Recent Storm and City-Wide Implications

Recommendation:

That the August 27, 2013, Financial Services and Utilities report CR_106, be received for information.

Report Summary

This report describes how Edmonton's drainage system has evolved over the years, evaluates the implications of major storm events on the city-wide drainage system and identifies ways to lessen potential impacts.

Previous Council/Committee Action

At the March 14, 2013, Utility Committee meeting, the following motion was passed:

> That Administration provide a report on the lessons learned from the recent storm events and the implications for the system City-wide.

Report

Edmonton's Drainage System

As Edmonton developed over time, servicing standards of the drainage system have evolved resulting in varied service levels across the City's neighbourhoods.

Neighbourhoods that were built prior to the early 1960's are serviced by a combined sewer system which carries both sanitary and storm flows in the same sewer pipe. The areas built between 1960's and late 1980's are serviced by separate sanitary and storm sewer systems. The areas built after late 1980's are serviced by separate sanitary and storm systems with well defined surface storages such as ponds and constructed wetlands. A significant portion of the combined sewer system and storm drainage in neighbourhoods built prior to the late 1980's have a less than 1 in 5 year service levels. This means that storm events of this magnitude have a 20 percent chance of occurring in any year.

The City's drainage system is made up of "minor" and "major" systems. The minor system refers to the conveyance network of local and trunk sewers, inlets and street gutters which have traditionally been provided to rapidly carry storm runoff away from road surfaces. The minor system in most of the mature neighbourhoods is designed to convey runoff from small and frequent rainfall events (that is approximately 38 mm rainfall in 4 hours).

Storm runoff that exceeds the capacity of the minor system will pond in depression areas or follows any available overland routes. These networks of planned or unplanned overland flow routes and ponding areas (including stormwater management facilities) are referred to as the major system. In essence, the minor system is designed for drainage and the major system is designed for flood control. Most of the neighbourhoods constructed prior to the late 1980's do not have defined or adequate major systems. The engineering design standards in effect at the time that these communities were developed did not consider a major system as part of the drainage network.

Storm Drainage Design Philosophy

The City's stormwater management goal has been to provide adequate drainage that preserves and promotes the general health, welfare, security, environmental protection and economic well being of Edmontonians, and to protect and enhance water quality of all receiving watercourses.

In 1989, the City updated the design standards and guidelines to include requirements for major drainage systems and provide a consistent level of service for the development of new neighbourhoods. The updates require that all new neighbourhoods be constructed such that:

Storm runoff in excess of the minor system collects in designated depression areas or follows a designed overland escape route;

Storm runoff from roofs, lots, streets and other outside areas, as well as infiltration water from foundation drains and other sources, is excluded from the sanitary sewer system. This is intended to reduce stormwater that may otherwise enter the sanitary system and cause basement flooding;

All storm drainage systems include stormwater management ponds that meet the following service level objectives:

Avoid significant property damage from a 1 in 100 year storm event (which is equivalent to 70 mm in 4 hours and has a one percent chance of occurring in a given year);

Avoid loss of life and injuries and minimize damage to property, through control of runoff during unusual or infrequent storm events with high-intensity rainfall and large runoff volume; and

Avoid degradation of receiving watercourses.

Characteristics of 2012 Storms

The storms that occurred in July 2012 were very intense, had relatively short durations, and were localized and fast moving. The most affected communities were in Mill Woods and southwest Edmonton.

The first storm event occurred on July 12, 2012, and was approximately 50 mm within 1.5 hours. This storm was rated larger than 1 in 200 years (i.e. one-half percent chance of this type of event occurring in any given year) in the Mill Woods area. This storm was five times the rainfall intensity that the City's minor drainage system is designed to convey.

Another significant storm occurred on July 14-15, 2012. This was a 30 hour duration storm with substantial amount of rainfall (85-105 mm) over the entire City. This long duration of rain saturated the ground, meaning that more surface runoff was generated.

Some areas of the City had as much as 240 mm of rainfall in July 2012. The normal total average July precipitation in Edmonton is about 90 mm. The month of July 2012 is on record to be in the top 1% of wettest months since recording began in 1880.

In addition, the rainfall was coupled with hail, vegetation, and debris that plugged catch basin inlets, reducing the effectiveness of the minor system.

2013 Storm Characteristics

On June 12, 2013, there was a very short, localized and high intensity storm event. A peak return frequency of more than 1 in 5 years (20% chance of reoccurrence in any given year) was recorded over several locations in the City. Another city-wide heavy storm event occurred on June 25, 2013 with a longer duration. A peak return frequency of more than 1 in 10 years (10% chance of reoccurrence in any given year) was recorded over several areas in the City. These events caused localized surface ponding on roadways and underpasses.

City-Wide Implications

The City's drainage system and facilities are currently not designed to handle over a greater than 1:100 year storm event such as those that occurred in July 2012. Since the capacity of the drainage system and topography vary across the city, the degree of vulnerability to flooding will also vary considerably. Engineering assessments show that:

Areas serviced by combined sewers have higher risk of basement flooding and private property damage. The older combined sewer neighbourhoods typically were designed to a lower level of service than the separated sanitary and storm sewer serviced neighbourhoods.

Areas that have separated systems, but do not have a defined major drainage system will be at risk of flooding. This has been observed in the storm events in 2012 and previously in 2004.

