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INFLOW AND INFILTRATION REDUCTION STRATEGY

The Environmental Services Committee recommends the adoption of the recommendations contained in the following report dated January 17, 2011, from the Commissioner of Environmental Services.

1. RECOMMENDATIONS

It is recommended that:

1. Regional Council endorse the Inflow and Infiltration Reduction Strategy (the Strategy), subject to minor adjustments to the final drafts arising out of the pre-submission consultation with the Ministry of the Environment. Through development and endorsement of the Strategy, York Region and local municipalities commit to:
 - Develop and maintain this Strategy including the programs, goals and inter-agency and regulatory reporting requirements for staged reduction of inflow and infiltration over the next 20 years
 - Recommend to future Councils that they commit funds for inflow and infiltration reduction that is economically justified by the avoidance of future treatment and conveyance costs
 - Measure wastewater flows before and after carrying out construction/rehabilitation works on sewers and to document inflow and infiltration expenditures and flow reduction measures
 - Continue to work together in a collaborative manner over the life of the Strategy and to commit the appropriate staffing and financial resources toward implementation of the Strategy based on a business case analysis
2. The Regional Clerk circulate this report to the Clerks of local municipalities.
3. The Regional Clerk forward a copy of this report to the Ministry of the Environment, Central Region Office.

2. PURPOSE

The purpose of this report is to present the Strategy developed in accordance with the current Inflow and Infiltration Reduction Program and pilot projects and requirements of the Conditions of the Minister of the Environment as part of the approval of the Southeast Collector Trunk Sewer Individual Environmental Assessment. York Region is the first Regional Municipality required by the Ministry of the Environment to meet such unique and stringent conditions related to inflow and infiltration in Regional and local sewer systems.

The Strategy provides an overview of current inflow and infiltration and describes the targets, activities, timelines and milestones of future objectives and programs being considered by the Region and local municipalities to manage inflow and infiltration.

3. BACKGROUND

Reducing inflow and infiltration has been an integral part of servicing considerations by the Region since the first Water and Wastewater Master Plan was developed in 1997. The 2001 York Durham Sewage System Master Plan update specifically identified water conservation and extraneous flow reduction as a significant design consideration for all York Durham Sewage System projects. In combination with alternatives considered during the Southeast Collector Trunk Sewer Individual Environmental Assessment, inflow and infiltration reduction efforts across the Region were increased in 2007 with Regional Council approving a commitment of \$23 million in the 10-year Capital Plan with ongoing efforts by both Regional and local municipal staff to control inflow and infiltration.

Although advances in inflow and infiltration reduction measures have been significant, a considerable amount of additional work is now required to meet the Minister's conditions. In summary, approval of the Southeast Collector Trunk Sewer is subject to stringent conditions based upon the following overall directions:

- A compliance, monitoring and reporting program is to be established
- York Region is required to establish a stakeholder advisory committee consisting of representatives from local and regional municipalities, agencies, environmental groups and residents
- A review of best in class inflow and infiltration reduction strategies are to be completed in conjunction with the Region and the local municipalities and an independent peer review of the Strategy is to be presented to the advisory committee, and submitted to the Ministry of the Environment
- A performance management plan is to be developed and then submitted to the advisory committee and the Ministry of the Environment

To date, York Region and local municipal inflow and infiltration reduction pilot programs have focused on identifying and reducing flows originating from public infrastructure. However, inflow and infiltration flows from private sources are common in the local municipalities within the Region. Based on similar systems across North America and the findings of the Industry Practice Scan, it is estimated that 50%–70% of all inflow and infiltration comes from private property sources.

Inflow and infiltration is inherent in York Region's sewer system

As sewer systems age, infrastructure tends to deteriorate and the likelihood that inflow and infiltration will enter the sewer tends to increase and consume additional sewer capacity. Poor construction practices and guidelines can also contribute to the amount of inflow and infiltration in the system. This extra volume of water can potentially overload the sewage collection system pipes causing back-ups. Raw sewage overflows can also occur during storm events posing risks to public health and the environment. Additional costs are incurred to convey and treat these extraneous flows.

2011-2031 inflow and infiltration reduction strategy developed in partnership with local municipalities

The purpose of the Strategy is to document and describe the recommended program and the implementation sequence for the Region and local municipalities to reduce flows from sewer systems within the Region.

The Region formed an Inflow and Infiltration Task Force in April 2010 to successfully develop a comprehensive Strategy that addresses the Minister's Conditions. The Task Force is comprised of representatives from all nine local municipalities and the Region and is responsible to review inflow and infiltration issues and formulate an overall direction for development and implementation of the Strategy.

The Strategy outlines efforts required to reduce flows and addresses the conditions as described above. The resulting action plan is based upon previous project experience, input from the Task Force and findings from the Industry Practice Scan and Peer Review Process. Throughout development of the Strategy, York Region and the local municipalities have worked collaboratively to identify the various activities and roles of their respective organizations to help support program implementation.

4. ANALYSIS AND OPTIONS

Establishing inflow and infiltration goals and targets is key to program success

The Southeast Collector Trunk Sewer Individual Environmental Assessment contained a detailed evaluation of the effectiveness of water conservation and inflow and infiltration reduction measures across several municipalities. An instantaneous peak flow reduction of 10% within the Southeast Collector during a 25 year storm event was the target outlined in the Southeast Collector Trunk Sewer Individual Environmental Assessment. This amount of instantaneous peak reduction corresponds to a volumetric reduction of approximately 71 megalitres over a 24 hour period under a 25 year storm event. Reducing this volume will be accomplished through the combined efforts of the Long

Term Water Conservation Strategy and the Inflow and Infiltration Reduction Strategy. The 10% peak reduction is approximately a 15% reduction in 2031 average day flows.

Preliminary assessment indicates that the Long Term Water Conservation Strategy will contribute 40%-50% of the overall reduction required, leaving approximately 41 megalitres per day targeted for inflow and infiltration reduction. The Long Term Water Conservation Strategy is defined in a separate report on the Environmental Services Committee February 9, 2011 agenda.

Through development and endorsement of the Strategy, York Region and local municipalities commit to:

- Develop and maintain this Strategy including the programs, goals and inter-agency and regulatory reporting requirements for a staged reduction of inflow and infiltration over the next 20 years
- Recommend to future Councils that they commit funds for inflow and infiltration reduction that are economically justified by the avoidance of future costs to treat and convey inflow and infiltration
- Measure wastewater flows before and after carrying out construction/rehabilitation work on sewers and to document inflow and infiltration expenditures and flow reduction measures
- Use the information for future inflow and infiltration reduction processes.
- Continue to work together in a collaborative manner over the life of the Strategy and to commit the appropriate resources towards the implementation of the Strategy

Inflow and infiltration reduction program timelines span a 20 year period and beyond

The schedule and timeline for achieving inflow and infiltration reduction goals are preliminary and will be updated as progress is made through implementing the Strategy. Final timing of activities is contingent upon successful implementation of preceding activities.

