

**CITY OF EDMONTON  
STORMWATER QUALITY CONTROL  
STRATEGY & ACTION PLAN**

**June 1, 2008**

## **1.0 Introduction**

The City of Edmonton has developed various initiatives that form the basis of its Stormwater Quality Strategy (SWQS). This document outlines the SWQ Strategy and provides a road map to guide the City's efforts for improving stormwater quality and watershed health. Much of the content in this document originates from the draft SWQ Strategy published January 2006. The draft strategy brought together the thoughts and philosophies on approaches to improving the City's stormwater quality. Further discussion and findings from supporting studies since 2006 has led to the development of this final SWQ Strategy document. It also serves Alberta Environment's requirement in the City's 2005-2015 Approval-to-Operate for submission of a SWQS by June 1, 2008.

## **2.0 Background**

The 13,900 km<sup>2</sup> North Saskatchewan River (NSR) watershed upstream of Edmonton conveys a daily average flow through the city of approximately 200 m<sup>3</sup> per second. Edmonton's stormwater system collects runoff from about 27,000 hectares. The combined sewer system receives runoff from about 5,000 hectares. Some stormwater from newer areas in the City does receive partial treatment flowing through any of the 70 plus stormwater management facilities (wet ponds and constructed wetlands). Stormwater enters the NSR or tributary creeks from over 210 storm sewer outfalls. The majority of the runoff entering the combined sewers is treated at the Gold Bar Wastewater Treatment Plant but some is directly discharged to the NSR through one of the 19 combined sewer outfalls.

Edmonton's current Approval-to-Operate issued by AENV for 2005 to 2015 is founded on the principle of limiting the total load of pollutants released to the NSR. This Approval requires the City to provide AENV with a Stormwater Quality Strategy final report by June 1, 2008. This document fulfills that requirement. The total loadings approach can be used as a decision-making tool to apply capital and operating budgets to best achieve improvements to watershed protection. Monitoring of sewer outfalls to the NSR commenced in the late 1970's and the program has steadily evolved to become the Environmental Monitoring Program (EMP) that it is today. Outfall and in-stream river monitoring has demonstrated that stormwater quality improvements are needed and will become more essential to protect the watershed as the City continues to grow and expand.

### **3.0 Goal**

The goal of the SWQS is to “*better* manage the impact of stormwater discharges on the NSR to protect water quality in the river.” This means enacting programs and policies that will limit the release of pollutants from the storm sewer system to the river. The SWQS supports the larger strategic City goal of total loads management from all pipe discharges and non-point sources. “*Total Loadings Concept Understanding*” is a brief document jointly produced by the City and AENV that outlines the principles related to municipal management of total loadings to the NSR.

### **4.0 Strategy Framework**

#### **4.1 Regulatory Context**

The City’s Approval-to-Operate requires that a Stormwater Quality Strategy and plan for implementation be developed to limit the release of key pollutants, in particular suspended solids, from the storm sewer system to the NSR. Edmonton’s Approval to Operate is based in principle on a total loadings framework. This management model serves to encourage Best Management Practices (BMPs) and Low Impact Development (LID) technology adoption. It is anticipated that the Province’s regulatory framework stemming from the Water for Life Strategy will place more focus on urban stormwater issues in the years to come. The emergence of the LEED-ND (Leadership in Energy and Environmental Design – Neighbourhood Design) standards is also expected to influence urban design in the Edmonton area. The Strategy can help foster interdepartmental co-operation to implement LEED-ND design elements in future years.

#### **4.2 Strategy Oversight**

The development and implementation of the SWQS will be managed by Environmental Monitoring, Drainage Services. An annual summary report for information purposes will be produced to highlight progress on action plan items and distributed to stakeholders. This will help to ensure the strategy continues to actively engage civic staff and its executive administration.

