conveyance. Rehabilitation of wastewater systems that have high I/I stormwater flows should show direct economic benefit via reduced sewer flows and increased capacity for future growth.

The I/I Program has two wet-seasons (Nov. 1 through Jan. 15 2000/2001 and 2001/2002) of observed total wastewater flows (including stormwater inflow, stormwater infiltration, and base infiltration) that have been used to calibrate continuous hydrologic models that serve as the foundation for the feasibility studies and 13 pilot rehabilitation projects that have been completed to examine and quantify the efficiency of I/I removal through specific rehabilitation and construction techniques. While the primary purpose of the pre- and post-condition modeling of pilot projects was to assess cost effectiveness of I/I flow removal techniques, the information related to flow removal should provide estimates, at the scale modeled, of how much stormwater

will be routed to drainage systems by proposed I/I removal projects. These estimates could help support specific investigations into the potential impacts to drainage systems through applicable permitting processes. The methods and procedures used to perform this hydrologic analysis were reviewed and found to be appropriate.

Preliminary results from the I/I Program indicate that one of the 13 pilot projects achieved an 83% reduction in stormwater I/I flow, or a 70% reduction of total I/I flow (including BI). The average I/I volume reduction for pilot projects with measurable reductions was found to be 28% for stormwater I/I volume, or 17.7% for total I/I volume. In peak flows terms, reductions in 20-year peak I/I flow as large as 87% were observed, with an average of 54% for those pilot projects with measurable reductions. The Skyway pilot project accounts for the highest I/I removal efficiencies for both volumes and peaks. Four of the project sites showed no apparent reduction in I/I flow volumes or peak flows. For more detailed information on the pilot projects, see the Pilot Project Report (King County Water Treatment Division, October 2004), now available.

Drainage review, as applied by the local permitting agency, will most often be performed under the guidance of either the King County or State Ecology stormwater manuals, since most jurisdictions in the wastewater service area have adopted one of these manuals. The general process for performing a hydrologic assessment includes 1) estimates of the amount of stormwater flow being re-directed away from the wastewater system, 2) identifying the fate (downstream flowpath) of the re-directed stormwater, and 3) assessing the downstream flowpath for existing and potential drainage problems.

Typically, drainage problems are characterized as being either an erosion or flooding problem. Erosion concerns are greatest for areas identified as being sensitive to erosion or landslides (e.g., identified sensitive/critical areas), but also exist for new point discharges into undefined or erodable drainage courses. Flooding concerns are primarily limited to roadways and habitable structures, including areas containing electrical and heating components. Proposed I/I rehabilitation projects upslope of these types of potential drainage problems warrant project-specific drainage analysis as part of the feasibility assessment or design phase.

Ideally, wherever practical, rehabilitated I/I flows would be reintroduced into the environment as dispersed or infiltrated flows into sufficiently large open-space areas, provided they are not adjacent to unstable slopes. Where I/I rehabilitation involves the removal of a concentrated flow source, or where dispersion/infiltration is not practical, it may be necessary to provide conveyance to an appropriate outfall location in the downstream drainage system. In many cases, rehabilitated I/I flows will not be isolated as a concentrated flow, but rather will simply not be intercepted by the rehabilitated system. In these cases, it is usually preferable to leave the flows in a dispersed state, provided the potential for new or aggravated drainage problems is small. The rehabilitation of a wastewater system immediately upslope of a potential unstable slope or flooding problem may require additional investigation to asses the impacts and mitigation requirements associated with the reintroduction of I/I flows back into the surface water system.

It is acknowledged that each I/I rehabilitation project will be unique in its challenges and opportunities. Therefore, it is recommended that the effectiveness of the I/I Program's rehabilitation projects be quantified individually to assess how rehabilitated I/I flows will affect the local landscape and the environment. It is recommended that each I/I project perform and document a hydrologic assessment including, at a minimum, a downstream analysis and estimate of I/I flow rates and volumes expected to be reintroduced into the local landscape or drainage system.

If you have any questions regarding this report, please do not hesitate to call me at 263-6053.

KW:inB22

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Appendix A6

Selected Legal Authorities Related to Implementing and Funding an Infiltration and Inflow Reduction Program

December 2004

Appendix A6

SELECTED LEGAL AUTHORITIES
Related to Implementing and Funding an Infiltration and Inflow Reduction Program
December 1, 2004

THE WASHINGTON CONSTITUTION

Article VIII STATE, COUNTY AND MUNICIPAL INDEBTEDNESS

SECTION 7 CREDIT NOT TO BE LOANED. No county, city, town or other municipal corporation shall hereafter give any money, or property, or loan its money, or credit to or in aid of any individual, association, company or corporation, except for the necessary support of the poor and infirm, or become directly or indirectly the owner of any stock in or bonds of any association, company or corporation.