A series of short term and ongoing activities is required to ensure that adequate planning activities are conducted and that resources are available to implement the Strategy. The Strategy will be submitted to the Ministry of the Environment on March 31, 2011. Annual performance management plans will be developed and submitted. Subsequent Strategy updates will be developed with the Region and local municipalities and submitted every five years.

Investigating and mitigating inflow and infiltration sources will ensure program success

Sanitary sewer system investigations are key in determining where critical areas of inflow and infiltration are occurring due to direct storm water connections, degrading infrastructure or improper installation.

Sanitary sewer investigation techniques include:

- Smoke testing
- Closed circuit television mainline inspection
- Closed circuit television lateral inspections (in many cases both private and public laterals)
- Manhole inspections
- Flood/dye testing
- Household drainage inspections

In February 2008, the York Region and local municipal Inflow and Infiltration Reduction Program started as a cooperative effort between the Region and the nine local municipalities. Approximately 25% of the entire wastewater system was monitored through 121 flow monitoring locations. A total of 77 locations were identified as having inflow and infiltration. These were prioritized to 26 locations in which inspections were conducted. Data collected during the program was used to identify specific defects that could be targeted for inclusion as potential remediation pilot projects.

A total of 1,585 manholes were inspected and analysed. More than half of the manholes did not appear to have structural defects. None of the manholes inspected demonstrated catastrophic failure. Twenty-two manholes had significant infiltration occurring at the time of inspection. Closed circuit television inspections were completed and analysed for 84 kilometres of mainline pipes in the local municipalities. Defective joints and encrustation were the most predominant defects. As the target area for the original flow monitoring was focused on older clay and concrete mains, this trend was expected. Two-thirds of the pipes were assigned a low inflow and infiltration potential with the remaining third having a high inflow and infiltration score.

Closed circuit television lateral inspections were analysed for approximately 80 kilometres of pipes. The majority of the laterals inspected did not have significant service defects. Minor defects were encountered in 200 inspections, moderate defects were found in 33 laterals inspected, and none of the pipes were deemed to be in detrimental repair. The most frequently encountered defects were defective joints, roots and encrustations. The majority of the pipes inspected were assigned a low inflow and infiltration score.

Asset management condition assessment programs are used to identify system deficiencies

Recognizing that the Region and local municipalities each conduct ongoing condition assessments as part of their asset management programs, any procedures utilized should recognize inflow and infiltration as a system deficiency. Ongoing condition assessment and any future inspections specific to inflow and infiltration reduction should complement this Strategy.

Appropriate inflow and infiltration investigation methods must be used to locate sources of inflow and infiltration. Standardized inspection procedures will lead to the development of a rehabilitation plan which includes the appropriate and cost-effective rehabilitation techniques that should be implemented to resolve inflow and infiltration related problems.

Bylaw enforcement for sewer inspections will help reduce inflow and infiltration from private property

To ensure access to the private portion of the sewer network, the Region and local municipalities will ensure that their respective sewer use bylaws include provisions such as right of entry or inspection that will allow for inspection access by the municipality or their contractors.

These bylaws can be used to access the property for all related work, including installing cleanouts, liners or new pipe as well as conducting closed circuit television work on laterals.

Currently, the City of Vaughan, Towns of Markham and Georgina have bylaws which stipulate access be given to staff into areas where wastes or storm waters are discharged for the purpose of inspection and examination of processes, private sewer connections and other works.

A best in class review of private access bylaws will be conducted with Regional and local municipal staff to formulate common language and direction for Region wide adoption.

Communication and education of inflow and infiltration reduction program is necessary

Communications, education and advocacy have been identified as necessary components required to achieve inflow and infiltration reduction in York Region. A coordinated team of Regional and local municipal staff will oversee the creation of clear and consistent messaging with a consistent brand identity for use both internally and externally with various stakeholder groups. The communications and advocacy staff team will work closely with other members of the program team to create a communications plan that will meet the needs of the evolving program.

Communications and advocacy will play a strong support role in working with technical staff to deliver key messages to various stakeholders. Key focus areas are:

- Internal communication for Steering Committee and staff
- External communication for council, public and other agencies
- Development of consistent and appropriate messaging (for council, public, other agencies)
- Coordination with leadership and advocacy to identify stakeholders

- Development of communication plan (timing, media, based on communication template, etc.)

York Region and municipal staff will work in collaboration to develop materials, workshops and tools required to assist staff in meeting the goals and objectives of the inflow and infiltration reduction program. The communications and advocacy team will liaise with regulatory compliance and policy staff to ensure that current and future works comply with all applicable regulations.

Continued industry communication and outreach will help build strong program and construction standards

The Inflow and Infiltration Reduction Program will consult with industry stakeholders on a regular basis to ensure that developing policies and standards meet the needs of inflow and infiltration reduction and the building/construction industry. Ongoing communication through an industry advisory committee could engage the various stakeholders. Stakeholders that will be included in this type of consultation are: building inspection officials, product and equipment manufacturers, engineering and design consultants, sewer and water contractors, developers and local homebuilders associations, environmental regulators, conservation authorities and trade groups.

The communications and advocacy staff team will identify opportunities to promote the ongoing inflow and infiltration reduction work to the water and wastewater industry through conferences, workshops, webinars, trade magazines and seminars. Continuous improvement efforts, partnerships for research, innovation and demonstration projects will be explored.

These relationships will ensure integrity of program and construction standards and will create support from industry practitioners for implementation of these standards in new development and construction.

Best in class practice research study shows York Region's strategy is leading edge

As part of the Strategy development, a comprehensive best in class practice research study of 16 International and North American agencies was conducted. The agencies selected for the best in class review had current strategies, were identified as leading practitioners within other industry program reviews, and had a reputation among practitioners as being progressive with well documented programs. The selected agencies shared similar problems and approaches to inflow and infiltration as experienced within York Region. Each agency had well documented components of a strategy, a similar governance structure, and was considered progressive in reducing inflow and infiltration and had similar goals and objectives to the Regional program.

Of the 16 agencies where the highest level of research was completed:

- Four were International (Greater Dublin – Ireland, Mullumbimby-Australia, Auckland – New Zealand and North Shore City –New Zealand)
- Five were Canadian (Metro Vancouver and Capital Regional District - British Columbia, Halifax Regional Municipality - Nova Scotia, the Region of Niagara and Region of Waterloo in Ontario)
- Seven were American (Metropolitan Council-St. Paul Minnesota , Western Lake Superior Sanitary District, Renewable Water Resources-South Carolina, Milwaukee Metropolitan Sewerage District, Wisconsin, King County, Washington Metropolitan Sewer District of Greater Cincinnati, and Massachusetts Water Resources Authority

Peer review provided positive feedback and suggested increased flow monitoring and private property rehabilitation

A peer review of the Strategy was completed along with the best in class practice scan. Metropolitan Council, St. Paul Minnesota; Milwaukee Metropolitan Sewerage District, Wisconsin; King County, Seattle; and Metropolitan Vancouver all took part in the Peer Review and provided comments and recommendations on the Strategy, timelines, deliverables and program components.

