City of Richmond

# Report to Committee

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| **To:** | Public Works and Transportation Committee | **Date:** | March 11, 2022 |
| **From:** | Suzanne Bycraft<br>Director, Public Works Operations | **File:** | 10-6045-01/2022-Vol 01 |
| | Milton Chan, P. Eng.<br>Director, Engineering | | |
| **Re:** | **November 2021 Atmospheric River Events - Summary and Outcomes** | | |

## Staff Recommendation

That staff apply the knowledge gained from the November 2021 atmospheric river event and response to inform future updates to the City's infrastructure plans and strategies, as well as future capital, operating and utility budget submissions.


Suzanne Bycraft
Director, Public Works Operations
(604-233-3338)

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


| REPORT CONCURRENCE | |
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| CONCURRENCE OF GENERAL MANAGER | |
| SENIOR STAFF REPORT REVIEW | INITIALS: |
| APPROVED BY CAO | |

## Staff Report

### Origin

The City, along with other jurisdictions in the Lower Mainland and Fraser Valley regions, experienced significant rainfall events during November 2021. These were termed 'atmospheric river' events due to consistent and substantial quantities of rainfall received over short periods of time. In many areas throughout the region, the capacity of drainage systems was exceeded.

The foresight and continued investment in the City's drainage and diking infrastructure over many years, including long-term infrastructure planning, maintenance and inspections, resulted in system resiliency during these events. Despite being tested at and beyond design levels, the City's system performed exceptionally well. Those areas built to current flood construction levels experienced no flooding concerns, while some areas not yet built to these levels experienced some degree of flooding.

As with all events of this magnitude, it is beneficial to reflect on areas of strong performance as well as identify areas of focus for creating even greater resilience and to enhance future response capabilities. This report provides an overview of the events and identifies areas to enhance mitigation and future response efforts.

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.*
>
> *1.3 Ensure Richmond is prepared for emergencies, both human-made and natural disasters.*

This report supports Council's Strategic Plan 2018-2022 Strategy #4 An Active and Thriving Richmond:

> *An active and thriving community characterized by diverse social and wellness programs, services and spaces that foster health and well-being for all.*
>
> *4.2 Ensure infrastructure meets changing community needs, current trends and best practices.*

### Analysis

Background

The City has a number of Council adopted strategies and plans in place that guide the City's management of flood risks. These include the Flood Protection Management Strategy, Integrated Rainwater Resource Management Strategy, and multiple phases of the Dike Master Plan. These documents are updated regularly to reflect current climate change science and regulatory requirements.

The principles and priorities from these documents are then combined with analysis from the ageing utility infrastructure planning process to inform the 5 Year Capital Plan, the Capital

Budget, the Utility Budget and the Operating Budget. Raising the perimeter dike is currently the strategic priority for improving the resilience of the City's flood protection system. The dike protects the City against flooding from any high tides and storm surges, as well as from high river flows caused by events such as spring freshet or prolonged heavy rainfall upstream of Richmond. Water from high river flows is also broadly disbursed by the time it reaches Richmond, lessening any potential impacts. The effect of high river flows is also reduced by the tide cycle, as the change in river level due to tides is much greater than the change due to high river flow events.

The interior drainage system and pump stations protect the City against flooding from heavy rainfall. The strategic priority in this area is to increase the capacity of the drainage pump stations. In the past 20 years, 14 pump stations have been rebuilt and 4 more have been significantly upgraded. With storm intensity and frequency expected to increase due to climate change, additional emphasis has been placed on the large box culverts renewal. The box culvert system largely mirrors the arterial road grid and is critical for conveying stormwater from all parts of the City to the pump stations . In 2017 Council supported the implementation of a box culvert maintenance program that will extend the life cycle of the culverts and minimize long term replacement costs. By minimizing replacement costs, more funding can be applied to new drainage infrastructure or upgrades.

November 2021 Atmospheric River

The City's diking network is designed to withstand a 500 year return period flooding event, and the drainage system is designed to withstand a 10 year return period rain event. The severity and intensity of the November 2021 atmospheric river far exceeded the original weather forecasts, and a 50 year return period rain event occurred, with 138 mm of total rainfall.

One of the anticipated effects of climate change is the increased frequency and duration of storm events. This means that the 10 year return period rain event that the drainage system is designed to accommodate will likely be more severe in the future. Staff are reviewing and updating the City's drainage model to determine what upgrades are potentially required to accommodate the changing nature of these events. Continuing to invest in upgrades to the drainage and flood protection system will help to ensure that the City can withstand these future storms.

Richmond experienced fewer issues than most other municipalities in the region, due in large part to the pro-active planning and implementation of Council's endorsed strategies and plans. Staff will use the observations from this event to further refine the City's drainage model and identify future drainage upgrades.

*Flooding Issues – Infrastructure Within Richmond's Jurisdiction*

Although some flooding occurred in various locations, the City's drainage system performed well overall during this event.