SECTION 10 ENERGY, WATER, OR STORMWATER OR SEWER SERVICES CONSERVATION ASSISTANCE. Notwithstanding the provisions of section 7 of this Article, any county, city, town, quasi municipal corporation, municipal corporation, or political subdivision of the state which is engaged in the sale or distribution of water, energy, or stormwater or sewer services may, as authorized by the legislature, use public moneys or credit derived from operating revenues from the sale of water, energy, or stormwater or sewer services to assist the owners of structures or equipment in financing the acquisition and installation of materials and equipment for the conservation or more efficient use of water, energy, or stormwater or sewer services in such structures or equipment. Except as provided in section 7 of this Article, an appropriate charge back shall be made for such extension of public moneys or credit and the same shall be a lien against the structure benefited or a security interest in the equipment benefited. Any financing for energy conservation authorized by this article shall only be used for conservation purposes in existing structures and shall not be used for any purpose which results in a conversion from one energy source to another. **[AMENDMENT 91, 1997** House Joint Resolution No. 4209, p 3065. Approved November 4, 1997.]

WASHINGTON STATE STATUTES

Storm Water and Sewer Utility Conservation Statute. This statute was enacted in 1998 to implement Washington State Constitutional Amendment No. 91 (above) by authorizing a conservation loan program for private homeowners:

RCW 35.67.360
Conservation of storm water and sewer services -Use of public moneys.
Any city, code city, town, county, special purpose district, municipal corporation, or quasi-municipal corporation that is engaged in the sale or distribution of storm water or sewer services may use public moneys or credit derived from operating revenues from the sale of storm water or sewer services to assist the owners of structures or equipment in financing the acquisition and installation of materials and equipment, for compensation or otherwise, for the conservation or more efficient use of storm water or sewer services in such structures or equipment. Except for the necessary support of the poor and infirm, an appropriate charge-back shall be made for the extension of public moneys or credit. The charge-back shall be a lien against the structure benefited or a security interest in the equipment benefited. [1998 c 31 § 2.]

Metro Statute
RCW 35.58.200. Powers relative to water pollution abatement.

If a metropolitan municipal corporation shall be authorized to perform the function of metropolitan water pollution abatement, it shall have the following powers in addition to the general powers granted by this chapter:

(1) To prepare a comprehensive water pollution abatement plan including provisions for waterborne pollutant removal, water quality improvement, sewage disposal, and storm water drainage for the metropolitan area.

(2) To acquire by purchase, condemnation, gift, or grant and to lease, construct, add to, improve, replace, repair, maintain, operate and regulate the use of metropolitan facilities for water pollution abatement, including but not limited to, removal of waterborne pollutants, water quality improvement, sewage disposal and storm water drainage within or without the metropolitan area, including but not limited to trunk, interceptor and outfall sewers, whether used to carry sanitary waste, storm water, or combined storm and sanitary sewage, lift and pumping stations, pipelines, drains, sewage treatment plants, flow control structures together with all lands, property rights,, equipment and accessories necessary for such facilities. Sewer facilities which are owned by a county, city, or special district may be acquired or used by the metropolitan municipal corporation only with the consent of the legislative body of the county, city, or special districts owning such facilities. Counties, cities, and special districts are hereby authorized to convey or lease such facilities to metropolitan municipal corporations or to contract for their joint use on such terms as may be fixed by agreement between the legislative body of such county, city, or special district and the metropolitan council, without submitting the matter to the voters of such county, city, or district.

(3) To require counties, cities, special districts and other political subdivisions to discharge sewage collected by such entities from any portion of the metropolitan area which can drain by gravity flow into such metropolitan facilities as may be provided to serve such areas when the metropolitan council shall declare by resolution that the health, safety, or welfare of the people within the metropolitan area requires such action.

(4) To fix rates and charges for the use of metropolitan water pollution abatement facilities, .and to expend the moneys so collected for authorized water pollution abatement activities.

(5) To establish minimum standards for the construction of local water pollution abatement facilities and to approve plans for construction of such facilities by component counties or cities or by special districts, which are connected to the facilities of the metropolitan municipal corporation. No such county, city, or special district shall construct such facilities without first securing such approval.

(6) To acquire by purchase, condemnation, gift, *or* grant, to lease, construct, add to, improve, replace, repair, maintain, operate and regulate the use of facilities for the local collection of sewage or storm water in portions of the metropolitan area not contained within any city or special district operating local public sewer facilities and, with the consent of the legislative body of any such city or special district, to exercise such powers within such city or special district and for such purpose to have all the powers conferred by law upon such city or special district with respect to such local collection facilities: PROVIDED, That such consent shall not be required if the department of ecology certifies that a water pollution problem exists within any such city or special district and notifies the city or special district to correct such problem and corrective construction of necessary local collection facilities shall not have been commenced within one year after notification. All costs of such local collection facilities shall be paid for by the area served thereby.

(7) To participate fully in federal and state programs under the federal water pollution control act (86 Stat. 816 et seq., 33 U.S.C. 1251 et seq.) and to take all actions necessary to secure to itself or its component agencies the benefits of that act and to meet the requirements of that act, including but not limited to the following:

(a) authority to develop and implement such plans as may be appropriate or necessary under the act.