In general, participating agencies endorsed the Strategy and confirmed that the document was well presented, comprehensive and met and often exceeded industry practice. Key comments include:

- A more robust flow monitoring program across the Region and local municipalities to accurately set a baseline
- Stronger and earlier consideration for private property rehabilitation and renewal in the Strategy
- The Task Force approach was felt to yield a more consistent focus for the program's longevity
- The Strategy lays good foundation to help the Region and local municipalities begin the infancy action plan to successfully build a sound asset management program

Table 1 provides a breakdown of the inflow and infiltration reduction program and component timelines based on continuing the current program and implementing new tactics.

Table 1
Inflow and Infiltration Reduction Region and Strategy Timelines

Activity	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020 - 2031
Establish Baseline flows													
Enhanced Program Development													
Pilot Project Implementation													
Measure Success of Pilot Projects													
Refine Targets for I/I Reduction													
Ongoing Capital Projects & Flow Reduction													
Up to 25% of Target Reduction													
25 -100% of Target Reduction													
MOE Annual Report													
Strategy Update to MOE													

5. FINANCIAL IMPLICATIONS

The objective of the funding component is to develop a sustainable source of funding to support the long term implementation of the Strategy that is equitable to the partners and community while addressing inflow and infiltration reduction targets.

Being a two tier system, local municipalities currently have responsibility for ensuring that the local sanitary collection system is maintained and operating effectively. Programs are funded at the municipal level with each municipality determining annual capital requirements based on asset condition. Funding sources for these programs are primarily derived from user rates calculated based on water consumption flows. Alternate funding has also been made available from time to time from various Provincial and Federal infrastructure programs.

The Region is responsible for transmission of sewage from the local systems to final treatment facilities as well as final treatment. Funding for the Regional system is provided through wholesale user rates incorporated into the local water/sewer billing and Development Charges Rates. The Region applies this funding primarily to the Regional infrastructure with some contribution towards infrastructure studies that benefit the local municipalities. Studies typically recommend improvements which are then implemented by the local municipalities. Until recently, there has been limited capital investment from the Region for improvement of the local systems. With the Region's recent 2007 program for flow monitoring and associated pilot projects, a significant investment of \$23 million was approved for the local systems across the Region.

Proposed system wide collaborative funding model will sustain inflow and infiltration reductions over the long term

The Inflow and Infiltration Reduction Strategy will be supported by a collaborative long term funding model based on a cost shared approach between the two tiers of local government. The key funding principles are:

- A set rate will be collected at both the local and Regional level as identified through the needs of the Strategy and as agreed to by the municipal partners
- The amount collected at the local level will be used to address priorities identified both through the Strategy and as determined by each local municipality
- The amount collected at the Regional level will be used to address Regional inflow and infiltration priorities both at the Regional and local level
- The allocation of Regional funds intended for use in the local systems will be managed and allocated by a joint team with staff representatives from each municipality and the Region. Funding will be granted based on the most effective application to achieve the desired inflow and infiltration improvements as quickly as possible

In the absence of a full program scope and based on staff estimates, an initial funding target of \$100 million over a 20 year period was used to assess the proposed funding requirements. This equates to an annual investment of \$5 million per year across the Region. The proportionate share based on an average cost of \$0.04 per cubic meter of water sales (\$0.02 of the local municipal rate and \$0.02 on the Regional rate). Where system improvements can be made to create an overall standing reduction in inflow and infiltration and thereby increasing system capacity, Development Charges Funding will be used.

From the \$23 million that Regional Council approved in 2007 as part of the 10 year Capital Plan:

- \$5 million has been spent in 2008-2010 on flow and rainfall monitoring and analysis
- \$10 million will be spent in 2011-2012 on nine local municipal high priority pilot projects for inflow and infiltration rehabilitation
- The remaining \$8 million will be spent in 2013 and beyond as part of Inflow and Infiltration Reduction Strategy

Strategic financial action plan to ensure funding model adapts to program findings

Short Term (1-5 Years) – Actions on the financial plan include the following:

- Develop preliminary cash flow plan to establish interim funding requirements
- Establish reserves where necessary to maintain funds
- Investigate other funding strategies used in governments with successful inflow and infiltration reduction programs

- Review funding and financing options to address private side inflow and infiltration reduction
- Establish process to identify and apply for alternative external funding sources
- Investigate development charge collection for equitable proportion of funding
- Establish appropriate governance and coordination model to manage overall funding and prioritization exercise effectively
- Initiate governance meetings
- Implement early phases of capital projects to achieve long term objectives

6. LOCAL MUNICIPAL IMPACT

Local municipal endorsement of the Inflow and Infiltration Reduction Strategy required to fulfill conditions of approval

Local municipal staff have been involved in the development of the Inflow and Infiltration Reduction Strategy through participation in the Water and Wastewater Steering Committee. Local municipal staff have committed to bring reports to local Councils to seek endorsement of the Inflow and Infiltration Reduction Strategy by March 31, 2011 to fulfill conditions of approval for both the Southeast Collector Trunk Sewer Individual Environmental Assessment.

Successful implementation of this program will require access to private property

Private property infrastructure generally refers to sewer service laterals, which connect building plumbing to the municipality's sanitary sewer systems. In some cases the private property infrastructure might also include collection pipes, pump stations, and/or treatment plants. Potential sources of inflow and infiltration from private property include: broken sewer laterals, root intrusions into laterals, uncapped sewer cleanouts, and cross connections from roof drains and/or foundation drains. Sump pump cross connections are an additional source of inflow and infiltration. The total length of the wastewater collection system in the York Durham Sewage System service area is approximately 7,000 kilometres. Of this total, approximately 300 kilometres is owned by York Region, 3,000 kilometres is owned by local municipalities, and 3,700 kilometres is owned privately.

Eliminating infiltration from the public mains while ignoring the private infrastructure will compromise the Region's efforts to reduce infiltration into the Southeast Collector Trunk Sewer short of the overall program goals. Reducing inflow and infiltration on private property is required for success of the Strategy and program. Access to private property is critical to achieving continued inflow and infiltration reductions over and beyond the Regional and local municipal systems.

As revealed in the Industry Practice Scan, the first step in addressing private infiltration is to ensure each municipality's sewer use regulations, specifications or bylaws establish guidelines for "acceptable" levels of infiltration and establish the municipality's authority to inspect private plumbing for infiltration and order repairs. A more thorough effort to reduce private infiltration will require direct internal inspection of private lines.