#### **4.3 Guiding Principles**

The traditional focus of stormwater management has been flood protection and system operation and maintenance. Stormwater management has been evolving for some years and to be considered innovative it must now also address quantity and quality issues, total loadings, runoff volume, and the impacts of runoff on watershed ecology. Some key guiding principles of the City’s SWQS:

- flood and erosion protection;

- controlling site-specific allowable peak runoff rate;
- working to advance design standards to also control for total runoff volume (not current practice but is considered an emerging approach for stormwater design that encourages LID practices);
- supporting the goals of the total loadings approach in partnership with AENV for the core parameters of nutrients, sediment, and bacteria;
- for existing developed basins, pursue retrofit opportunities where practical and feasible for stormwater quality improvement including end-of-pipe facilities (Kennedale wetland for example);
- pursue pilot demonstration projects for testing new stormwater design technologies;
- on-going watershed monitoring programs; and
- for both new and existing areas, advance and promote innovative stormwater management practices that addresses quality and quantity.

#### **4.4 Related City Initiatives/Programs**

The Strategy will benefit from linking with and/or supporting other City programs that serve to reduce total loadings to the NSR from different sources. The Interconnection Control program is one such program that involves monitoring of IC sites to identify possible system improvements. The long-term CSO Control program is another on-going initiative that will result in improved capture of combined sewer overflows and a reduction in the bacterial load released to the river. The \$146 million flood control program currently underway does not directly address stormwater quality improvements. Site specific opportunities will be considered for quality improvements where practical.

#### **5.0 Action Plan Elements**

The Stormwater Quality Strategy Action Plan provides for a multitude of action items for improved stormwater quality and reducing annual loadings of pollutants discharged to the river in future years. For each category, an integral action component are the supporting studies needed to identify, scope, and provide design details for implementation whether its site construction or the delivery of a public education curriculum. Action item categories include:

- “green infrastructure” on city lands;
- innovative stormwater design policies/guidelines;
- technical tools;
- partnering/networking;
- education and outreach.

## **5.1 Green Infrastructure on City Lands**

Green infrastructure in this context means the retrofitting of end-of-pipe storm sewer outfalls to include treatment facilities and also retrofitting of existing City urban lands to demonstrate more sustainable stormwater management practices.

### **5.1.1 End-of-Pipe Retrofit Projects**

A program to identify and design end-of-pipe treatment facilities, namely constructed wetlands, is already underway. Basin review studies are underway and at various stages for each of the four major storm basins: Kennedale, Groat Road, Quesnell and 30<sup>th</sup> Avenue. Recent CAMRIF (Canada-Alberta Municipal Rural Infrastructure Fund) funding has accelerated the progress on the Kennedale basin and its end-of-pipe constructed wetland project. This project is at the final design stages at projected cost of \$10 million. This is a major cornerstone project in the overall Stormwater Quality Strategy as this facility will provide treatment of baseflow for Edmonton's largest storm basin. This single facility can provide a measurable reduction in annual loadings. Another significant project already underway is the Pylypow constructed wetland, also in the final design stages with a projected cost of \$10 million. This wetland will provide for both flood control and water quality improvement. Subsequent studies will assess site potential for end-of-pipe facilities in Groat Road basin at Government House Park and 30<sup>th</sup> Avenue basin in the vicinity of Whitemud Creek. Construction of future sites is expected over the next 10 years with capital funding of \$18 million already budgeted. Monitoring programs will be used to assess end-of-pipe facility performance for pollutant load capture.

### **5.1.2 Retrofit Projects on City-lands**

For retrofit project opportunities on City-owned lands, the City will strive to apply the use of Best Management Practices (BMPs) - technologies that capture pollutants for removal and/or capture and infiltrate stormwater. The City's requirement for oil/grit separators on approaches to bridge crossings of the NSR is an example of a structural BMP approach. This has already been successfully implemented during the refurbishment of Capilano bridge in 2005. Other structural approaches can include bioswales that serve to infiltrate and also treat a portion of the stormwater flow. An example of this innovative stormwater practice is the Altalink-Cumberland bioswale project currently underway. A monitoring program will be used to assess bioswale performance and demonstrate the potential of these infiltration/treatment systems. Future studies planned for 2008/2009 will provide further recommended applications for City sites. The retrofit program also includes the use of low-flow diversions such as those proposed for the Quesnell basin. This allows stormwater to be diverted and conveyed to the Gold Bar WWTP for treatment rather than directly to the NSR. This option for Quesnell basin is under review as of early 2008.

