

Staff Report

Origin

The City of Richmond is situated approximately one meter above sea level and flood protection is integral to protecting the health, safety and economic viability of the City. Richmond is protected from flooding by infrastructure that includes 49 km of perimeter dikes, 642 km of drainage pipes and culverts, 165 km of watercourses and 39 drainage pump stations.

Demands on the City's flood protection infrastructure are most significant during storm seasons in the winter and freshet season in the spring. This report provides Council with an update on 2018's winter storms and ongoing works regarding the City's flood protection program.

Analysis

2018 Winter Storms and Flood Protection System

Significant Rainfall Events

Rainfall amounts and water levels in the City's drainage system and the Fraser River are monitored using five rain gauges, twelve drainage level sensors and nine river level sensors. Attachment 1 shows the total annual rainfall over the past 10 years and identifies record high total rainfall in 2018.

The City's drainage system is designed to accommodate a 10-year return period rainfall event. Between November 2018 and January 2019, the City experienced three significant rainfall events that exceeded the 10-year event. In recent years, there has been an increase in the occurrences and intensities of significant storms, with multiple storms exceeding a 10-year return period intensity in a given year. This is consistent with predicted climate change impacts on local weather patterns and reinforces the need for the City's continued flood protection upgrade program.

Staff analysis of these storms and recent trends has led to an update of the Intensity Duration Frequency design standards for drainage systems within Richmond. These updated standards will provide Richmond with more robust infrastructure to meet future needs.

December 11 and 13 Rainfall Events

During the December 11 and 13, 2018 storms, local surface flooding was experienced in the northern portion of Lulu Island, particularly within the Bath Slough drainage catchment. Staff undertook additional maintenance activities to clear the drainage system in response to these events. These measures were effective and no localized flooding was recorded for subsequent storm events. Staff have assessed the need for drainage improvements within the Bath Slough catchment and recommended projects are included in the five year capital program.

Rainfall is pumped off of Lulu Island through 39 drainage pump stations throughout the City. To date, 11 pump stations have been re-built to modern standards with higher capacity and reliability. During the December events, a number of the older pump stations were operating near full capacity. These stations have been identified to require upgrades through capacity analysis.

Projects to upgrade or replace these stations are either included in current capital programs or will be brought forward for Council's consideration as part of future capital programs.

December 20 King Tide and Wind Storm Event

On December 20, 2018, the region experienced a king tide event together with a significant wind storm. While the storm caused significant wave action, widespread power outages and damage throughout the region, the City's flood protection system performed well and no flooding issues were identified. A minimum freeboard of 0.7 m (excluding wave action) was recorded in the Steveston area during this event. While the storm caused local damage to rip-rap and debris build-up along the dike, the dike structure was never at risk. Staff responded immediately to reinstate erosion protection and prevent damages to the dike.

BC Hydro reported that the December 20, 2018 windstorm was the most damaging storm in their history, with over 750,000 of their customers province-wide without power. Within Richmond, approximately 9600 customers were impacted, and of these, over 98% had their power restored within 24 hours. During significant events such as this recent windstorm, the City works with BC Hydro to keep the public safe. The City relays information received from the public and staff on known outages and problem locations to BC Hydro and emergency services as needed. City crews are often dispatched to reported problem areas to investigate, and to secure the area and may close traffic lanes or sidewalks and barricade off the area when there is a potential risk to the public.

BC Hydro has reported that from reviewing the December 20, 2019 storm there are things that can be improved on. For example:

- BC Hydro knows some customers had challenges learning about the status of their outage, and will continue to ensure it is providing timely updates to its customers;
- BC Hydro will work with cities and municipalities to better map out major intersections and primary traffic routes so circuits feeding these areas can be prioritized to avoid traffic congestion and related safety issues.

Flood Protection Planning

Flood Protection Management Strategy Update

The City's flood protection efforts are guided by the 2008-2031 Richmond Flood Protection Strategy. The Strategy, originally adopted in 2006 and last updated in 2008, provides a framework for addressing flood protection within the City by assessing flood risks, defining roles and responsibilities, assessing funding strategies, establishing design standards with considerations for climate change, and identifying the components of Richmond's flood protection system. Since 2008, significant advances have been made to improve Richmond's resilience to flooding and many of the goals established in the Strategy have been achieved. Staff is currently undertaking a comprehensive update of the City's Flood Protection Management Strategy, funded through the National Disaster Mitigation Program grant, and will bring forward a draft strategy for Council's consideration in spring 2019.