To successfully address inflow and infiltration from private property the long term Strategy must include the following:

- Establish legal authority to enter private property under municipal bylaws or other binding agreements
- Create a strong program of communication and technical assistance to help homeowners design an alternative discharge method for the flows
- Establish a clear policy regarding responsibility for the cost of repairs including subsidy or grant programs
- Establish municipal authority to order the remediation of the problem by the property owner, even if the municipality plans to cover the cost of disconnecting the flows itself
- Include a program of follow up inspections after repairs are made and periodically inspect repairs/disconnections thereafter
- Establish a strong public outreach and education component so that the public is aware of the problem and the benefits of inflow reduction

How extraneous flows from private property can be addressed

The industry has identified a broad range of options to address extraneous flows from private property. The Region and local municipalities should consider the following options within the coming years:

- Household plumbing and drainage inspections
- Downspout disconnection by Region, municipality or property owners
- Foundation drain disconnection programs by Region, municipality or property owners
- Lateral rehabilitation programs by Region, municipality or property owners
- Time of re-sale inspections and/or lateral inspection or certification programs

7. CONCLUSION

York Region and local municipalities will take joint overall responsibility to implement the Inflow and Infiltration Reduction Strategy. The Region and local municipalities will also be required to further define and implement the requisite activities necessary to ensure that the Strategy is continually maintained, enhanced and implemented. This process will commence in April 2011 and is anticipated to continue as a sustained program. The Strategy will be updated as required as data is collected, new information is learned and new technology becomes available.

Review and update of the overall Strategy will require the sustained commitment of Regional and local municipal resources over the life of the program. Updates and

revisions to the Strategy will be presented to the Ministry of the Environment annually and in five-year update reports. York Region will submit to the Regional Director and the Southeast Collector Advisory Committee an annual report detailing its progress on implementing the Strategy including inflow and infiltration reduction. In addition to the first report that will be delivered to the Minister on March 31, 2011, the Region is required to update the Strategy, to the satisfaction of the Regional Director, at least once every five years until the Strategy is finalized or until otherwise directed by the Ministry of the Environment.

For more information on this report, please contact Lucas Cugalj, Director, Strategy and Business Planning at (905) 830-4444, Ext. 5041.

The Senior Management Group has reviewed this report.

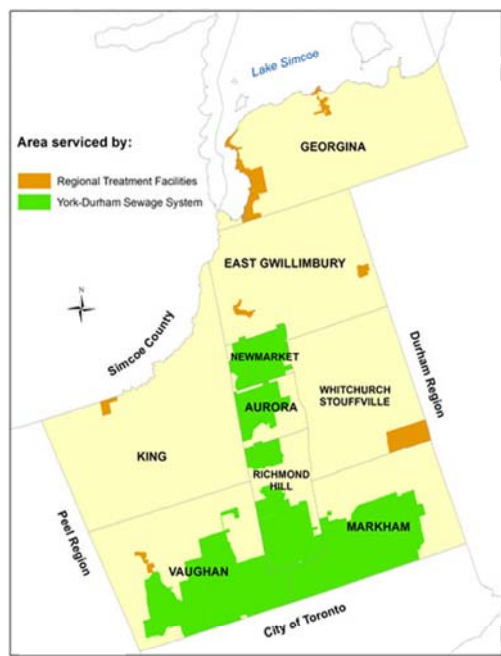
(The attachment referred to in this clause is attached to this report.)



DRAFT INFLOW & INFILTRATION REDUCTION STRATEGY EXECUTIVE SUMMARY

Executive Summary

York Region (the Region) is one of six Regional, “upper tier” Governments in Ontario. There are nine local or “lower tier”, municipalities within the Region: the City of Vaughan, the Towns of Aurora, East Gwillimbury, Georgina, Markham, Newmarket, Richmond Hill, Whitchurch-Stouffville, and the Township of King.



Wastewater servicing is multi-jurisdictional based on a two tier municipal governance structure. Sewage from most of the communities in the Region is collected through a combination of local municipal and Regional sewer systems. York Region is responsible for major pumping stations, trunk sewers and treatment plants. The local municipalities provide direct collection and management of the local system infrastructure and wastewater flows into the Regional trunk system. In addition, private property owners are responsible for wastewater mains and service laterals within their property.

On March 31, 2010, the Minister of the Environment approved the Individual Environmental Assessment for York Region’s Southeast Collector (SEC) Trunk Sewer project which involves the construction of a 15 km tunneled sanitary trunk sewer. This capital project is vital to service the approved growth within the Region. The approval was subject to a series of conditions.

Specifically, Subsection 8.2 states that the Region is required to develop an Inflow and Infiltration Reduction Strategy (the Strategy), which ***“shall include a program for the reduction of inflow and infiltration by the Regional Municipality of York to the Southeast Collector Trunk Sewer from its and its lower tier municipalities’ sewage systems. This program shall include reduction priorities, targets, timelines, tactics and initiatives, and the associated costs to implement these.”***

This Strategy document has been developed by the Region and local municipalities in response to the Minister's Conditions and describes the process that the Region intends to undertake in order to successfully meet those conditions.

The Strategy will build upon programs already underway. York Region and local municipalities each have existing programs in place, including but not limited to operations and maintenance programs, asset management programs, inspection and monitoring programs, and inflow and infiltration reduction. It is the purpose and intent of this Strategy to build upon these existing programs to meet or exceed the requirements and intent of the Minister's Conditions.

Through its development and implementation, York Region and the local municipalities have an opportunity to demonstrate leadership in inflow and infiltration reduction within the water and wastewater industry. The Region and local municipalities' current commitment to inflow and infiltration reduction will serve to form the foundation upon which a world class program can be developed.



The Strategy document is divided into 3 sections:

Section 1: Background and Rationale

Inflow and infiltration is surface water and groundwater that enters the sewage collection system. Inflow: is water from rainfall or snow melt that enters the sewage system through direct sources such as: yard, roof and downspouts, cross-connections with storm drains, foundation drains, and manhole covers. Infiltration: is groundwater that enters through holes and cracks in manholes, laterals and sewer pipes.

Reducing inflow and infiltration has been an integral part of servicing considerations by York Region since the first Water and Wastewater Master Plan developed in 1997. The 2001 York Durham Sewage System (YDSS) Master Plan update specifically identified “water conservation / extraneous flow reduction” as a significant design consideration for all YDSS projects. In conjunction with alternatives considered during the Southeast Collector Trunk Sewer Individual Environmental Assessment, inflow and infiltration reduction efforts were stepped up in 2007 with Regional Council approving a commitment of \$23 million in the 10 year capital plan to study and implement pilot remediation projects in both Regional and local municipal systems.

