City of Richmond

Report to Committee

To:	Public Works and Transportation Committee	**Date:**	June 12, 2024
From:	Milton Chan, P.Eng Director, Engineering	**File:**	10-6000-01/2024-Vol 01
Re:	**Fraser River Freshet and Flood Protection Update 2024**		

Staff Recommendation

That the staff report titled "Fraser River Freshet and Flood Protection Update 2024", dated June 12, 2024, from the Director, Engineering be received for information.

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

Att. 2

REPORT CONCURRENCE		
ROUTED TO:	**CONCURRENCE**	**CONCURRENCE OF DEPUTY CAO**
Public Works	☑	
SENIOR STAFF REPORT REVIEW	**INITIALS:**	**APPROVED BY CAO**
	CJ	

Staff Report

Origin

This report provides Council with a summary of the 2024 Fraser River freshet, along with an update on 2023 rainfall statistics and ongoing works regarding the City's flood protection program.

As detailed in the Flood Protection Management Strategy 2019, the City of Richmond is situated approximately 1.0 metre 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 kilometres of dikes, 598 kilometres of drainage pipes, 61 kilometres of culverts, 155 kilometres of watercourses and 39 drainage pump stations.

This report supports Council's Strategic Plan 2022-2026 Focus Area #3 A Safe and Prepared Community:

> *Community safety and preparedness through effective planning, strategic partnerships and proactive programs.*
>
> *3.1 Advance proactive, sustainable, and accelerated flood protection in collaboration with other governments and agencies.*
>
> *3.3 Ensure the community is collectively prepared for emergencies and potential disasters.*
>
> *3.4 Ensure civic infrastructure, assets and resources are effectively maintained and continue to meet the needs of the community as it grows.*

Analysis

2024 Fraser River Freshet

In recent years, extended periods of drought conditions have occurred throughout the Province due to climate change, which has contributed to reduced snow depth levels in southern BC. For 2024, the Province has advised that average provincial snowpack levels were 57% of normal as of June 1, 2024. This has led to a reduced spring freshet with river flows below a 1-year return period. Low flows in the Fraser River are anticipated to continue into June and based on snow melt conditions and the level of remaining snow, it is anticipated that freshet flows are currently at or near the peak for the year.

The City's diking system is built to withstand a 500-year return period freshet event and no flooding has occurred in Richmond during the 2024 freshet. The City continues to be a leader in flood protection planning and mitigation through Council-endorsed capital projects and the annual dike maintenance program. Predicted climate change impacts, which include more extreme wet and dry weather events, could result in an increased variability in freshet flows in the future. This reinforces the need for the City's continued flood protection upgrade program.

2023 Rainfall

Significant Rainfall Events

Rainfall highlights for 2023 include the following:

- The City received approximately 1,015 mm of rainfall in 2023, which was 19% lower than the average annual rainfall over the last 10 years;
- December was the wettest month of the year, with 246 mm of rainfall measured at the Fire Hall No. 7 rain gauge, which accounted for 24% of the total rainfall measured at Fire Hall No. 7; and
- Six significant rainfall events with return periods of two years or greater were recorded in 2023. The most significant event had a 10-year return period, with 73 mm of rainfall over 24 hours.

The City's drainage system is designed to withstand a 10-year return period rainfall event. The drainage system performed well during winter rainfall events. The total annual rainfall over the last 10 years is included in Attachment 1.

Drainage System Performance

273 service requests related to drainage issues were recorded by Public Works in 2023. This was lower than the average annual number of service requests received over the last 10 years, as identified in Attachment 2.

November 2021 'Atmospheric River' Initiatives

Since the November 2021 'Atmospheric River Event', staff have undertaken a number of initiatives to assess and improve the City's drainage system based on observations and data collected from the event. Some of the completed initiatives include the following:

- Large-scale maintenance activities for canals and drainage pipes in the Horseshoe Slough catchment to significantly improve flow in the area;
- Construction of site drainage improvements and relocation of electrical equipment for the Edgemere Sanitary Pump Station;
- Development of a sandbag staging and distribution program to help protect private properties from potential localized flooding during extreme weather events; and
- Upgrades to fuel supply infrastructure at the City Works Yard, including underground conduit repairs, installation of rain covers, and replacement of fuel dispensers.

Some of the ongoing initiatives include the following:

- Monitoring the results of maintenance activities in the Horseshoe Slough catchment;
- Coordinating with the Province on field testing and assessment of drainage infrastructure at the Highway 99/91 interchange to identify drainage patterns and potential capacity issues and requesting that this area be included for drainage upgrades as part of the George Massey Tunnel Replacement Project; and
- Development of specifications for acquiring fueling trucks and resources to provide access to independent portable fuel supplies during extreme weather events.