Dike Master Plans

Climate change scientists estimate that sea level will rise approximately 1.0 m by 2100 and 0.2 m of subsidence is expected in that same time period. A key action identified in the City's Flood Protection Strategy involves preparing and implementing a comprehensive program to raise the City's perimeter dikes by 1.2 m over the next 25-75 years to stay ahead of climate change induced sea level rise. The City's Dike Master Plans addresses this need by recommending dike upgrade options for each dike reach throughout the City.

Public consultation for Dike Master Plan Phases 3 and 5 is currently underway. Finalized plans that incorporate the feedback received through public consultation will be brought forward to Council for consideration in spring 2019. Preparation of Dike Master Plan Phase 4 is underway and a draft will be brought forward to Council in 2019.

Infrastructure Improvements

Funded by the Drainage and Diking Utility and grants, the City's flood protection infrastructure is continuously upgraded and improved to address infrastructure age, growth and climate change.

Dike Upgrades

Design work has been completed for the upgrade of the South Dike between Gilbert Road and No. 3 Road. Upgrades include raising and widening approximately 650 m of dikes and improving the adjacent multi-use path to enhance the safety and accessibility of pedestrians and cyclists. A public open house was held on site on June 23, 2018. Construction is expected to commence in spring 2019.

Design is underway for dike upgrades along the South Dike between No. 3 Road and Finn Slough. Ongoing works include coordination with Parks Services for the impacts to the dog off-leash area at the No. 3 Road Waterfront Park and a public information session to be held in late spring 2019.

Design of South Dike upgrades between No. 9 Road and west of McMillan Way is awaiting provincial approvals and construction is anticipated to commence later in 2019.

In addition to dike upgrades completed as part of the capital program, 1.4 km of dikes were re-armoured with 10,500 tonnes of rip-rap as part of the City's Dike Maintenance Program in 2018.

Pump Station Upgrades

Significant progress has been made in upgrading the City's drainage pump stations to accommodate growth and climate change. Over the last 18 years, since the City introduced the Drainage and Diking Utility, the City has rebuilt 11 of its 39 drainage pump stations and has performed significant upgrades on four. Re-construction of the No. 2 Road North Drainage Pump Station upgrade was completed in 2018. Re-construction of Horseshoe Slough Pump Station is underway. Construction of the No. 7 Road South, Shell Road North and No. 2 Road South pump stations are expected to begin later in 2019.

Flood Protection Improvement Financing

Improvements to the City's flood protection system to address the needs of aging infrastructure and climate change are funded through three basic funding sources.

Drainage and Diking Utility

The Drainage and Diking Utility was established by Council in 2000 and currently generates \$11.6 million to maintain and upgrade Richmond's flood protection infrastructure.

Senior Government Grant Funding

The City's Flood Protection Strategy aims to pursue 50% funding for dike improvement efforts from senior government. As a result of proactive flood protection planning efforts, the City has been successful in securing \$18.5 million in senior government grants that will go towards implementing \$30 million of dike and pump station improvements as well as ongoing flood protection assessments, exceeding the strategy's target of 50%.

Development

The City has successfully partnered with developers to secure dike upgrades through development. In particular, the City is actively pursuing opportunities to construct superdikes, where land supporting development behind the dike is filled to the same elevation as the dike crest. This eliminates visual impacts of a raised dike structure on waterfront views while providing an enhanced flood protection structure for the City. Superdikes constructed through development include sections near the Richmond Olympic Oval and at the Imperial Landing and Kawaki developments in Steveston. Superdike construction is expected to occur at the Parc Rivera development and the River Green developments in 2019. Staff estimates that up to 20% of dike upgrades along Lulu Island's perimeter dikes will be completed through development.

Financial Impact

None.

Conclusion

While the City's flood protection system meets current provincial standards, evolving climate change impacts must be addressed, as highlighted through the significant storms observed in the winter of 2018. Richmond maintains a robust and comprehensive flood protection program that proactively addresses the impacts of climate change.

The City's Flood Protection Strategy proactively guides the City to forecast, plan and improve the City's flood protection system to meet long-term requirements. Long-range planning of the City's diking needs are addressed through the ongoing Dike Master Planning efforts. Richmond's drainage infrastructure is well developed, with computer based hydraulic models to forecast future capacity requirements. Through the capital improvements and investment in preventative maintenance programs, the City has developed the ability to proactively prepare and respond to

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flood related concerns. Significant progress continues to be made in advancing the City's dike planning efforts and implementing infrastructure improvements to the City's flood protection system.

A handwritten signature in blue ink, appearing to read 'E. Sparolin'.

Eric Sparolin, P.Eng.
Acting Manager, Engineering Planning
(604-247-4915)

Att. 1: Annual Rainfall Data

Annual Rainfall Data

