City of Richmond

Report to Committee

To:	Public Works and Transportation Committee	**Date:**	March 19, 2021
From:	Milton Chan, P.Eng. Director, Engineering	**File:**	10-6000-01/2021-Vol 01
Re:	**2020 Winter Rainfall and 2021 Flood Protection Update**		

Staff Recommendation

That the staff report titled "2020 Winter Rainfall and 2021 Flood Protection Update", dated March 19, 2021 from the Director, Engineering be received for information.

Milton Chan, P.Eng.
Director, Engineering
(604-276-4377)

Att. 1

REPORT CONCURRENCE		
ROUTED TO:	**CONCURRENCE**	**CONCURRENCE OF GENERAL MANAGER**
Sewerage and Drainage Roads and Construction	☑ ☑	
SENIOR STAFF REPORT REVIEW	**INITIALS:**	**APPROVED BY CAO**

Staff Report

Origin

As detailed in the Flood Protection Management Strategy 2019, the City of Richmond is situated approximately 1.0 m 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 dikes, 585 km of drainage pipes, 61 km of culverts, 165 km of watercourses and 39 drainage pump stations.

Demands on the City's flood protection infrastructure are most significant during storm season in the winter and freshet season in the spring. This report provides Council with an update on 2020/2021 winter rainfall and ongoing works regarding the City's flood protection program.

This report supports Council's Strategic Plan 2018-2022 Strategy #1 A Safe and Resilient City:

Enhance and protect the safety and well-being of Richmond.

1.2 Future-proof and maintain city infrastructure to keep the community safe.

Analysis

2020 Winter Rainfall and Flood Protection System

Significant Rainfall Events

The City's drainage system is designed to accommodate a 10-year return period rainfall event. Rainfall amounts and water levels in the City's drainage system and the Fraser River are monitored using 5 rain gauges, 12 drainage level sensors and 9 river level sensors. Attachment 1 shows the total annual rainfall over the past 10 years and identifies higher than average total rainfall in 2020.

Between September 2020 and January 2021, the following significant rainfall events occurred:

- Three 2-year return period rainfall events;
- One 5-year return period rainfall event; and
- One 10-year return period rainfall event.

The drainage system performed well during these events.

Total rainfall volume in November 2020 was 23% higher than the historical 10-year average, while total rainfall volume in December 2020 was 39% higher than the historical 10-year average. During this time, there was an increase in drainage-related service requests over the 10-year average of 124. Staff responded to a total of 195 drainage-related service requests, 35 of which were due to significant rainfall events. All drainage issues were alleviated through maintenance of the drainage system.

In recent years, there has been an increase in the occurrences and intensities of significant storms, with the potential for 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.

Storm Surge

On January 13, 2021, the City experienced a king tide event together with a wind storm and storm surge. The City's flood protection network performed well; however, the storm caused local damage to the rip-rap armouring along the south dike west of Gilbert Road, and a significant amount of large logs and woody debris accumulated in the area. No rip-rap damage was observed in the Gilbert Road to No. 3 Road area, where dike upgrades were recently completed.

As outlined in the staff report titled "South Dike Repairs – Gilbert Road Area", dated February 17, 2021 from the Director, Engineering, Council endorsed that funding from the Drainage Improvement Reserve Fund be approved to complete dike armouring repair and debris removal along the south dike at Gilbert Road. Coordination and environmental permitting are underway to complete the dike repair ahead of the upcoming spring freshet.

Minor seepage at the Britannia Shipyard floodwall was also observed during the elevated tide levels that took place on January 12, 2021 and January 13, 2021. Staff temporarily repaired the floodwall to prevent further seepage and are conducting an assessment of the area to develop a scope of work for the full repair.

Flood Protection Planning

Flood Protection Management Strategy

The City's flood protection efforts are guided by the recently updated Flood Protection Management Strategy. The strategy update was funded through the National Disaster Mitigation Program grant and provides a framework that outlines short-term and long-term strategies for policy planning, infrastructure upgrades, and other areas related to flood risk mitigation.

Key elements of the Flood Protection Management Strategy include raising dikes, updating policies with current flood protection science, updating the City's dike operations and maintenance manual, performing a seismic flood hazard assessment and establishing a world-class flood protection standard. These key elements will be advanced to improve the City's overall resilience to flooding. Staff will continue to engage key stakeholders and the public on climate change, flood protection, and area-specific considerations through the use of social media, open houses, presentations and other platforms.

Current climate change science estimates that sea level will rise approximately 1.0 m by the year 2100 and 0.2 m of land subsidence is forecasted over the same time period. As outlined in the staff report titled "Review of Land Raising Initiative in the City's Flood Protection Management Strategy", dated February 22, 2021 from the Director, Engineering, land raising over the long term (100-year horizon) would mitigate the impacts of climate change induced sea level rise and land subsidence. Staff will be presenting the content of that report to future Food Security and Agricultural Advisory Committee and Advisory Committee on the Environment meetings. A

subsequent memorandum will be provided to Council to advise on the meeting discussions and address additional questions on land raising from the March 15, 2021 General Purposes Meeting.

