




---

**To:** Public Works and Transportation Committee      **Date:** May 31, 2016  
**From:** John Irving, P.Eng. MPA      **File:** 10-6060-01/2016-Vol 01  
Director, Engineering  
**Re:** Fraser River Freshet and Flood Protection Update 2016

---

**Staff Recommendation**

That the staff report titled, "Fraser River Freshet and Flood Protection Update 2016", dated May 31, 2016, from the Director, Engineering, be received for information.

John Irving, P.Eng. MPA  
Director, Engineering  
(604-276-4140)

REPORT CONCURRENCE		
<b>ROUTED TO:</b>	<b>CONCURRENCE</b>	<b>CONCURRENCE OF GENERAL MANAGER</b>
Roads and Construction	<input checked="" type="checkbox"/>	
Sewerage and Drainage	<input checked="" type="checkbox"/>	
<b>REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE</b>	<b>INITIALS:</b> DW	<b>APPROVED BY CAO</b> 

## Staff Report

### Origin

The staff report titled, “Annual Flood Protection Report 2015” dated March 1, 2016, from the Director, Engineering, identified below average snow packs in BC and the potential for increased flood risk in early spring on the Fraser River due to the warmer than normal temperature impact of the El Nino cycle. Furthermore, Phase I results of the Lower Mainland Flood Management Strategy was presented by the Fraser Basin Council on May 30, 2016 and is intended to provide a better understanding of flood hazards, flood vulnerabilities and the state of flood protection infrastructure, policies and practices across the region. The purpose of this memo is to update Council on the 2016 Fraser River freshet and Phase I results of the Lower Mainland Flood Management Strategy.

This report supports Council’s 2014-2018 Term Goal #6 Quality Infrastructure Networks:

*Continue diligence towards the development of infrastructure networks that are safe, sustainable, and address the challenges associated with aging systems, population growth, and environmental impact.*

### Findings of Fact

#### Fraser River Freshet

Snow pack is a significant element that is used to predict extreme river conditions. The snow basin index for the middle of May 2016 was a new record low. This reflects the accelerated melt of the snow pack due to the extremely warm spring weather consistent with an El Nino cycle. This year’s late-May snow melt conditions are more typical of snow pack that is observed in late-June, indicating that snow melt and freshet runoff are progressing four weeks ahead of normal.

Rainfall has also been below average, which has contributed to lower than normal freshet flows. Most rivers have experienced the peak of the freshet season and are now experiencing declining flows as snow packs become depleted. The forecasted Fraser River peak flow for the 2016 freshet was 7,000 m<sup>3</sup>/s and withdrew to below normal flows by mid-May (the actual peak in 2015 and 2014 was 7,950 m<sup>3</sup>/s and 10,083 m<sup>3</sup>/s, respectively).

As a result, seasonal flood risk due to snow melt has declined and there has been negligible freshet flood risk to date with no significant impacts on the City’s dike and drainage system. Emergency Management BC issued the final Provincial River Outlook of the season on May 27, 2016 and will not provide any future updates this year unless a significant change in weather warrants one.

City staff will continue to monitor Fraser River water levels until the end of the 2016 freshet and will report any significant changes to Council.

#### Lower Mainland Flood Management Strategy

The Fraser Basin Council presented Phase I results for the Lower Mainland Flood Management Strategy on May 30, 2016. The strategy is intended to provide a better understanding of regional flood hazards, flood vulnerabilities and the state of flood protection infrastructure, policies and practices across the region.

Phase 1 of the strategy consisted of three projects:

- Project 1 - Analysis of Future Flood Scenarios
- Project 2 - Regional Assessment of Flood Vulnerabilities
- Project 3 - Assessment of Flood Infrastructure, Policies & Practices

While Fraser Basin Council's work is scoped at a regional scale, the City largely completed this scope of work at a higher level of accuracy and detail for Richmond with the adoption of the 2008-2031 Richmond Flood Protection Strategy in 2008.

#### Project 1 - Analysis of Future Flood Scenarios

Project 1 estimated current and future flood water levels in the Lower Mainland for utilization in Project 2's conservative analysis of flooding and flood related damage.

The current provincial standard (2008) is based on a 1 in 200 year return period high water event and the City's current flood protection systems are more than capable of withstanding this event. Fraser Basin Council has arbitrarily selected a 1 in 500 year return period event plus an additional 0.6 m for "uncertainties and site variation" that is well beyond the current provincial standard. Based on the 1 in 500 year event and the conservative 0.6 m increase, the coastal flood water levels estimated in the study are 3.4 m in the present day scenario and 4.4 m in the year 2100 scenario. Current City flood protection improvements target a dike crest of 4.7 m, which exceeds the 4.4 m identified for the year 2100 scenario.

#### Project 2 – Regional Assessment of Flood Vulnerabilities

Project 2 is a vulnerability assessment to estimate regional losses based on the floods estimated by Project 1. The assessment assumed all dikes fail and that flood waters would inundate all low-lying areas for a two to four week period. Both of these assumptions are highly conservative. Richmond's flood protection infrastructure will not universally fail and it is not possible for Richmond to be inundated for a long duration under existing sea level conditions. These issues will become more important as sea level rises. This is the focus of Richmond's dike master planning efforts and long-term dike improvement program.