Peak inflow and infiltration usually occurs during long periods of precipitation, snow melt or large storm event, and can result in sewer backups, system overflows, risks to health, damage to the environment and increased costs.

Excessive inflow and infiltration consumes sewer capacity for existing residents and future growth. In addition, as sewage systems age it is more likely that inflow and infiltration will enter the collection system. Developing this long term Strategy has; therefore, been developed to proceed with York Region’s initiatives further to achieve set goals for reducing inflow and infiltration throughout the Region while ensuring that all of the Minister of the Environment’s conditions of approval related to reduction of inflow and infiltration for the SEC project are met.

This section depicts the purpose and goals of the Strategy as well as asset principals, and provides a brief description of the Region and local municipal sewage system, its major hydraulic components and the impact that anticipated growth could have on the system. Previous projects and existing inflow and infiltration control efforts that are being conducted within the system are also discussed in detail.

Section 2: Strategy Development

In order to develop such a comprehensive Strategy to meet the Minister’s Conditions, the Region formed an Inflow and Infiltration Reduction Task Force (the Task Force) in April 2010. The Task Force established a Water & Wastewater Steering Committee (the Steering Committee) that is comprised of representatives from each of the nine municipalities and the Region. The Steering Committee is responsible to reviewing inflow and infiltration issues and formulating an overall direction for the development of the Strategy.



To support the Steering Committee, five working groups were established to address the following Strategy areas:

- Strategy Development
- Funding
- Communication and Advocacy
- Audit, Monitor and Measure
- Standards, Implementation and Continuous Improvement.

Through a series of bi-weekly and monthly meetings by each of the working groups, each reviewed, developed and strategized the key program initiatives and they developed work plans for the implementation of the Inflow and Infiltration Reduction Strategy. In addition, another committee has been formalized at the direction of the Minister's Conditions which is the Southeast Collector Advisory Committee (SeCAC). This committee included members of the local community, Regional staff and staff from external agencies. The committee is charged with providing input, comments and suggestions on topics relating to the commissioning of the Southeast Collector Trunk Sewer and input and comments on the Strategy document.

To ensure that the components are met or exceed leading industry practice, the Region undertook an industry wide international best in class review. The key findings from this international review are also included within the Strategy document and a number of programs to align with best practices have been identified within this Strategy. A gap analysis between international practices and the Region's programs was completed and the recommended Strategy was developed. It was found that the programs and activities included within this Strategy meet and often exceed international best practices. Section 2.5.2 in the Strategy includes a comparison table describing key components and activities of leading edge practices against the current and future inflow and infiltration reduction program in the Region.

The recommendations, work plans and conclusions of the working groups were determined through a consensus based approach using input gathered through the best in class review and the input of the Steering Committee and working group members.

Finally, a peer review of the overall strategy document was completed in December 2010 by several leading agencies which included King County (Seattle, Washington), Milwaukee Metropolitan Sewerage District (Milwaukee, Wisconsin), Metropolitan Council (St. Paul, Minnesota) and Metro Vancouver (Vancouver, British Columbia). A PowerPoint presentation and electronic copies of the Strategy document were presented to the peer reviewers. Comments were compiled, validated by York Region and where appropriate were incorporated in the finalization of this Strategy. In general, the feedback received about the Strategy from the peer review agencies was very positive and constructive. No significant gaps were identified, demonstrating that the Strategy was well received and thorough.

Section 3: 2031 Inflow and Infiltration Reduction Strategy

The Strategy is defined in a series of high level program areas, each of which will require that a number of specific program activities be accomplished. The program areas were selected based on their consistent representation in other best in class inflow and infiltration reduction programs.

This approach includes defining or addressing issues in each of the following program areas:

- Establish Overall Program Goals and Targets
- Monitor and Analyze Flows
- Investigate and Mitigate
- New Construction and Capital Projects
- Financial Management
- Communication and Education
- Report Inflow and Infiltration Reduction
- Continuous Improvement

Section 3 defines each of these program areas and provides descriptions of the specific program activities and deliverables that will be required within each program area. These deliverables are necessary to successfully reduce inflow and infiltration in the area tributary to the Southeast Collector Trunk Sewer and to meet the Minister's Conditions.

Governance and Formation of Strategy Leadership

It will be necessary to define the leadership for implementing the Strategy. The Region intends that the Strategy will be championed and led jointly by the Task Force with overall leadership, direction and assistance provided by Regional staff. The Task Force, comprised of representatives from each of the nine municipalities and the Region, was initially responsible to review inflow and infiltration issues and formulate an overall direction for the development of this Strategy. Local municipal members were responsible for reporting back to their respective organizations and Councils.



As the Regional Strategy is implemented over the next 20 years, the Task Force will continue to provide primary leadership for the Strategy, representing the interests of both the Region and each of the municipalities, and having responsibility for reporting to the Minister as required to meet the Conditions that have been set forth.

Program Area 1 – Establish Inflow and Infiltration Reduction Program Goals and Targets

The Southeast Collector Trunk Sewer Individual Environmental Assessment contained a detailed evaluation of the effectiveness of water conservation and inflow and infiltration reduction measures across several municipalities. In general, a targeted 10% reduction of flows is thought to be achievable in York Region.

For the service area draining to the Southeast Collector (SEC) Trunk Sewer, it was determined that the volumetric reduction target is 71 mega litres over a 24 hour period. [Reduction of this volume will be accomplished through the combined efforts of the Long Term Water Conservation Strategy and Inflow and Infiltration Reduction Strategy.](#)

Preliminary assessment has indicated that the Long Term Water Conservation Strategy would contribute 40% to 50% of the overall reduction required.

At the highest levels, the goals of the Region and the local municipalities include:

- Reduce inflow and infiltration rates over a 20 year period into the Southeast Collector Trunk Sewer and within the Region,
- Minimize total conveyance, treatment and disposal system costs, and
- Implement a long term program that exceeds the Conditions set forth by the Minister.

Through the development of this Strategy, York Region and the local municipalities commit:

- To develop and maintain this Strategy including the programs, goals and inter-agency and regulatory reporting requirements for a staged reduction of inflow and infiltration over the next 20 years.
- To recommend to future Councils that they commit funds for inflow and infiltration reduction that is economically justified by the avoidance of future costs to treat and convey inflow and infiltration.
- To measure wastewater flows before and after carrying out construction/rehabilitation work on sewers and to document inflow and infiltration expenditures and flow reduction measures.
- To use the information gathered in future inflow and infiltration reduction processes.
- To continue to work together in a collaborative manner over the life of the Strategy and to commit the appropriate staffing and financial resources toward the implementation of the Strategy.