- *Horseshoe Catchment Area*
  The majority of flooding challenges associated with infrastructure under the City's jurisdiction was experienced in the area between Steveston Highway, Williams Road, No. 4 Road and No. 5 Road. This area experienced recurring flooding issues during smaller

rainfall events in the past and has always presented challenges as existing land elevations are among the lowest in the City.

Recognizing these challenges in the past, in the mid 2000's over five kilometres of drainage pipes were upgraded, and in the past decade new drainage pipes have been installed in most of the back lanes of this area. The Horseshoe Slough Drainage Pump Station was recently upgraded, and a hydraulic study of the slough upstream of the pump station was done in 2018 that found the slough had adequate design standard capacity to accommodate the storm water runoff from the catchment area.

While the recently upgraded Horseshoe Slough Drainage Pump Station performed as designed, parts of the pipes, box culverts and drainage canals in this area were at capacity and water began entering some properties in the Seacote area.

Although staff will continue to review potential drainage upgrades that will improve the ability to move storm water to the pump station, there are limits to the level of drainage that can be provided to the lower lying properties and many of these upgrades have already been installed to address the historical flooding issues.

The dwellings that experienced flooding are older and are below the City's current Flood Construction Levels. One of the points of emphasis in the Flood Protection Management System is long term raising of the land levels as a principle strategy within the City to protect against this type of flooding. Staff are reviewing additional interim measures that can be taken to protect against flooding of lower lying properties during future extreme storm events.

*Flooding Issues – Infrastructure Within Metro Vancouver and Provincial Jurisdiction*

- *No. 5 Road and Highway 99 Corridor*
  Highway 99 was closed by the Ministry of Transportation and Infrastructure (MOTI) due to flooding of the highway north of Westminster Highway. The City's drainage system in this area is interconnected with that of MOTI. Staff have requested that MOTI include drainage analysis and any identified upgrades extending to Highway 91 as part of the upcoming George Massey Crossing project.

  Staff have also requested that MOTI coordinate inspections and maintenance schedules with the City and ensure that regular ditch maintenance practices are conducted to maximize the highway system's capacity to convey storm water during rainfall events.

- *Metro Vancouver Sanitary Sewer Failure at Gilbert and Blundell Roads*
  Flooding and damaged infrastructure resulting in road closures occurred when an access chamber in the Metro Vancouver sanitary sewer system that connects to the Gilbert Trunk Sewer experienced a failure. As this system operates under pressure during daytime flows, a large amount of liquid waste was discharged onto the street.

  Completion of the new Gilbert Trunk Sewer and connecting sewer lines would significantly reduce the chances of a similar failure in the future. Metro Vancouver staff

have advised that the next phase of the project is in the procurement stage. Staff will continue to push for updates and timely completion of this project.

In the interim, to prevent a repeat occurrence, staff are requesting that Metro Vancouver identify any other locations along the complete length of the sanitary sewer main where a similar configuration exists and install mitigation measures.

*Fraser River Flows*

As seen by the flooding events that occurred in other areas of the province, Fraser River flows were elevated for a short period as a result of the atmospheric river.

- *Flow Data*
  Data from Environment and Climate Change Canada indicate that the peak river flows at Hope were 6,230 cubic metres per second (m3/s), and peak flows at Mission were 10,700 m3/s. For comparison, the average freshet flow over the past five years has been 9,400 m3/s at Hope, and 11,150 m3/s at Mission. River level sensors at Richmond's drainage pump stations showed river levels were slightly higher than would be expected from tidal effects alone.

The high flows from the atmospheric river had a much shorter duration than freshet flows. While freshet flows can last for weeks, the high flows in November subsided within a day.

This information indicates that widespread, heavy, prolonged rain events that include a significant portion of the entire Fraser River watershed can raise river flows to the extent that the effect is similar to a short duration freshet event. Richmond's dike system is designed to protect the City against these types of flows.

Staff are continuing to communicate with the BC River Forecast Centre and other stakeholders to better understand the impact of the atmospheric river on the Fraser River flows, in particular the large difference seen between the flows measured at Hope and Mission. Staff are also reviewing the location and quantity of river level sensors around the City to improve the quality of data collected in the future.

*Communications*

- *Call Management*
  The overnight deluge resulted in an overwhelming number of calls to Public Works Dispatch as residents awakened to the impacts from the rainfall event. Over 1,300 calls were received during this event, approximately 600 of which were received in simultaneous fashion, causing call queueing and delays. While calls were distributed throughout many areas of the City, the Horseshoe catchment area and the Highway 99/No. 5 Road corridor were the areas where the highest concentration of calls were received.

  Calls for sandbagging assistance were prioritized based on residents ability to collect them from the Works Yard and City crews delivered and placed sandbags at homes where residents were elderly or otherwise unable. City crews also helped residents fill

and place sandbags into residents' vehicles at the City Works Yard. Staff will review options to provide greater distributed access for sandbags throughout the City if resources permit in future events. For example, the Sidaway soil/operations site could serve as a satellite distribution point.