#### Project 3 - Assessment of Flood Infrastructure, Policies & Practices

Project 3 is focussed on the effectiveness of flood protection in the Lower Mainland including a dike assessment. Fraser Basin Council reported that few Lower Mainland dikes met current provincial standards and none fully met or exceeded the standards.

Richmond's dikes exceed the 1 in 200 year flood elevations identified by the provincial standard. As identified in Fraser Basin Council's report, all Richmond dikes have at least 0.3 m of freeboard beyond the provincial standard. As such, there is no short or medium range risk that Richmond dikes will be overtopped by forecast events. Long term sea level rise will require that Richmond dike elevations be improved and this work is the focus of the Dike Master Plan and long term improvement program.

Project 3 was a desktop study with no field verification and includes disclaimers that further work must be done to determine actual dike condition. Fraser Basin Council did not provide the Project 3

report or results to Richmond staff prior to its release. Staff will work with the Fraser Basin Council to update the Project 3 work to represent Richmond's actual dike elevations and conditions.

### Flood Protection Strategy Update

Since the establishment of the 2008 – 2031 Flood Protection Strategy, the City's guiding framework for continuing upgrade and improvement of the City's flood protection system, there's been progress this year on numerous initiatives.

In December 2015, the City received approval from the Province to begin survey and investigation for the construction of a dike on Steveston Island. The investigation is required to further develop the feasibility, impact and cost associated with building the Steveston Island Dike recommended in the Lulu Island Dike Master Plan – Phase 1.

Dike Master Plan – Phase 2 began in 2015. This phase of the plan includes the North West Dike and the Middle Arm Dike west of No. 6 Road. Staff will update Council with the findings of the Dike Master Plan – Phase 2 later this year.

In addition, the City has performed a large number of dike improvements through capital programs and partnering with development adjacent to the dikes. The following is a list of key improvements that have been made in the last few years:

- Bath Slough Drainage Pump Station Rebuild (completed in 2016)
- No. 1 Road North Drainage Pump Station Rebuild (completed in 2014)
- Williams Road Drainage Pump Station Rebuild (completed in 2013)

The following dike improvement projects are currently underway:

- No. 2 Road North Drainage Pump Station Rebuild (design and construction to be completed in 2016)
- Horseshoe Slough Drainage Pump Station Rebuild (design work to be completed in 2016 and construction completed in 2017)
- No. 7 Road South Drainage Pump Station Rebuild (design work to be completed in 2016 and construction completed in 2017)

The following projects are included in the approved 5 Year Financial Plan (5YFP):

- Shell Road North Drainage Pump Station Rebuild (2017)
- No. 2 Road South Drainage Pump Station Rebuild (2018)
- Dike Upgrades – 1.2 km in Various Locations (2017-2020)

The City's annual inspection and maintenance program ensures that the City's dikes are well protected against other diking issues such as bank erosion and excessive seepage, which crews monitor along with water levels during high tides throughout the freshet period. Furthermore, 500 linear meters of rip rap maintenance and upgrades have been completed this year. Crews will continue to perform regular dike maintenance work as well as other seasonal improvements and repairs this fall.

City of Richmond flood protection is better than identified in the Lower Mainland Flood Management Strategy by the Fraser Basin Council. Staff look forward to helping the Fraser Basin Council improve on the work they have completed to date.

### Seismic Upgrading

A number of geotechnical analyses to date have indicated that Richmond's dike system will experience some deformation due to liquefaction during a 1 in 475 year return period seismic event. The expected subsidence is not excessive and the dike is expected to remain largely intact, requiring some local repair. The long term dike improvement program will improve the dikes resistance to seismic events as climate change induced sea level rise becomes a factor.

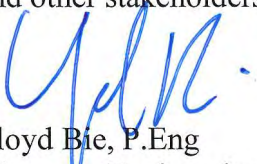
### **Financial Impact**

None.

### **Conclusion**

This year's late-May snow melt conditions are more typical of snow pack that is observed in late-June, indicating that snow melt and freshet runoff are progressing four weeks ahead of normal. Most rivers have experienced the peak of the freshet season and are now experiencing declining flows as snow packs become depleted. Staff will continue to monitor Fraser River water levels until the end of the 2016 freshet and will report any significant changes to Council.

Fraser Basin Council presented Phase I results for the Lower Mainland Flood Management Strategy on May 30, 2016 and the reports are intended to provide a better understanding of regional flood hazards, flood vulnerabilities and the state of flood protection infrastructure, policies and practices across the region. The three projects included in Phase I are highly conservative and do not represent a likely event in Richmond. Staff will continue to work with the Fraser Basin Council and other stakeholders to improve forecasting and address regional flood protection issues.



Lloyd Bie, P.Eng  
Manager, Engineering Planning  
(604-276-4075)

LB:ch