(b) authority to require by appropriate regulations that its component agencies comply with all effluent treatment and limitation requirements, standards of performance requirements, pretreatment requirements, a user charge and industrial cost recovery system conforming to federal regulation, and all conditions of national permit discharge elimination system permits issued to the metropolitan municipal corporation or its component agencies. Adoption of such regulations and compliance therewith shall not constitute a breach of any sewage disposal contract between a metropolitan municipal corporation and its component agencies nor a defense to an action for the performance of all terms and conditions of such contracts not inconsistent with such regulations and such contracts, as modified by such regulations, shall be in all respects valid and enforceable. [1975 c 36 § 1; 1974 ex.s. c 70 § 6; 1971 ex.s. c 303 § 7; 1965 c 7 § 35.58.200. Prior: 1957 c 213 § 20.]

JUDICIAL AUTHORITY

The City of Tacoma v. The Taxpayers of/he City of Tacoma, 108 Wash.2d 679, 743 P.2d 793 (1987). This case was a declaratory judgment action to determine the validity of a City of Tacoma electrical conservation program. The City of Tacoma enacted an ordinance authorizing Tacoma City Light to issue electric revenue bonds and use other public funds to pay for electrical conservation measures in commercial and residential structures. The ordinance was challenged as 1) going beyond the authority granted by RCW 35.92.050, the municipal utility enabling statute, and 2) authorizing an unconstitutional gift of public funds. The Supreme Court upheld the City's program on both counts, ruling that: 1) Tacoma's ordinance was validly enacted under RCW 35.92.050 because Tacoma's conservation program was the functional equivalent of purchasing electricity, and 2) Tacoma's payment for the installation of conservation equipment in private commercial and residential buildings was not an unconstitutional gift or loan of public funds under Art. 8, §7 of the Washington Constitution.

Appendix A7

Inflow and Infiltration Survey Report

December 2004

Appendix A7

King County Department of Natural Resources & Parks

Inflow and Infiltration Survey Report
December 2004

Prepared by:
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METHODOLOGY

This report presents key findings of a recent telephone survey conducted by the Evans/McDonough Company for King County's Department of Natural Resources and Parks on Inflow and Infiltration (I & I). Four hundred (400) interviews were conducted among residents within King County's wastewater treatment area, and an additional one hundred (100) interviews were conducted among residents in three Pilot Project Areas. In both populations, the sample was created through a reverse look-up, whereby the resident addresses within the County's wastewater treatment area and the Pilot areas were matched with their respective telephone numbers. Residents were then contacted using a random pattern, giving everyone an equal probability of selection. Participants were screened for ownership of a single or multi-family house. Trained, professional telephone interviewers calling from a central, monitored location conducted the interviews during the evening and weekend hours of November 14 – 18, 2004.

The margin of error for the overall results is ± 5.0 percentage points and ± 9.9 percentage points for the Pilot Area, both at the 95% confidence interval. This confidence interval means that if the survey were conducted 100 times, it would produce results within the stated margin of error percentage points 95 times out of 100.

The purpose of the telephone survey is to investigate homeowner opinion on possible solutions to the problem of clean water infiltration of the sewer system. This report is an analysis of the results of the survey.

STRATEGIC RECOMMENDATIONS

1. Homeowners support spending on the program

A strong majority of residents in both the County (63%) and the Pilot Area (70%) support their sewer entity spending money on programs to reduce the amount of clean water that gets into sewer lines.

2. A supermajority of homeowners say they are willing to pay an additional $1.00 per month to help reduce I & I.

Well over three-quarters (83%) of homeowners in the County overall and exactly three-quarters (76%) of homeowners in the Pilot Area say they would pay an additional $1.00 per month to help pay to reduce the amount of clean water going into the sewer lines. The overwhelming level of support for this nominal fee is a strong indication that homeowners are willing to pitch in to help fix I&I problems at this level.

3. Homeowners are divided over who should pay for Main Line repairs, but a majority feel they should be shared in some way.

Combined, two-thirds (65%) of residents support sharing the costs of repairs across the region. Residents are divided, however, on where the bulk of the share should fall. A third (35%) says all regions should share, a third (30%) think customers in districts where the problems are should pay more, and nearly a quarter (22%) think customers in the district where there is a problem should pay 100% of the costs.

4. A majority of homeowners think the property owner should pay the total cost for Side Sewer repairs.

A majority (54%) of residents think property owners should pay the full cost of side sewer repairs. This is divided between a third (33%) who thinks residents should have access to low interest loans to be paid back on their bill, while 21% think the property owner should pay 100%. Forty-two percent (42%) think these costs should be shared.

5. Homeowners are divided over who should pay for land repairs resulting from side sewer work on private property, but homeowners agree that property owners share some of the burden.

Residents are divided again, with a third (31%) saying that property owners should pay 100%, and slightly more than a third (37%) saying the costs should be shared, either in the local sewer district (13%) or across the regional district (24%).