Activity	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020 - 2031
Establish Baseline flows													
Enhanced Program Development													
Pilot Project Implementation													
Measure Success of Pilot Projects													
Refine Targets for I/I Reduction													
Ongoing Capital Projects & Flow Reduction													
Up to 25% of Target Reduction													
25 -100% of Target Reduction													
MOE Annual Report													
Strategy Update to MOE													

The service area will be divided into a series of increasingly smaller, nested drainage basins to allow analysis, rehabilitation and auditing within reasonably sized geographic areas.

GEOGRAPHIC DELINEATION	NUMBER	AVG. LENGTH (KM)	DESCRIPTION
Service Area	1	2,740	Permanent Monitoring of the entire area draining to the Southeast Collector Trunk Sewer
Sewer Shed	5	548	Permanent Monitoring of the York Durham Sewer System Local Municipalities
Major Basin	54	343	Short Duration Monitoring of model calibration basins
Audit Basin	159	17	Permanent Monitoring of basins at the level which inflow and infiltration reduction is audited
Mini Basin	450	7	Temporary Monitoring of mini basins
Catchment	2900	1	Temporary monitoring of sub catchments

Geographic Delineation of the YDSS

Existing inflow and infiltration volumes, targets and successful reduction will be reported at the audit basin level.

Due to the complexity of the audit and measure process, the detailed procedures for the analysis and audit processes will be included in a separate appendix of this Strategy.

Program Area 2 – Monitor and Analyze Flows

Wet weather flows can be highly variable depending on seasonal groundwater table fluctuation, snow pack, and antecedent moisture condition. Continuous and permanent flow monitoring over a sufficient time period is necessary to reveal these variations in flow. York Region and its local municipalities will need to utilize a network of short duration and continuous flow monitors in order to measure and record the changes in inflow and infiltration rates over time and determine flow rates under a variety of seasonal conditions.

It is recognized that a variety of flow metering technologies will be required to meet the requirements of the Strategy beyond the equipment currently owned by York Region. The selection of flow monitoring equipment will be determined by matching the appropriate technology with local hydraulic conditions. The flow monitoring implementation will balance the cost / benefit of various technologies and will also consider site specific hydraulic conditions. The flow monitoring program requirements for all levels of flow monitoring will be developed early on in the Strategy and will include details such as flow meter type, meter accuracy, data quality and management procedures, financial costs, meter relocation planning, etc.

Flow monitoring will include:

- Permanent Trunk / Municipal Monitoring
- Audit Basin
- Mini Basin
- Post Construction
- New Development Areas
- Rainfall Monitoring
(including “virtual rain gauges”)

Based on best practice experience and conclusions acquired from the International Best Practices Study it is anticipated that ongoing flow monitoring activities will be required throughout the course of



the Strategy.

During the Region and Municipal Phase 1 Pilot Project in 2008-2010, the Region developed comprehensive inflow and infiltration analysis procedures that will continue to be used in future years of the Strategy.

The methodologies for each of the major activities used in the analysis of inflow and infiltration related flows are generally:

- Rainfall analysis
- Dry weather flow analysis
- Wet weather flow analysis

Inflow and infiltration characterization and prioritization

York Region has previously developed and will continue to utilize a color coding system for plotting the inflow and infiltration responses for each rain event. Audit basins will be analyzed using the key factors identified in the following table. Based on the results of the thresholds, each basin will be categorized as a low (green), medium (yellow) or high priority (red).

Key Factors for Prioritization	Ranges & Color-Coding
Instantaneous Peaking Factor (Flow Peak/Flow Average)	PF < 4 (Low) 4 < PF < 6 (Medium) PF > 6 (High)
RDI per Pipe Area (Lp/dm²-hr)	RDI < 280 (Low) 280 < RDI < 550 (Medium) RDI > 550 (High)
% of Rain Entering System (%)	CV < 5 % (Low) CV > 5 % (High)
York Region (Towns) Peak II Flow per hectare (Inflow+Infiltration) (L/s/ha)	Flow/ha < 0.25 (Low) 0.25 < Flow/ha < 0.35 (Medium) Flow/ha > 0.35 (High)

Program Area 3 – Investigate and Mitigate

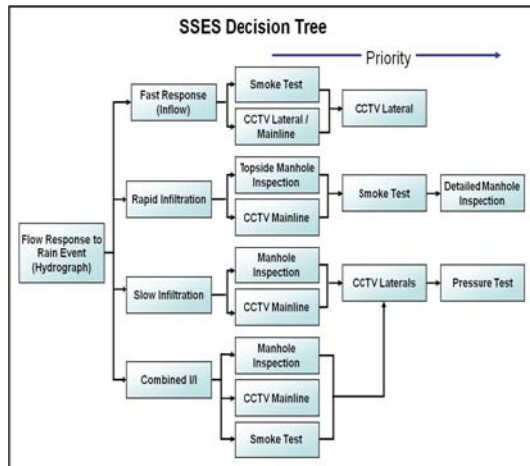
The Strategy describes the processes that will be applied to investigate the severity, extent and location of inflow and infiltration sources. The sewerage system that drains to the SEC has been delineated into a series of drainage basins. Additional flow monitoring will be conducted at the outlet of mini basins in order to identify specific locations or areas that display evidence of elevated inflow or infiltration flows.

Inspections

Specific basins will be identified where additional desktop, physical and electronic inspections will be required. In addition to specific inflow and infiltration related inspections, ongoing asset management related condition assessment programs will be completed. The inflow and infiltration related inspections will be implemented as a series of sanitary sewer evaluation studies

(SSES) and/or conducted as part of the condition assessment program.

A sample decision making tree for inspection activities is shown below.



The two major objectives of the field investigation activities and analysis are:

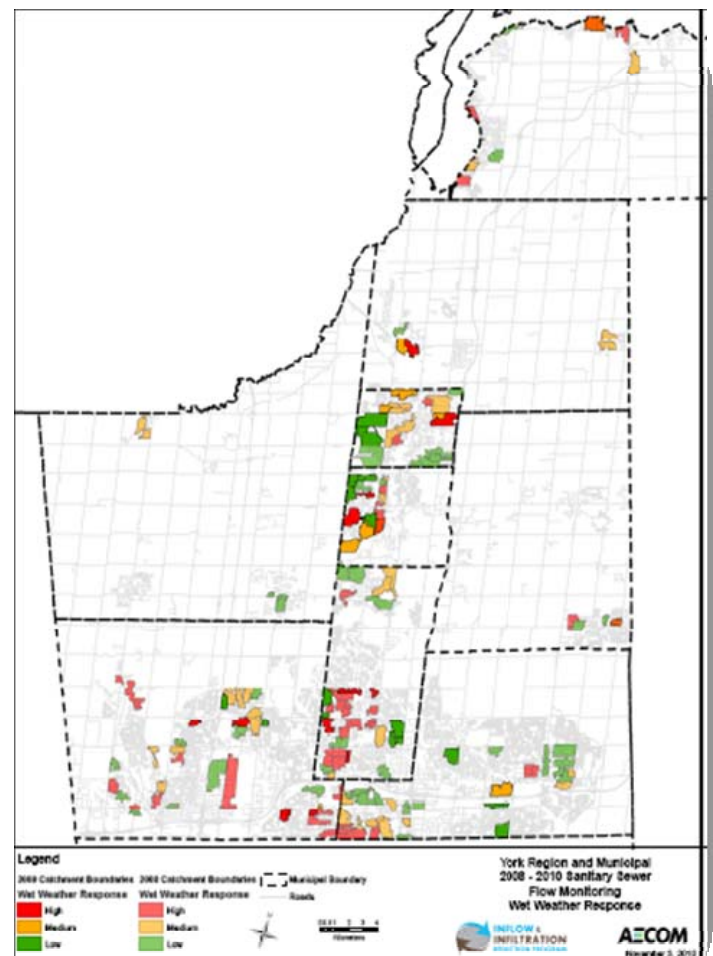
- Identifying specific inflow and infiltration sources and system structural and performance conditions.
- Applying standardized defect distress coding and inspection practices in order to reflect the severity and extent of issues.