Private properties built in low-lying areas and without major drainage outlets or located in flood plain zones may be impacted by large storm events.

Dwellings in newer areas developed after 1989 are at less risk of flooding. However, large runoff volumes could exceed the capacities of stormwater management ponds which are designed for a 1:100 year event.

Additional impacts on the drainage system include:

Combined sewer overflows into the river as the combined and sanitary sewers become overwhelmed.

Considerable damage to drainage infrastructure across the city. This includes a number of manhole cover blowout, pump station flooding, park trail wash-outs, outfall washouts, and bridge abutment erosion.

Lessons Learned

There has been increasing frequency and severity of extreme weather events in Edmonton. As a result, the City has initiated research studies into climate change. A Spatial Distribution Study involves a review of a large set of high resolution weather radar rainfall data recorded over the City and its surrounding areas. The goal of this study is to categorize storm intensities and distribution patterns, in order to develop a properly designed storm management approach for the City's drainage infrastructure. The City has

also initiated a climate change study with the University of Alberta. The objectives of this research work involve the development of a Regional Climate Model, prediction of future extreme storm events, and risk assessment of the potential impact to the City's drainage system. Key findings will be available by the end of 2014.

The City is working on increasing citizen awareness of the City's drainage system, and how the citizens can minimize flooding potential on personal/private properties.

In 2012, the City opened a Drainage Operations Control Centre which operates 24 hours a day, 365 days of the year. This allows a more efficient mobilization of resources on a priority basis, in response to a storm event, and a direct point of interaction with the 311 call centre when responding to citizen inquiries.

Neighbourhood renewal and road way rehabilitation designs need to consider the impact that curb and gutter and surface grading have on the overland drainage routes.

Approval of development near flood plain zones should be carefully considered to mitigate the effects and potential of flooding.

The City could consider installing passive monitoring systems at underpasses on freeways to warn drivers of potential flooding at these locations.

Approaches to addressing flooding should not only involve engineering solutions to improve the drainage system, but also include emergency awareness and preparedness. The Office of Emergency Preparedness continues to educate individuals, families and businesses of their role by being personally prepared, and by ensuring their emergency plans and business continuity plans are in place.

Because of the spatial variation in rainfall, the City should improve data collection by installing weather radar systems to accurately record future storm events.

The Way Forward

The nature of the recent major storms, associated damages, and the limitations of the drainage system, reinforces Drainage Service's continued effort to have proactive strategies and programs in place to address these challenges. Key drainage strategies and programs that have been implemented or are in the process of being implemented are:

In response to the flooding that occurred in July 2004, a Flood Prevention Program was implemented in 2006. The program seeks to reduce flooding issues in 43 at-risk neighbourhoods from similar rainfall events in the future. Neighbourhood sewer and stormwater system improvements are being worked on simultaneously to expedite the work. This program is proposed to be expanded as a result of the July 2012 flooding.

An Opportunistic Flood Prevention program was initiated in 2011. This program allows for the development of stormwater management facilities for the purpose of flood prevention in mature neighbourhoods on an

opportunistic basis.

Stormwater Servicing Strategy which was developed in 2010 to identify work required in solving existing drainage problems in developed areas and the work required to provide proper drainage facilities in the development of new neighbourhoods.

In the combined sewer serviced areas the City will continue to implement:

The Combined Lateral Sewer Upgrading Strategy which addresses inconsistent levels of service within the combined sewer service areas;

The Sanitary/Combined Trunk Sewer Upgrading Strategy which deals with upgrading capacities of sanitary and combined trunk system with the intent of improving the level of service; and

The Opportunistic Sewer Separation Program which deals with partial sewer separation of combined sewer service areas.

The City will continue to develop and promote other proactive strategies to reduce the potential for future flood risk.

Expanded Flood Prevention Program Updates:

A number of engineering solutions have been identified to help reduce the risk of future flooding in Mill Woods and southwest Edmonton communities. The recommended solutions include: upgrading existing sewers and stormwater management ponds, building new storage sewers, sealing a number of manholes in trapped low areas, improving overland drainage routes, and constructing new stormwater management dry ponds where possible.

Expansion of the existing Flood Prevention Program is underway to ensure that implementation of these solutions are expedited. In the short-term, a limited number of small construction projects are being considered for some of the impacted communities. Design of the highest priority projects will commence in early 2014 in anticipation of capital funding approval starting in 2015. Adminstration is prioritizing the long-term construction plans and developing a capital profile for the 2015-2018 budget. This will be presented to Utility Committee as part of the 2015 business plan and budgeting process.

Corporate Outcomes

The Way Ahead, Edmonton's Strategic Plan:
- Preserve and Sustain Edmonton's Environment
- Improve Edmonton's Liveability
- Safe and Clean City
- Transform Edmonton's Urban Form

Budget/Financial Implications

Most of the key capital programs/strategies mentioned above are already funded. However, future recommendations regarding the funding mechanisms for the Expanded Flood Prevention Program to reduce flooding in high risk areas will be forwarded to the Utility Committee and Council for approval. A close examination of the capital investment requirements and sources of financing will be part of the process.

Others Reviewing this Report

- D. H. Edey, General Manager, Corporate Services
- B. Belcourt, Acting General Manager, Transportation Services
- L. Cochrane, General Manager, Community Services
- R. G. Klassen, General Manager, Sustainable Development