Dike Master Plans

A key action identified in the City's Flood Protection Management Strategy involves continuing to upgrade the City's perimeter dike to 4.7 m in the next 25 to 75 years to stay ahead of climate change induced sea level rise. The City's Dike Master Plan addresses this need by recommending dike upgrade options for each dike reach throughout the City.

Dike Master Plan Phases 1, 2, 3 and 5 have been adopted by Council. Dike Master Plan Phase 4, which includes the north dike of Lulu Island between No. 6 Road and Boundary Road, is anticipated to be presented for Council consideration in a separate report this year.

Staff are continuing to implement the work plan endorsed by Council as part of Dike Master Plan Phase 1 for the Steveston Island dike concept. At the January 19, 2021 Public Works and Transportation Committee Meeting, Council endorsed the grant submission for the Steveston Island Preliminary Dike Design to the National Disaster Mitigation Program. The project includes the preliminary design of the Steveston Island dike and related studies necessary to assess the impact of sedimentation patterns, tidal velocities and water quality. Should the grant application be unsuccessful, the Steveston Island Preliminary Dike Design will be brought forward for Council's consideration as part of the proposed 2022-2026 Capital Program.

At the April 6, 2021 General Purposes Committee Meeting, Committee endorsed the following recommendation as outlined in the staff report titled "Accelerated Flood Protection Program Concept and Flood Protection Rate Structure Review", dated February 26, 2021 from the Director, Engineering:

> *That a target annual revenue level of $30 million by 2031, for the Drainage and Diking Utility, be endorsed for use in future utility budget planning in order to support Option 1 – 50 Year Implementation Period for an accelerated flood protection program.*

Upon Council endorsement, staff will prepare the 2022 utility budget and rates accordingly, including budgeted expenditures for additional staffing, maintenance of the flood protection works, and operational resources for Council's consideration as part of the annual budget process.

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.

Capital Dike Upgrades

Design is complete for south dike upgrades between No. 3 Road to 400 m west of No. 4 Road, and between 200 m west of No. 9 Road and the Ewen Road Drainage Pump Station. Procurement is underway for both projects and construction is anticipated to begin in summer 2021.

Design of the south dike upgrade between No. 4 Road and No. 5 Road will begin in summer 2021.

Dike Rehabilitation

In addition to dike upgrades completed as part of the Capital Program, 460 m of dikes were re-armoured with 3,672 tonnes of rip-rap as part of the City's Dike Maintenance Program in 2020.

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 20 years, since the City introduced the Drainage and Diking Utility, the City has rebuilt 14 of its 39 drainage pump stations and has performed significant upgrades on four. Re-construction of the Horseshoe Slough and Shell Road North Pump Stations is complete. Re-construction of the No. 7 Road South Pump Station is nearing completion. Designs are complete for the No. 2 Road South, Steveston Highway and No. 3 Road and Steveston Highway and Gilbert Road Pump Stations.

During extreme events, a number of the older pump stations operate 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 consideration as part of future capital programs.

Flood Protection Improvement Financing

Improvements to the City's flood protection system to address the needs of ageing 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 $13.4 million annually to maintain and upgrade Richmond's flood protection infrastructure. Staff are continuously monitoring regional and global climate change science to inform the City's Flood Protection Program.

Options and recommendations for future utility rates are presented in a separate report titled "Accelerated Flood Protection Program Concept and Flood Protection Rate Structure Review".

Senior Government Grant Funding

The City's Flood Protection Management Strategy aims to acquire senior government funding for a wide range of flood prevention and protection research, monitoring, studies, planning and improvements. As a result of proactive flood protection planning efforts, the City has been successful in securing approximately $40 million in senior govermment grants since 2010 that helped fund over $70 million of dike upgrades, pump station improvements and master planning updates.

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. Staff estimate that up to 20% of dike upgrades along Lulu Island's perimeter dikes will be completed through development. Superdikes constructed through development to date include sections near the Richmond Olympic Oval, Parc Riviera and at the Imperial Landing and Kawaki developments in Steveston. Superdike construction is underway at the Western-Citimark development, and is anticipated to begin later this year for the Vancouver Airport Fuel Facility Corporation (VAFFC) and ASPAC development.

Financial Impact

None.

Conclusion

The City received above average rainfall in 2020 and experienced two significant rainfall events that exceeded a 2-year return period in the 2020/2021 winter rainfall season. Through the capital improvements and investment in preventative maintenance programs, the City has developed the ability to proactively prepare and respond to 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.

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JH:mg
Att. 1: Annual Rainfall Data (2011-2020)

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