## **5.2 Innovative Stormwater Design Policies/Guidelines**

For some years the City has made major strides in promoting BMPs and building green infrastructure. To date, over 12 constructed wetlands that provide a high level of treatment performance for stormwater have been constructed. Drainage Services design guidelines already require that constructed wetlands are to be used to treat flows from new subdivisions prior to release to a receiving watercourse. The City will work to revise its current design criteria and/or provide a process to more easily implement innovative stormwater management policies and guidelines. Innovation in this context means implementing policies that promote water resource smart growth: preservation of natural areas and mitigation of impacts on natural wetlands; riparian protection; and low impact development design principles. This extends beyond just including BMPs and bioswales in new developments. The LID principle means addressing site hydrology to help in the management of total loadings. A key land development project to date is the agreement in concept to develop Big Lake Neighbourhood One as an LID site. This project could serve as an example of urban land development that better mimics pre-development hydrology. An LID study is planned for 2008/2009 to identify policy and City department procedural processes to help encourage more use of LID principles in new land development. Other examples demonstrating the City's commitment to LID include: the Griesbach project by Canada Lands Corporation looking to use innovative roadway materials; The Quarters project for east downtown; and the North-East Area Structure Plan that incorporates the concept of ECO industry. Establishing a mix of innovative policies and guidelines in the coming years will lead to more sustainable land development practices.

## **5.3 Technical Tools**

A suite of technical knowledge and tools have been and continue to be developed to foster adoption of more sustainable stormwater practices. Firstly, this includes the City's Environmental Monitoring Program (EMP) which involves the sampling and analysis of lakes, creeks, outfalls, and the river in-stream to assess loadings and related impacts. The Strategy has been shaped by a series of consultant studies to date, namely: the NSR Impact Study - Development of Total Loading Management Objectives for the City of Edmonton (2005); Major Storm Outfall Mitigation and BMP Implementation Study (2006); and Stormwater Quality Enhancement Study (2008). Subsequent studies planned for include: the Stormwater Contaminant Outfall Prioritization Study; Sediment Capture Study; LID study; Government House Park End-of-Pipe Constructed Wetland Design Study; and Concept Review Study for 30<sup>th</sup> Avenue. Monitoring activities at various demonstration sites for LID or BMP technologies also serve as technical tools. It should be noted that the City in 2005 funded the development of a state-of-the-art river modeling simulation tool for assessing impacts on the NSR from its pollutant loading discharges. Starting in 2007 and continuing

through 2008, the City is monitoring the biodiversity of select constructed wetlands. This serves as a benchmark study towards improving constructed wetland facility design guidelines.

## **5.4 Partnering/Networking**

To foster the implementation of new approaches for managing stormwater, the City is making efforts to partner and involve other key stakeholders whenever possible. Within the City, there are synergies to be gained from continued participation of Drainage staff on the City Operations Water Management Committee. This group is helping city operations to conserve water and examine re-use opportunities for grey water, storm water, and membrane filtered wastewater. The City will continue to support the efforts and be a key founding member of the non-profit Alberta Low Impact Development Partnership (ALIDP). The ALIDP organized an LID conference in Edmonton in 2007 and is developing web-based design tools for stormwater source control to be made available in 2009. Watershed monitoring programs are developed annually in a collaborative process with AENV, EPCOR Water, and the Alberta Capital Region Wastewater Commission. Continued support and involvement with the North Saskatchewan Watershed Alliance (NSWA) is also a critical component in the overall strategy of promoting better watershed management.