SSES investigation techniques will include:

- Desktop analysis and drive by inspections
- Smoke testing
- Closed circuit television mainline inspection
- Closed circuit television lateral inspections (in many cases both private and public laterals)
- Manhole inspections
- Flood/dye testing
- Household drainage inspections

Mitigation through Project Delivery

Following the results of detailed flow analysis and structural and hydraulic assessments, cost effective solutions will be identified and specific rehabilitation techniques will be selected. Potential rehabilitation projects have been identified and prioritized based on several factors including: cost benefit, criticality, risk of failure, expected lifecycle and performance improvements, environmental impacts, social implications, plant performance, and operation and maintenance cost savings.



The project delivery and assessment phase of the Strategy will involve the design and construction of rehabilitation and replacement projects. Projects will be selected based on defined criteria and approved by the Steering Committee.

A risk framework and process has been implemented in the Region that includes an assessment of the risk associated with health and safety, financial impact, service level impact, socio-economic impact, liability and regulatory compliance. The risk of failure is then reviewed against the probability of failure to determine an overall priority.

The initial phase of project delivery is already underway with the implementation of the initial nine pilot projects that were identified in the Region and Municipal Inflow and Infiltration Phase 1 Pilot Program. Construction of the initial public right of way pilot projects is anticipated to occur prior to 2013. Upon completion, post construction flow monitors will be installed to validate that inflow and infiltration reduction has been successfully achieved.

Future project prioritization activities include:

- Develop an inter-agency project prioritization model (or optimized decision model) that will help to ensure consistency in the way that inflow and infiltration reduction related projects are prioritized.
- Prioritize and provide funding for the 16 un-committed Phase 1 Pilot Program Projects as described in Section 1 of the Strategy.



Determining Inflow and Infiltration Reduction Achieved

In a manner similar to the pilot projects planned for the Region and Municipal Inflow and Infiltration Phase 1 Pilot Program, and after future projects are constructed, reduction will be measured and the structural condition of the rehabilitated sewer system will be evaluated to ensure that the predictions for flow reduction and the effectiveness of the selected solutions were met.

As system rehabilitation and repair work is completed and post construction flow monitoring is conducted and the data is analyzed, a hydraulic model will be updated with revised hydrologic input parameters which simulate inflow and infiltration entering the system. Upon recalibration, the hydraulic model will then be used to characterize the newly repaired Audit basin and the 25 year design storm projections can be simulated. Revised inflow and infiltration volumes and reduction targets will be input into an audit process spreadsheet model to reflect actual reductions and to quantify any remaining difference between actual and targeted inflow and infiltration reduction.



External Asset Management Condition Assessment Programs

To complement the Strategy, the Region and local municipalities are currently conducting ongoing condition assessment as part of their asset management programs, ongoing programs, procedures and condition assessments as they relate to asset management or inflow and infiltration reduction should complement this Strategy. The Steering Committee or its designated working group have been collaborating to coordinate these municipal programs with the Regional Strategy.



Inspection Standards

In order to support the efficient collection and use of inspection records, it is important that inspections are completed in a consistent manner (including the municipal right of way and private property) and data is collected using standardized procedures and terminology. York Region has developed a series of Technical Specifications and Standards for closed circuit television mainline/lateral inspections, manhole inspections, and smoke testing that will be collectively used by the Region and the local municipalities for future inspections.

A comprehensive “routine” inspection program including the frequency and type of the inspection recommended is being developed that is based on the age and criticality of the discrete components.

Design and Construction Standards

Efforts to prevent inflow and infiltration from occurring in new construction should be ongoing, even as the program addresses existing inflow and infiltration sources. Precluding the entry of potential future inflow and infiltration into the system from new construction is an important element of the Strategy. Application of sound engineering design practices, development of specifications cognizant of inflow and infiltration, and enforcement of the specifications through adequate construction inspection of both the public and private infrastructure at all phases of construction are being recognized as key elements for achieving a tighter sewer system. A review and update of existing design standards is being recommended and is on going.

Program Area 4 – New Developments and Capital Projects

The objective of this section is to describe how construction standards for right of way and private infrastructure are being updated and utilized to ensure conformity to design intent.

New development commissioning practices have been developed and reviewed by the Region and local municipalities that consider:

- Visual Inspection
- Leakage Tests (Infiltration and Exfiltration)
- Deflection Testing
- Closed circuit television Inspections
- Smoke Tests
- Flow Monitoring

Through the analysis of flows in new development areas, a review of the current Infiltration allowance for inflow and infiltration is going to be completed.

In addition, future activities identified include:

- Finalizing development of design and rehabilitation standards,
- Compilation of Regional and local municipal Sewer Use and Discharge Bylaws,
- Development of uniform Sewer Use Bylaws to allow access and improvements on private property,
- Development of standard procedures for flow analysis and catchment prioritization.

Program Area 5 – Financial Management

The objective of the funding component is to develop a sustainable source of funding to support the long term implementation of this Strategy that is equitable to the partners and community while addressing the inflow and infiltration reduction targets required through the Minister's Conditions.

In the absence of a full program scope, and based on Regional estimates, an initial funding target of \$100 million over a 20 year period was used to assess the potential funding requirements. This equates to a future annual investment of \$5 million per year across the Region.



The Strategy will be supported by a collaborative long term funding model based on a cost shared approach between the two tiers of government.