Staff will continue to implement flood protection infrastructure upgrades and emergency response protocols to enhance the City's flood resilience during extreme weather events.

2023/2024 Winter Storm Events

Seasonal high tides and king tides were not significant over the winter, and the City's diking system performed well. Erosion and debris run up continue to be addressed as part of the dike maintenance program.

Infrastructure Improvements

The City's flood protection system has a replacement value of $3.6 billion, comprised of an extensive drainage network and 49 kilometres of perimeter dike. Staff are continuously upgrading and improving flood protection infrastructure to address the impacts of growth, infrastructure age and climate change.

Capital Dike Upgrades

Current climate change science estimates that sea levels will rise approximately 1.0 metre by the year 2100 and 0.2 metres of land subsidence will occur over the same time period. The City's Flood Protection Management Strategy is the guiding framework for continual upgrades and improvements to the City's flood protection system. A key action identified in the City's Flood Protection Management Strategy is to continue raising the City's perimeter dike to 4.7 metres in advance of climate change induced sea level rise.

The following dike improvement projects have been approved through the capital budget and are progressing:

- Design of north dike upgrades between Lynas Lane and No. 2 Road;
- Design of south dike upgrade between No. 4 Road and No. 5 Road; and
- Design of south dike upgrade between No. 2 Road and Gilbert Road.

Funding to construct dike upgrades will continue to be secured through proposed capital projects, which will be brought forward for Council's consideration as part of the annual budget process.

Dike Rehabilitation

Staff have implemented annual inspection and maintenance programs to ensure that the City's dikes are well-protected against issues such as erosion and seepage. Notable inspection and maintenance work completed this year includes the following:

- Responded to 6 high water events over 29 days of patrols;
- Installed new stairs at Lynas Lane and River Road to improve pedestrian accessibility to the north dike;
- Installed 1300 metres of rip rap armoring at various sections of dike throughout the City to reinforce the water side dike slope;
- Installed 5 new gates at dike access points to improve dike access for maintenance activities, dike patrols and emergency situations; and
- Removed 320 tonnes of large, woody debris from shorelines at various sections of dike throughout the City to avoid impacts to rip rap and dike slope stability.

Pump Station Upgrades

Significant progress has been made in upgrading the City's drainage pump stations to accommodate growth and climate change. The total capacity of the City's drainage pump stations has increased by 30% since 2005.

Over the last 20 years, the City has rebuilt or upgraded 19 of its 39 drainage pump stations. Upcoming drainage pump station upgrade projects include the No. 3 Road South and No. 9 Road-Westminster Highway Pump Stations.

During extreme events, a number of older pump stations operate near full capacity. These stations have been identified to require upgrades through capacity analyses. Projects to upgrade or replace these stations are either included in current capital budgets or will be brought forward for Council's consideration as part of future capital budgets.

Box Culvert Repair and Preventative Maintenance

The City has approximately 61 kilometres of culverts, the majority of which are 40 to 50 years in age. Although the box culverts have a design life of 100 years, premature failure of some joints has been observed in recent years.

The City has implemented a preventative box culvert maintenance program to inspect the condition of box culverts and identify sections that require repair or replacement on a 7-year cycle. Staff are proactively managing the condition of box culverts by identifying and repairing deteriorating joints before they cause significant damage. Repair of significant defects identified through the program will continue to be presented to Council for consideration as part of the annual capital budget.

Staff inspected 11.9 kilometres of box culverts within 17 drainage catchments in 2023. Results of each inspection are documented through written reports as well as images and video records. This allows staff to monitor changes to the condition of box culverts, thereby better informing long-term infrastructure improvement planning. In 2023, no significant defects were encountered and all minor defects that were identified have been repaired.

Design for the rehabilitation of the No. 4 Road box culvert from Granville Avenue to Alderbridge Way has been completed. The rehabilitation will include conventional methods along with injection grouting to prevent infiltration into the box culvert and fill potential voids on the outside of the box culvert. Construction for the section of box culvert between Westminster Highway and Alderbridge Way is anticipated to begin in summer 2024. The rehabilitation will help mitigate the deterioration of the box culvert joints and extend the service life of the box culvert.

The Woodwards Slough, Green Slough, Shell Road North, and No. 4 Road North drainage catchment areas are scheduled for inspection in 2024.