## **5.5 Education and Outreach**

These programs are intended to influence the behaviour of different stakeholders. To influence land developers and contractors, the City has developed its Erosion & Sediment Control Guidelines and Field Handbook. This educational process has greatly improved awareness for the site control of sediment during the construction phase of land development. Similarly, the City has developed its Treat it Right! outreach program for grade 5 students. This program is being piloted in 2008 through Inside Education and will include class time instruction on the role of stormwater in watershed protection and also student field trips

## **6.0 Opportunities & Barriers to Success**

To date, a total of \$18 million dollars has been approved to fund the end-of-pipe retrofit projects and low-flow diversion projects. With secured funding, these site specific projects are likely to proceed on schedule. The Strategy can be further expanded as needed. This would however require additional monies to fund an expanded scope of work.

## **7.0 Strategy Metrics**

### **7.1 Monitoring & Performance Measures**

Watershed monitoring is a key measure to assess annual system performance in terms of pollutant loading rates to the NSR. Year round monitoring of storm sewer outfalls for volumes and concentrations of pollutants provides a measure of total loading mass. Another management tool is the City's Quasi Real-Time river sampling program. This utilizes the raw water intake structures at the E.L. Smith WTP and Dow Chemical facility in Ft. Saskatchewan for sampling collection and will provide a detailed baseline assessment during spring and summer wet weather events. This data can provide a measure of downstream water quality impacts that is more applicable for urban watershed management than the province's Water Quality Index (WQI).

### **7.2 Strategy Review & Reporting**

A summary report listing major accomplishments will be provided by June 1 on an annual basis to AENV. This annual summary will provide an update on development and implementation of SWQ Strategy-related projects and programs in the calendar year.

## **8.0 SWQS Action Plan Elements**

This section outlines some of the detailed SWQ Strategy Action Plan components, including: current infrastructure and on-going projects, new initiatives, studies underway or planned, and monitoring activities.

### **8.1 Current Infrastructure Projects**

The City of Edmonton has a number of infrastructure projects at various stages of completion that are either key SWQS projects and/or support the goal of better controlling pollutant loads discharged to the river. The Kennedale constructed wetland is a core feature of the SWQS action plan – it being Edmonton's only stormwater management facility constructed exclusively for treatment of stormwater for pollutants (and not for flood control). The Pylypow wetland will provide for both quantity and quality level of service improvements. Both Kennedale and Pylypow projects are partly funded under the Canada Alberta Municipal Rural Infrastructure (CAMRIF) Program. Morris pond will also provide indirect stormwater system benefits. These facilities add to the existing inventory of eleven (11) constructed wetlands currently providing treatment to urban runoff in Edmonton. The Double Barrel Replacement program also supports the goal of the SWQ Strategy by reducing the amount of bacteria that currently is released to the river via a major storm sewer trunk line.

### 8.1.1 Kennedale Wetland

The Kennedale constructed wetland is a storm basin-level project that will improve the quality of stormwater being discharged into the North Saskatchewan River. This project will convert an existing water body, a remnant of former gravel extraction operations in Hermitage Park, into a stormwater management facility. Stormwater will be diverted from the Kennedale storm trunk into the wetland that will treat stormwater through the combination of shallow storage, complex microtopography, soils, microbial flora and plant material.

### 8.1.2 Pylypow Wetland

The Pylypow regional constructed Wetland involves construction of an off-stream naturalized stormwater management facility adjacent to Fulton Creek in southeast Edmonton. The facility has two functions: stormwater storage (mitigate the existing flood risk in the Fulton/Mill Creek basin); and stormwater quality improvement. A separate forebay is included in the design. Total surface area is 9.8 ha and the facility will provide 150,000 m<sup>3</sup> of storage volume. Baseflow in Fulton Creek will be conveyed through the sediment forebay. This constructed wetland will improve water quality, provide wetland habitat and protect the Fulton Creek Natural Area.