6. A majority of homeowners think fixing I&I problems should be mandatory. A plurality thinks it should be the owner's decision whether or not to disconnect roof drains on private property.

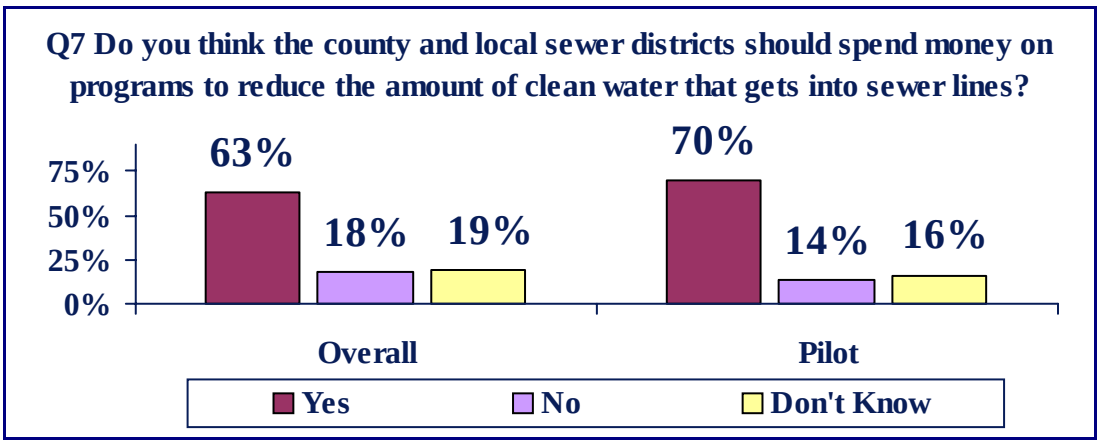
Half (52%) of homeowners think property owners should be required to fix I&I side sewer problems. At the same time, half (49%) think the property owner should decide whether to disconnect their roof drains from the sewer system.

DETAILED FINDINGS

Support for the Program

A strong majority of homeowners think the County and Local Sewer Districts should spend money on programs to reduce I & I.

- This strong majority exits among homeowners County-wide and in the Pilot Area.

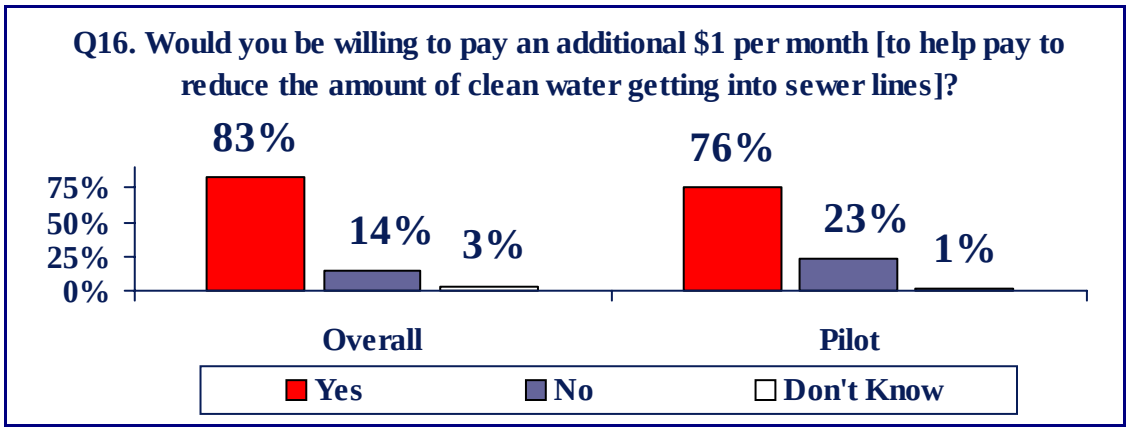


- Geographically, homeowners in East King County are the most supportive (65% Yes), while those in Central King and Seattle are least supportive (52% Yes).

Willingness to Pay

A supermajority of homeowners in both the Overall and Pilot area favor a small increase in their monthly sewer rates to help pay for efforts to reduce I&I.

- Three-quarters or more of homeowners (83%) and Pilot area homeowners (76%) say they would pay $1.00 per month on their sewer bill to help pay to reduce I&I problems.



- Only 14% of homeowners in the County oppose paying $1 more a month to help fix I & I problems.