The key funding principles are:

- A set rate will be collected at both the local and regional level as identified through the needs of the Strategy and as agreed to by the municipal partners.
- The amount collected at the local level will be used to address priorities identified both through the Strategy and as determined by each local municipality. The funding is to be used to meet the objectives of the Strategy in support of inflow and infiltration reduction. Any additional investments required to maintain local sanitary infrastructure will be in addition to the amounts required by the Strategy.
- The amount collected at the Regional level will be used to address Regional inflow and infiltration priorities both at the Regional and local municipal level. Investments in the local systems will be made to accelerate resolution of Regional priorities through augmenting local funding sources.
- The allocation of Regional funds intended for use in the local systems will be managed and allocated by a joint board made up of representatives from each municipality and the Region, and will be granted based on the most effective application to achieve the desired inflow and infiltration improvements as quickly as possible.

The Strategy requires that each local municipality contributes and maintains a specific and sustainable funding allocation towards the Inflow and Infiltration Reduction Program. However, this funding shall be allocated to the local system from which it is collected for future allocation through reserves or other appropriate means.

The funding requirement does not preclude the local municipality from collecting additional funding from the rate for other infrastructure and asset management needs of the local sewer system.

The net impact of the new Strategy could be an increase in local rates or a reallocation of existing local rates. This would be dependent on current and future needs as determined by each municipality and provided that the local municipal system meets a Regional performance standard determined through the Strategy.

Funding is a Region wide controlled pool that is directed by the Task Force, and is allocated based on the priorities developed through the Inflow and Infiltration Reduction Strategy to achieve the greatest system benefits region wide.

A preliminary list of program activities that will require funding includes:

- Flow monitoring
- Inspection programs
- Data analysis
- Development of common guidelines and standards
- Continuous improvement
- Communications programs
- Rehabilitation/replacement programs
- Pilot tests

To accomplish this, short term (1-5 years), medium term (5-10 years) and long term (10 years and beyond) planning horizons have been developed to establish and sustain funding for the Strategy. Funding requirements will continue to be reviewed and updated throughout the implementation of the Strategy.

Program Area 6 – Communication and Education

Communications, Education and Advocacy have been identified as one of the components required to successfully achieve inflow and infiltration reduction in York Region. A coordinated team of Regional and local municipal staff will oversee the creation of clear and consistent messaging with a consistent brand identified for use both internally and externally with the various stakeholder groups. The communications and advocacy staff team will work closely with other members of the program team to create a communications plan that will meet the needs of the evolving program.



Communications and Advocacy will play a strong support role in working with technical staff in delivering the key messages to the various stakeholders.

The key areas of focus will be:

- Internal communication for Steering Committee and staff
- External communication for council, public, other agencies
- Identify who needs to know what and when

- Development of consistent and appropriate messaging (for council, staff, public, other agencies)
- Coordination with leadership and advocacy to identify stakeholders
- Development of a communication plan (timing, media, based on communication template, etc.)

The communications and advocacy staff team will liaise with regulatory compliance and policy staff to ensure that current and future works comply with all applicable regulations.

Program Area 7 – Report Inflow and Infiltration Reductions

The Region has developed this Strategy for long term inflow and infiltration reduction and it is anticipated that the Strategy will evolve over time and as such it will be a living document to be used by the Region and local municipalities to guide the management of the Inflow and Infiltration Reduction Programs.

Per the Minister's Conditions (Condition 8.8) the Region is charged with submitting to the Ministry of the Environment and the SeCAC, an annual report detailing its progress on implementing the Strategy including inflow and infiltration reductions. The first report is required to be provided one year following finalization of the Strategy and every 12 months thereafter.

The first annual report will be submitted to the Ministry of the Environment on March 31, 2012. This report will describe the status of each of the milestone activities and the progress towards the stated inflow and infiltration reduction target.

In alignment and support of the annual and five year update reporting requirements that the Region has with the Ministry of the Environment, each local municipality will be required to plan for and develop

an annual Inter-Agency Summary Progress Status as well as Achievement reports.

The Inter-Agency reports will contain information that describes the local municipalities inflow and infiltration reduction activities that have occurred during the previous year and activities planned for the upcoming period:

- Sewer system mapping
- Update on the amount of infrastructure inspected for inflow and infiltration source detection purposes
- The extent of new sewer construction and sewer repair and replacement work
- A summary of the results of all flow monitoring work undertaken
- The location and frequency of all sanitary sewer overflows
- A summary of expenditures for sewer system evaluation, repair and replacement activities
- Planned activities, milestones and budget allocations for the upcoming period

Program Area 8 – Continuous Improvement

Continuous improvement is an ongoing effort to improve the way services or programs are implemented. While this Strategy serves as a starting point and seeks to provide the technical requirements of implementing the various programs, there will be a number of key areas and future initiatives required over the short and long term.

The following areas have been identified as areas to focus on which may require enhancement as the Strategy is implemented:

- Review and refine data analysis and exchange procedures
- Review and refine flow monitoring standards
- Review and refine/implement rehabilitation standards

- Develop/update Sewer Use Bylaws and Building Codes
- Review and refine inspection Sewer System Evaluation standards (SSES)
- Review new technologies (inspection and rehabilitation)
- Review and refine Design and Construction Standards
- Review and implement private property mitigation programs
- Review and update overall Inflow and Infiltration Reduction Strategy document

Private Property Inflow and Infiltration Reduction Programs

Private property mitigation is a key component of any best practice program. This Strategy makes specific recommendations about the future programs that are required within the Region to mitigate extraneous wet weather flows from private property. These programs include the access and inspection of properties in order to confirm the locations of any direct storm water connections and the structural condition assessment of private laterals through to the implementation of projects on private property.

Private side inspection and mitigation projects could include:

- Enhanced standards for construction on private property
- Household drainage and inspection programs
- Authoritative power review such as consent to enter
- Downspout and foundation drain disconnection projects
- Lateral rehabilitation and replacement projects
- Outreach and Communication Programs
- Financial assistance programs

Review and Update Overall Strategy

The Steering Committee, led by, and in collaboration with an assigned Program Manager employed by the Region, will assume joint responsibility to implement this Strategy. They will also be required to further define and implement the requisite activities necessary to ensure that the Strategy is continually maintained, enhanced and carried out properly and in a timely manner. This process will commence in 2011 and is anticipated to continue until the Strategy is finalized.

The Strategy will be updated when necessary as data is collected, new information is learned, and new technology becomes available. Review and update of the overall Strategy will require the continual commitment of Regional and local municipal resources over the life of the Strategy. Updates and revisions to this Strategy will be presented to the Ministry of the Environment annually and in five year update reports.

Conclusion

York Region and local municipalities will take joint overall responsibility to implement the Inflow and Infiltration Reduction Strategy. Furthermore, they will be required to further define and implement the requisite activities necessary to ensure that the Strategy is continually maintained, enhanced and implemented. The implementation process will commence in April 2011 and is anticipated to continue as a sustained program. The Strategy will be updated as required as data is collected, as new information is learned and as new technology becomes available. Review and update of the overall Strategy will require the continual commitment of Regional and municipal resources over the life of the program.