### 8.1.3 Morris Pond

The City of Edmonton has acquired this large 10 ha wetland located in southeast in Edmonton near Goldbar Creek. It lies within the existing Goldbar Creek floodplain and presently provides flood attenuation for the creek. The wetland has formed as a result of historical urban activity and thus Alberta Sustainable Resource Development has elected to not claim this wetland as a Crown waterbody. Goldbar Creek between the tablelands and the North Saskatchewan River is sensitive to water erosion. Further upstream developed areas along the Creek are subject to flooding. This wetland facility will provide flood control, water erosion control, and water quality benefits for the Goldbar Creek watershed.

### 8.1.4 Double Barrel Replacement Program

Drainage Services is presently designing the Mill Woods Double Barrel Replacement Project, and it will begin construction in 2009 with completion in 2012. The project will construct approximately 3.4 kilometres of large diameter storm water pipe and convert approximately 3 kilometres of double barrel trunk sewer pipe into sanitary conveyance, at a cost of about 32 million dollars. This work will prevent the recurring leakage of sanitary sewage into the storm sewer from these pipes.

## **8.2 SWQ-related Programs**

### **8.2.1 Interconnection Control (IC) Program**

The IC program is an on-going program to monitor for dry weather overflows of sanitary sewage into the storm sewer system. Once sites are identified and tracked, the site is reviewed and if possible the interconnection is sealed-off to prevent further discharges of bacteria to the receiving watercourse via storm sewers.

### **8.2.2 Long-term Combined Sewer Overflow (CSO) Control Program**

The CSO program is a long-term initiative begun over ten years ago to improve the capture and treatment of combined sewer overflows that are otherwise discharged to the river. In lieu of complete sewer separation, the CSO control program involves major infrastructure improvements such as the construction of an Enhanced Primary Treatment (EPT) facility at the Gold Bar WWTP and tunnel conveyance to the wastewater plant. The benefits to the SWQS are indirect but serve the larger purpose of watershed protection.

### **8.2.3 Total Loadings Framework**

Reporting a Total Loadings Strategy is a new requirement of the City's Approval to Operate. The SWQS evolved out of discussions with the province on the need to manage the City's total loadings. This program indirectly supports the SWQS as it brings a focus on the role of stormwater loadings to the river in comparison to IC releases, CSO discharges, and releases from the GBWWTP from plant and secondary bypasses, EPT-treated and UV-disinfected final effluents. This framework will be further developed to meet the June 2009 submission deadline to AENV.

### **8.2.4 Flood Control Program**

Severe rainstorms in July 2004 caused flooding on streets, roadways and in more than 4,000 homes throughout Edmonton. This event prompted Drainage Services to make flood prevention a top priority. Drainage Services' flood prevention action plan includes a financial package of \$146 million to pay for system upgrades which will take several years. A public education program informs homeowners on how to make lot level drainage improvements, and includes the following: Home Flood Prevention Check-up; Public Information Campaign; and Neighbourhood Education Initiative. System improvements may also provide some measure of stormwater quality improvement and load capture on a site-specific basis.

### **8.2.5 Erosion & Sediment Control (ES&C) related Programs**

Drainage Services has published ES&C Guidelines and a Field Manual that lot grading staff refer to for improving local land development practices from a

watershed perspective. As well, the Branch has an annual Overland Flow program to address localized flooding and related erosion problems caused by overland flow issues. Creek erosion studies for Whitemud and Blackmud creeks have also been undertaken to establish allowable peak runoff rates from developed basins.

### **8.3 Future Infrastructure Projects and SWQS Studies**

SWQS studies have helped to shape the development of the SWQS Action Plan. Current infrastructure projects were first conceptualized in the *Major Storm Outfall Mitigation and BMP Study* completed in 2006. Building on the findings of this study is the *Stormwater Quality Enhancement Study (STOQES)* to be completed by June 2008. This current study explores the cost-benefit and conceptual engineering feasibility of constructing low-flow diversions in the Quesnell and 30<sup>th</sup> Avenue basins. Low-flow diversions serve to capture baseflow in storm pipes and provide conveyance to GBWWTP for treatment. More significantly, this study is exploring conceptual options for treating Groat Road basin stormwater flow end-of-pipe at Government House Park. Building on the findings of this study, an engineering conceptual design study for an end-of-pipe treatment facility in Government House Park is expected to commence in late 2008.