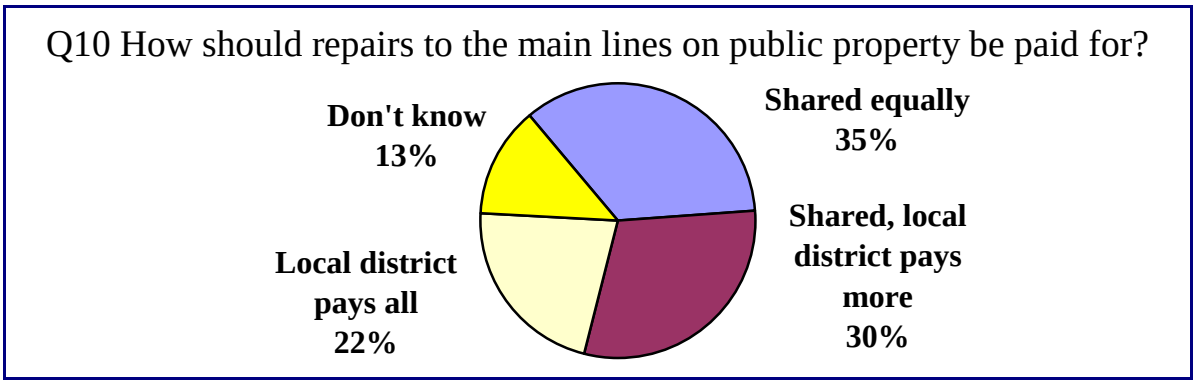
- Younger homeowners are more likely to support this increase. Ninety percent (90%) of homeowners under fifty years old say they are willing to pay $1 more a month, while three-quarters (78%) of homeowners over 50 say the same.

- Support among Pilot area homeowners is a net 16 points lower than among homeowners overall. However, support is well above a supermajority in both groups.

Who Should Pay?

Main Sewer Lines

- Homeowners are divided on who bears the financial burden for Main Sewer repairs.



- Homeowners are most likely to say that the regional sewer system should bear some responsibility (65%). Of these homeowners, a plurality says these costs should be shared equally across all systems, regardless of which local district the problems are in (35%). Another 30% think customers in the local district where they problems are should pay more. An additional quarter (22%) think customers in the local district should pay 100%.

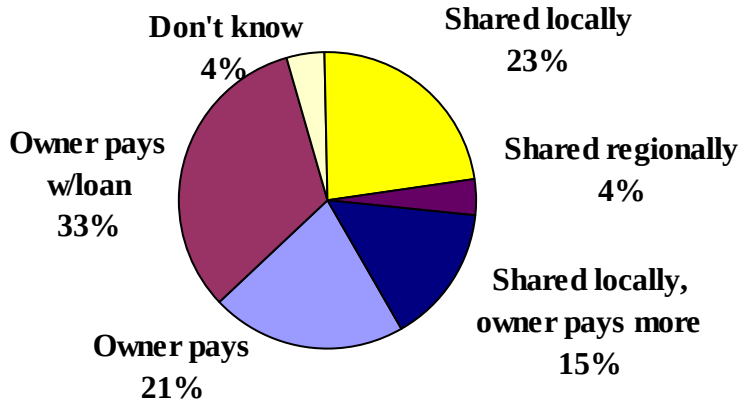
- Homeowners under 50 years old are more likely than those over 50 to say customers in the regional system should share. Forty-one percent (41%) of homeowners under fifty choose this option, compared with thirty percent (30%) of homeowners over 50.

Side Sewer Lines

- A majority of homeowners (54%) think the property owner should pay the total cost of repairs to side sewer lines. Most of these homeowners think low-interest loans should be

offered (33%) that would be paid back on sewer bills. An additional twenty-one percent (21%) think property owners should be responsible for 100% of the costs.

Q11 Who should pay for repairs to the side sewer lines that are on private property?



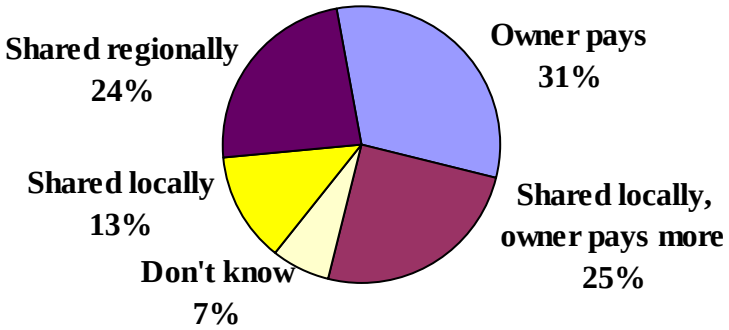
A significant portion (42%) think costs should be shared. The vast majority of this group thinks these costs should be shared among people in the local sewer district with everyone paying the same (23%) or that it should be shared in the local district but the property owner should pay more (15%). Only a few think the costs should be shared across the entire regional district with everyone paying the same (4%).

- Residents in the Pilot Area are more likely to say that costs should be shared across the regional district with everyone paying the same (17%).

Landscaping and Hardscaping

- Homeowners are divided over who should pay for the repairs to landscaping and hardscaping that result from work on side sewer lines. A third (31%) think the property owner should pay 100% of the costs.

Q12 Who do you think should be responsible for the costs of restoring things like landscaping, driveways, and private sidewalks after the pipe is repaired?



- Slightly more than a third (37%) think the costs should be shared equally across the local district (13%) or the entire regional district (24%) with everyone paying the same. Another quarter (25%) think the costs should be shared locally, with the property owner paying more.