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 to date. include sections of dike near the Richmond Olympic Oval, along the north dike near No. 4 Road, along the south dike at Riverport Way, and in Steveston. Superdike construction is underway by Western-Citimark and Vancouver Airport Fuel Facility Corporation.

Financial Impact

None.

Conclusion

The City observed the second lowest annual rainfall over the last 10 years in 2023 and below average freshet flows in the spring of 2024. The drainage and flood protection system performed well, with negligible freshet flood risk and a below average number of drainage-related service requests.

Demands on the drainage and flood protection system will continue to increase due to climate change and growth. The Flood Protection Management Strategy guides the City to proactively forecast, plan, and improve the City's flood protection system to meet long-term requirements. Through capital improvements and investment in preventative maintenance programs, the City is able to manage flooding risks and maintain a high level of service to Richmond residents.

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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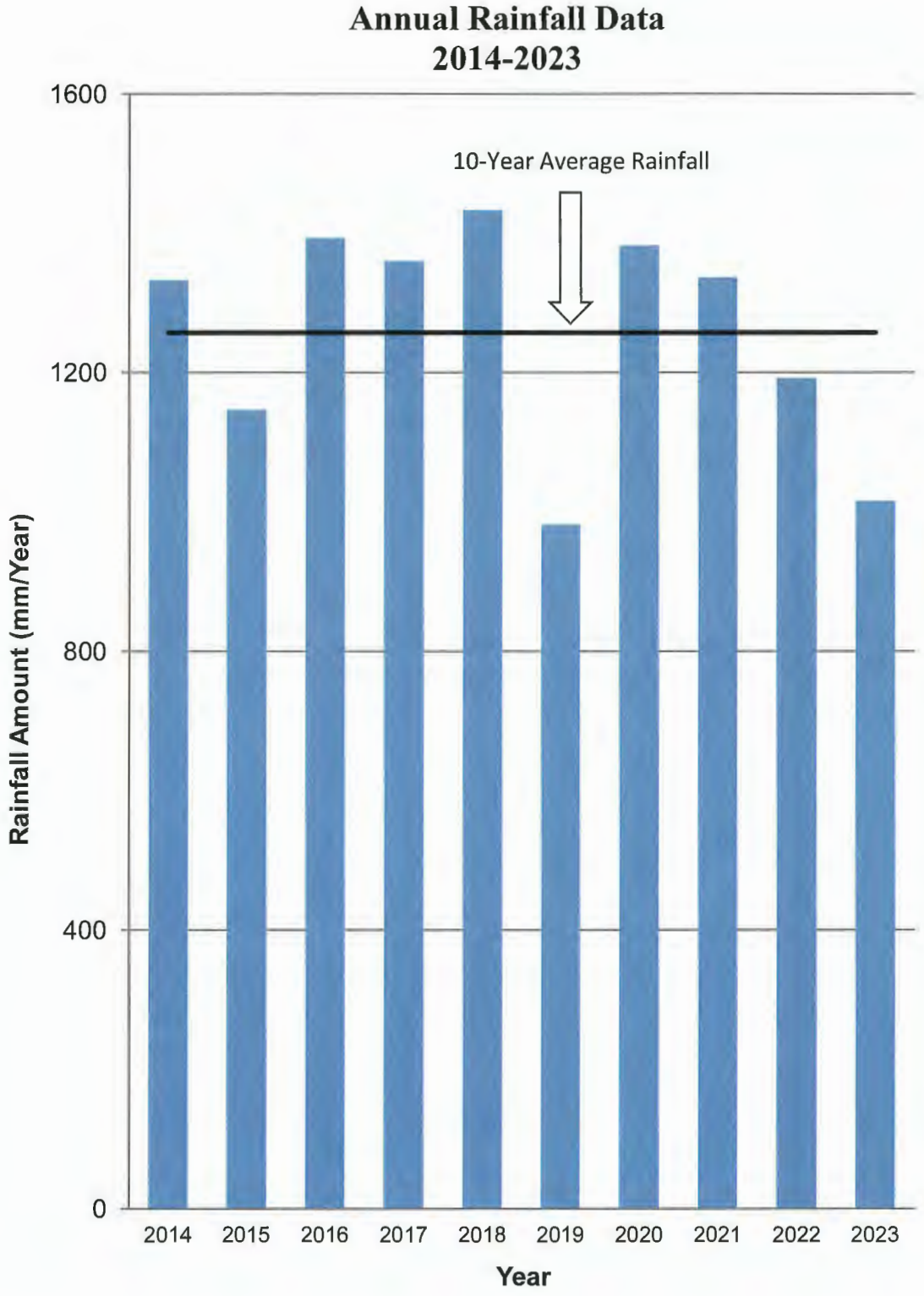
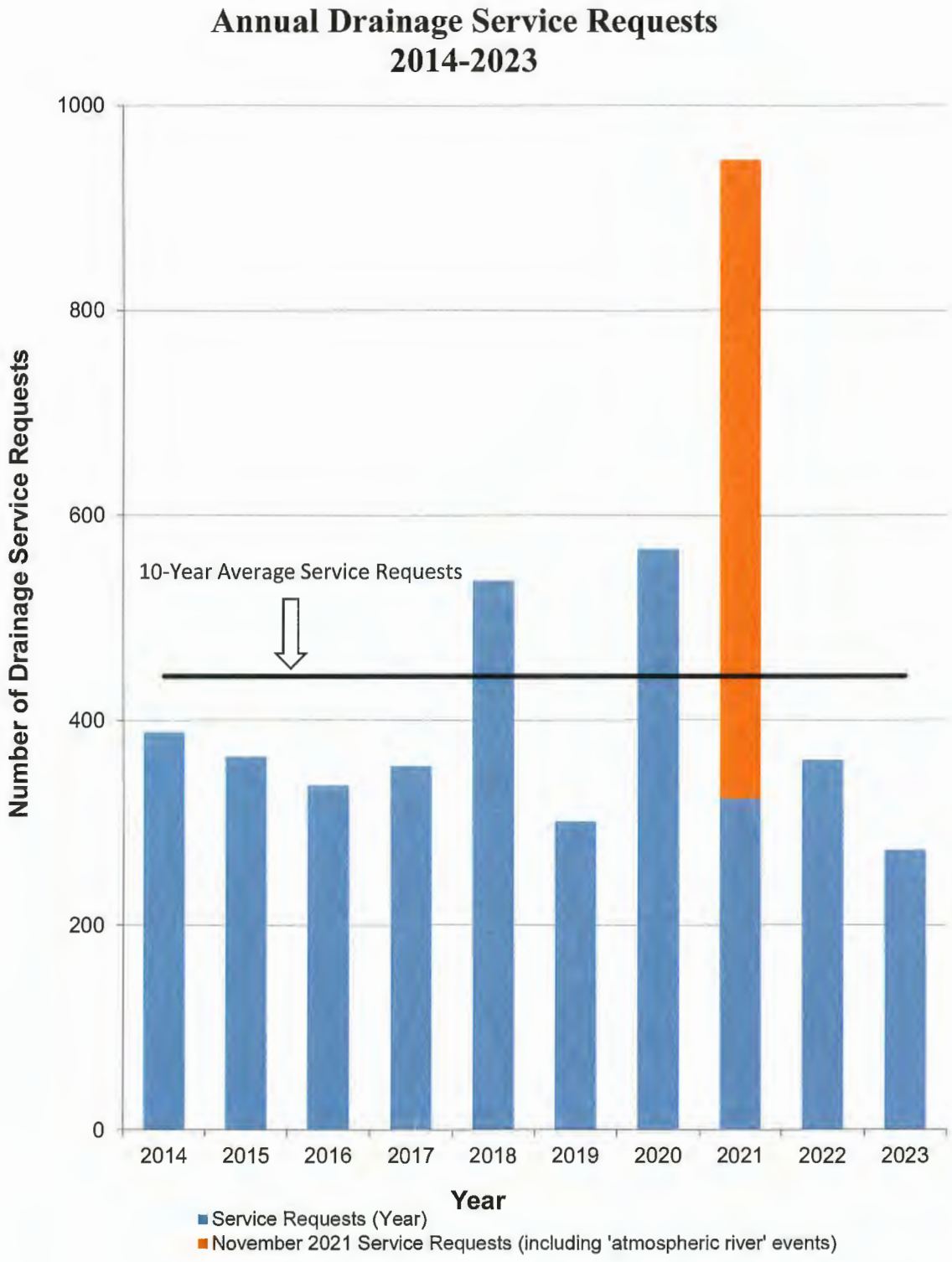
Att. 1: Annual Rainfall Data 2014 - 2023
2: Annual Drainage Service Requests 2014 - 2023


Annual Rainfall Data
2014-2023
1600
1200
800
400
0
10-Year Average Rainfall
Rainfall Amount (mm/Year)
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year


Annual Drainage Service Requests
2014-2023
1000
800
600
400
200
0
Number of Drainage Service Requests
10-Year Average Service Requests
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
Service Requests (Year)
November 2021 Service Requests (including 'atmospheric river' events)

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