The *Stormwater Contaminant Outfall Prioritization Study* that commenced April 2008 will provide an assessment of the proportional volumes and loadings from the various larger-sized storm outfalls. The *Sediment Capture Study* that commenced May 2008 will help to optimize efforts to reduce sediment loadings to the storm drainage system and receiving watercourse. Upcoming studies include a concept review for an *End-of-Pipe Facility on Whitemud Creek for 30<sup>th</sup> Avenue Basin* expected to start late 2008. A Low Impact Development (LID) Study is expected to commence late 2008 which will explore technical issues and barriers to LID implementation in the City of Edmonton.

### **8.4 Monitoring Programs**

Watershed monitoring is an essential component of the SWQ Strategy and Action Plan for tracking system performance. Monitoring efforts include:

- Annual EMP and NSR river sampling;
- Quasi real-time river water intake sampling;
- Biological diversity assessment of six constructed wetlands;
- Future site monitoring of the Kennedale constructed wetland;
- Site monitoring of Altalink-Cumberland bioswale;
- Monitoring of Clover Bar Creek and Mill Creek Roper Pond for site risk management;

- Monitoring for stormwater retention on any porous pavement surfaces installed on demonstration sites in the Griesbach development or City-owned parking lots; and
- Annual system-wide total loadings assessment and reporting.

## **8.5 Partnering/Networking Initiatives**

Partnering and collaborating with other City departments and external agencies is also important for effecting improvements to the watershed. To this end, Drainage Services is engaged in the following initiatives:

- Support of the North Saskatchewan Watershed Alliance through in-kind support and having Drainage Branch staff participate on NSWA committees;
- Continued support and implementation of the ES&C Guidelines;
- Membership in the Alberta Low Impact Development Partnership (ALIDP); and
- Treat It Right! Outreach Program for Grade 5 students, coordinated with Inside Education – piloting school visits to constructed wetlands in June 2008.

## **9.0 Conclusions**

Improvements to stormwater quality have already been made and will continue into the future. The SWQ Strategy will help to shape these on-going improvements and provide a framework to encourage new policies and technologies such as LID. On-going monitoring and reporting will document performance. The Appendix provides a concise listing of project SWQ-related budget projections. For 2008-2027, the current budget projection is \$109 million with the projects as listed. Not including Double Barrel replacement and the Overland Drainage project, the budget for 2008-2027 is \$50 million.

## Appendix – Summary of SWQS Budget Projections

|   |                              |           |
|---|------------------------------|-----------|
| <b>Watershed Studies:</b>                 | \$630,000                    | 2008-2011 |
| <b>Constructed Wetlands:</b>              |                              |           |
| Kennedale                                 | \$6.4 million                | 2008-2009 |
| Pylypow                                   | \$8.8 million                | 2008-2009 |
| Morris                                    | \$14.4 million               | 2008-2011 |
| <b>Government House Park</b>              | \$1 million (design)         | 2008-2011 |
| <b>End-of-Pipe Facility</b>               | \$10 million (construction)  | 2012-2015 |
| <b>Environmental Improvements:</b>        |                              |           |
| Double Barrel – Millwoods                 | \$30.4 million               | 2008-2010 |
| Double Barrel – SESS Stage                | \$19.8 million               | 2008-2010 |
| Overland Drainage                         | \$8.4 million                | 2008-2017 |
| Creek Erosion & Flood Protection          | \$2.3 million                | 2008-2017 |
| <b>3 Low-Flow Diversions</b>              | \$1.5 million (design)       | 2017-2021 |
|   | \$2.0 million (construction) | 2018-2022 |
| <b>30<sup>th</sup> Ave/Whitemud Creek</b> | \$3 million (design)         | 2025-2027 |
| <b>End-of-Pipe Facility</b>               |                              |           |