Mandatory or Voluntary Fixes

A majority (52%) of homeowners think fixing I&I problems should be mandatory

- On the other hand, a third (34%) of homeowners think fixing I&I problems should be voluntary.

- Homeowners outside of Seattle are more likely to say fixing I&I problems should be mandatory. Half of homeowners in South King (52%) and East King (53%) say fixing these problems should be mandatory. In Central King/Seattle, only 37% of homeowners think this should be mandatory. Nearly half (44%) of homeowners in this area think it should be up to the owner to fix I&I problems.

Half (49%) of homeowners think disconnecting roof drains should be the choice of the property owner.

- Another third (36%) believe it should be required that homeowners disconnect their roof drains from the sewer system.

- Support for the County or local sewer agency requiring roof drains be disconnected is highest in the Central King/Seattle area (48%). Homeowners in South King are the most supportive of voluntary action (54%), while East King residents are divided (46% Voluntary / 37% Required).

- Homeowners in the Pilot area are more likely than the overall to support requiring roof drain disconnection. Half (49%) of homeowners in the Pilot area think this should be required, while only a third (36%) of the overall say the same.

Appendix A8

Options Considered and Not Selected

Appendix A8

Options Considered and Not Selected

The following includes options that originally were possibilities for inclusion in this Report. After evaluation of these options and input from the Engineering and Planning (E&P) Subcommittee and the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC), these options were not selected for further consideration because they are not feasible, too costly, not practicable, or not desirable. They are included here, however, to document those options that were considered.

A8.1 Core Components

A8.1.1 I/I Reduction Goal

Option: Altering 30-percent reduction goal

Via the E&P Subcommittee, King County and local agency staff discussed the possibility of establishing a reduction goal lower than 30 percent; for example, 15 percent.

REASON dropped: The group decided not to pursue this option since it is inconsistent with the RWSP and because periodic program reviews provide opportunities for adjusting program goals in the future.

A8.1.2 Measure of Cost Effectiveness

Option: Ratios greater than 1:1

Via the E&P Subcommittee, the County and local agency staff considered requiring a higher ratio of benefits to costs for a project to be considered cost effective.

REASON dropped: The group decided not to pursue this option because the selected I/I reduction costs are considerably higher than those found in the pilot projects and from local agency experience. It was thought that this conservative approach ensured that all projects with a 1:1 benefit to cost ratio would actually save public monies.

A8.1.3 Project Funding

Option: Required local agency match to obtain County funding

This option requires local agencies to contribute some percentage of any regional grant for I/I reduction (for example, 20 percent) to obtain the grant.

REASON dropped: Local agencies requested this option be dropped since they lack incentive to pay under current contract terms and enforcement practices. County staff also expressed concern over the administrative changes needed to enact this funding approach.

Option: Market rate loans

This option provides loans to local agencies for I/I reduction projects but at a market rate interest rate.

REASON dropped: Local agency representatives stated that they would not utilize market rate loans from the County when they could borrow money from other sources with fewer requirements.

Option: Interest rates vary according to local agency match amount (similar to the State of Washington Public Works Trust Fund Program)

This option provides an approach that the interest rate paid by a local agency for an I/I reduction project is variable based on the amount of match money that the local agency provides. The more money contributed, the lower the interest rate paid. This approach was modeled from the State's Public Works Trust Fund program.

REASON dropped: The County and local agencies agreed to drop this option because of concerns on both sides: local agencies lack incentive to put forth matching dollars under current contract terms and enforcement practices, while County staff expressed concern over the administrative changes required to enact this funding approach.

Option: Interest rates vary according to the severity of local agency I/I

This option ties interest rates to the amount of I/I contributed by a local agency.

REASON dropped: The County and local agencies agreed to drop this option since some local agencies contribute far higher levels of I/I to the regional system than others; basing financial terms on a criterion with such variance results in conditions that are not equitable. In addition, County staff expressed concern over the administrative changes required to enact this funding approach

A8.2 Variable Component Options

A8.2.1 Standards, Procedures, and Policies

Option: Adopting all design standards as mandatory and enforceable

The Standards, Procedures, and Policies would be adopted and used by all local agencies.

REASON dropped: Local agencies expressed a clear preference for autonomy and flexibility in administering projects, especially those funded from their own coffers. Local agency representatives also feel that their operating procedures and design practices are sound and do not lead to higher I/I.

Option: Numerous specific Standards, Procedures, and Policies during development

The process of developing the Standards, Procedures, and Policies was a collaborative effort among the County, the local agencies, and the Earth Tech Team; the process spanned several years. Initial standards, procedures, and policies were developed with the specific goal of maximizing I/I removal. E&P Subcommittee efforts with the County resulted in a *Final Draft* document that considers I/I removal as well as a local agency experience (see *Appendix B2* for more detail on the agreed-upon items). Included in the *Final Draft* document is a table of many options evaluated that were not included in the final chosen options.

REASON dropped: The options shown in the *Final Draft* were dropped because they were felt to be unfeasible or too costly.

A8.2.2 I/I Threshold

Option: Varying threshold over time (for example, over time, the amount of I/I a local agency could contribute decreases)

This option considers changing the I/I threshold over time as an incentive to reduce I/I, recognizing that I/I reduction projects take time to construct.

REASON dropped: Difficult to monitor; perceived as arbitrary; I/I reduction beyond certain levels may not be cost effective; potential increase in administering program.

Option: Setting thresholds without degradation

This option sets a threshold at a certain amount without allowing for degradation of the pipe over time and a resultant I/I increase.

REASON dropped: All parties (local agencies/County) agreed that degradation is inevitable and should be included.

Option: Setting thresholds at today's flows with and without degradation

Using the flow data collected as part of an I/I control program, set each agency's threshold based on those results.

REASON dropped: Such a situation provides very little incentive to lower higher I/I flows and some agencies would have a very high threshold while others would have a much lower threshold, creating equity issues among the local agencies.

Option: Using a model or mini-basin as the application area for a threshold

This option sets a threshold based on a model or mini-basin, a smaller subdivision when compared to a local agency.

REASON dropped: The existing threshold that is included in the contracts does not address the unit area the threshold is applied to, be that on a local agency basis or a smaller model basin or mini-basin level. It was thought that the smaller area units are too small to use as the threshold basis and require too much effort to monitor and model.

A8.2.3 Pre-1961 Pipe

Option: Varying thresholds for pre-1961 and post-1961 pipe

This option sets different thresholds for sewers constructed before 1961 and after 1961.

REASON dropped: Complex to determine and monitor, and expensive to administer this option.

Option: Pre-1961 exempt for some time period, then not exempt

Because some pre-1961 pipe will be replaced or repaired as a result of pipe deterioration, this option sets a time period for that to happen, after which the local agency is responsible for I/I flows.

REASON dropped: Complexity, expense of monitoring, delineating, and tracking when the change in exemption occurs.

A8.2.4 Private Property Issues

Option: Local agency ownership of all side sewers

This option establishes that each local agency becomes the owner of all side sewers.

REASON dropped: The E&P Subcommittee commented that agency ownership of side sewers is not feasible due to liability, maintenance issues, and cost implications.

Option: A regional I/I control program develops a right-of-entry agreement for all local agencies to use

This option establishes a region-wide access agreement that all agencies would use.

REASON dropped: The E&P Subcommittee commented that the local agencies should not be required to use an access agreement developed by the County. The E&P Subcommittee also questioned whether or not the County could legislate a region-wide ordinance.

Option: Restoration of private property to pre-construction conditions

Option: Restoration of private property to original grade only without restoration of surface improvements

These options provide standards to which private property needs to be restored after an I/I reduction project is constructed on private property.

REASON dropped: The E&P Subcommittee noted that restoration of private property to pre-construction conditions can never be completely accomplished**.** The E&P Subcommittee also noted that restoration to original grade without any restoration of surface improvements is not viable**.**

Option: King County inspects new installations for compliance with I/I control requirements

With this option, the County is responsible for all I/I reduction projects for I/I components of the project.

REASON dropped: The E&P Subcommittee noted that inspection of private sewers by the County would be duplicative with local agency inspections and is not realistic.

Option: A regional I/I control program establishes reporting requirements for local agencies to track inspection performed and results

With this option, the local agencies submit reports to the County on I/I reduction project construction.

REASON dropped: The E&P Subcommittee noted that the use of forms and reporting requirements is not effective as the forms are often misused and reports are often overlooked or ignored.

A8.2.5 Public Education and Involvement

Option: King County develops and implements public involvement program and designs public education materials

The County has the sole responsibility for developing and implementing public education/involvement programs and materials with this option.

REASON dropped: Local agencies felt that under no circumstances would it be appropriate for the County to develop and implement a public education/involvement program without some amount of local agency input and involvement.

A8.3 Program Components Where Agreement Has Been Reached

A8.3.1 Planning Assumptions

Please compare the options in the middle column to those in the right column in Table A8-1 for the options considered and not selected. Refer to *Appendix A4* of this Report for details of these issues.

Table A8-1. Planning Assumptions

Subject	Suggested Assumption	Final Assumption
Design flow	• 20-year peak flow	• 20-year peak flow + 5%, based on Sea-Tac 60-year rainfall record (the additional 5% is the factor to accommodate the difference between the best fit curve and the third-highest 20-year flow)
Future Population	• Puget Sound Regional Council (PSRC) forecast, then straight-line extrapolation	• Puget Sound Regional Council (PSRC) forecast through 2030; apply straight line projection through 2050
Water conservation (base flow projections)	• 10%-reduction by 2010; no additional reduction thereafter	• 10% reduction by 2010; no additional reduction thereafter
Degradation	• 7% per decade up to 28%	• Existing pipe: 7% per decade starting from 2000 up to 28% • New construction: 7% per decade starting after date of construction, up to 28%
Septic conversion	• All sewerable areas sewered by 2030	• 90% of unsewered but sewerable area in 2000 sewered by 2030 • 100% sewered by 2050
New system I/I allowance	• 1,100 gallons per acre per day (gpad) pending new data	• 1,500 gallons per acre per day (gpad)
Sizing of facilities	• 20% to 30% safety factor	• 25% safety factor (when sizing facilities, a safety factor of 25% of additional capacity will be used)

A8.3.2 I/I Reduction Assumptions

Please compare the options in the middle column of Table A8-2 to those in the right column for the options considered and not selected. Refer to *Appendix A4* of this Report for details of these issues.

Table A8-2. I/I Reduction Assumptions

Subject	Suggested Assumption	Final Assumption
I/I reduction costs	• Sewer main rehabilitation: $90/lf • Direct disconnect[1]: $1,000 ea • Manhole rehabilitation: $2,800 each • Lateral rehabilitation: $3,900 each	• Sewer main rehabilitation: $110/lf • Direct disconnect[1]: $3,000 ea • Manhole rehabilitation: $3,600 ea (NOTE: consider life expectancy in cost effectiveness analysis) • Lateral rehabilitation: $3,900 ea (NOTE: based on 1 per lot; size-on-size) • Side sewer rehabilitation: $3,500 ea • Lateral and side sewer rehab: $6,800 ea
Percent basin rehabilitated	• Direct disconnect (DD): 4% • Replace everything + DD: 95% + DD • Rehabilitate public portions of basin + DD: 50% + DD • Private property with some laterals + DD: 70% side sewer + 25% lateral/side sewer + DD	• Direct disconnect (DD): 4% • Replace everything + DD: 95% sewer main 95% manhole 95% Sewer (lateral/side sewer) + 4% DD • Rehabilitate public portions of basin + DD: 50% sewer main 50% manhole 50% lateral/side sewer + 4% DD • Private property with some laterals + DD: 50% lateral/side sewer 45% side sewer only
Percent I/I reduction	• Direct disconnect (DD) 15% • Replace everything + DD 80% • Rehabilitate public portions of basin + DD 45% • Private property with some laterals + DD 75%	• Direct disconnect (DD) 10% • Replace everything + DD 80% • Rehabilitate public portions of basin + DD 40% • Private property with some laterals + DD 60%

Subject	Suggested Assumption	Final Assumption
Cost estimating factors	• Allied cost factor: 52% of estimated construction costs (*NOTE: May need to add mitigation costs for environmental or other concerns)*	• Allied cost factor: 52% of estimated construction costs *(NOTE: May need to add mitigation costs for environmental or other concerns)*
	• Common work savings: Subtract 20% of construction cost from allied costs *(NOTE: May need to add mitigation costs for environmental or other concerns)*	• Common work savings (for total system replacement): Use 42% allied cost factor *(NOTE: May need to add mitigation costs for environmental or other concerns)*
	• Utility conflicts: None (included in construction costs of pilot projects)	• Utility conflicts: None (included in construction costs of pilot projects)
	• Traffic control: None (if no traffic control needed) Avg: $5/linear foot sewer main Heavy: $10/linear foot sewer main	• Traffic control: None (if no traffic control needed) Avg: $5/linear foot sewer main Heavy: $10/linear foot sewer main
	• Dewatering: None (assume trenchless)	• Dewatering: Project-specific
	• Sales tax: 8.8% of construction estimate	• Sales tax: 8.8% of construction estimate (or according to jurisdiction's tax rate)
	• Project contingency: 0% of construction estimate	• Project contingency: 30% of construction estimate
Discount rate	• 6%	• 6% and 5.5%
Inflation rate	• 3%	• 3%
Operations and maintenance (O&M) analysis	• New pipes: $.15 per linear foot annually • New pump station: $4,104 *million gallons per day + $60,384 • New storage facility: $34,091 *million gallons + $4,546 • Treatment plant: per average wet weather flow * Reflected total O&M at the plants.	Same methodology as the Regional Wastewater Service Plan (RWSP). Update the following numbers: • New pipes: $.15 per linear foot annually • New pump station: $4,104 *million gallons per day + $60,384 • New storage facility: $34,091 *million gallons + $4,546 • Treatment plant: $15,000 to $30,000 per million gallons per day of average annual flow reduction. Plant-specific. Covers energy and disinfection costs. * Reflected total O&M at the plants.

A8.3.3 Program Review Period

Several program review periods were originally considered, including every year, every 10 years, and every RWSP update time.

REASON dropped: These options were rejected because the every other RWSP period made logical sense. This is especially true when considering that the costs for monitoring and modeling are considerable so whatever is chosen should be logical and cost effective. Using the RWSP update as a starting point allows for timely adjustments to flows and a period that keeps costs reasonable.

A8.3.4 Environmental Review

No other options were considered.

A8.3.5 I/I Program Support

No other options were considered.