- *Public Communications*
  Operational status reports were provided regularly and as the situation unfolded across the City, allowing information to be conveyed regularly via social media channels and the media. A web page was also created to provide ongoing updates. While the dynamic and changing nature of events such as this can be challenging, feedback from the public, stakeholders and media about the level of timeliness and nature of communication from the City was extremely positive.

  Moving forward, helping residents understand the importance of the flood protection management system and individual resident's roles in keeping conveyance systems clear will continue to be integrated into public outreach and through enhanced social media. Additional instructional videos will be produced to inform residents on flood protection measures in general. Public engagement on the Dike Master Plan Phase 4 will be expanded to obtain input on the best methods to share this type of information.

The event showed that some improvements could be made to the Public Works call management system to handle extremely high call volumes. Staff have implemented measures to allow for rapid call centre expansion to reduce queueing and delays in the future.

The benefits of providing the public with more information on the City's drainage and flood protection system was also identified. Moving forward, helping residents understand the importance of the drainage system and individual resident's roles in keeping the system clear will continue to be integrated into public outreach and through enhanced social media. Additional instructional videos will be produced to inform residents on flood protection measures in general. Public engagement on the Dike Master Plan Phase 4 will be expanded to obtain input on the best methods to share this type of information.

*Works Yard*

- *Fuel Supply*
  Storm events of this magnitude and the wide-scale impact caused throughout the region highlighted the level of reliance on suppliers and vendors, particularly for fuel supply. The Works Yard serves as the fuel supply hub for all the City's various business units plus Richmond Fire Rescue, RCMP and the Richmond School Board. There are seven fire halls that also have on site diesel fuel tanks. Total fuel capacity at the Works Yard is 67,570 litres, inclusive of gasoline, diesel and propane. Fire halls have a total of 37,259 litres of diesel fuel capacity.

  In a major event, it is expected that normal supply chains may be impacted. While the City's primary fuel supply continued uninterrupted, mobile fueling for off-site generators was impacted. To manage these issues, staff will work with our primary fuel vendor to ensure back-up sources in the event of supply chain disruptions. Staff will also identify

additional portable fuel capacity and fuel pump upgrade requirements necessary to ensure robustness of the current fueling station for future funding consideration.

The City's in-ground fuel tanks are also subject to potential impacts from storm water infiltration which would hinder the City's ability to respond to a major event.

- *Other Municipalities*
  Staff note that the Works Yard sites for some other municipalities in BC were flooded and this severely impacted their response capability.

The City's ability to respond to future events is dependent on having supporting infrastructure that is resilient enough to withstand the event. Many of the resources deployed in response to the event are based out of the Works Yard. Although the Works Yard performed well during this event, the site is below the current Flood Construction Level and should be raised as identified in the Flood Protection Management Strategy.

The overall resiliency of the Works Yard, Fire Halls and other City facilities needs to be continually assessed to ensure that they can withstand the expected increasing severity of future substantial weather events.

*Emergency Response / Emergency Operations Centre (EOC) / Emergency Management BC*

- *Departmental Operations Centre*
  Staff response was co-ordinated interdepartmentally through a departmental operations centre at the Public Works Administration Building. Public Works, Parks and Engineering resources were managed at the departmental level. During the event, the need to activate the Emergency Operations Centre and access provincial resources was continually assessed and was ultimately not required.

  The City also responded to and provided resources to assist with the Metro Vancouver sanitary sewer failure at Gilbert and Blundell, and offered assistance to MOTI and their contractor for the flooding on Highway 99.

The severity of events elsewhere in the province caused Emergency Management BC, Metro Vancouver and a number of other municipalities to activate their EOCs. During the event, staff experienced communication delays from external agencies when seeking updates and information on issues such as the Metro Vancouver sanitary sewer failure and the flooding on Highway 99 with MOTI.

This event highlighted the degree to which there can be impacts caused by the failure of infrastructure located in the City, but under the jurisdiction of other agencies and, hence, outside of the City's direct management and control. Staff regularly work with these partner agencies to ensure their maintenance standards and/or response actions are sound and timely to reduce impacts to City-owned infrastructure and private property. However, during large scale events such as this, the partner agencies may be dealing with multiple issues of equal or much greater severity throughout the region, resulting in Richmond specific issues being prioritized accordingly. In cases like this, inter-agency communication is key so that the public can be kept properly informed.

Staff are currently in the process of reviewing and updating the City's Emergency Response Plans. A fundamental component of these plans will be inter-agency communication and collaboration. As the severity and frequency of extreme weather events is forecasted to continue to increase, adopting a comprehensive approach to address these issues will enhance the City's response capability.

In response to the atmospheric river, Metro Vancouver has created a Flood Resiliency Task Force to provide advice and recommendations to the Metro Vancouver Board and to the Board members appointed to the Leadership Committee of the Lower Mainland Flood Management Strategy on issues related to flood resiliency. Should the opportunity arise, staff will provide comments consistent with Council's adopted position on the Lower Mainland Flood Management Strategy, as well as comments relating to improved communication protocols during emergency events.

Metro Vancouver is looking at renewal of the Public Works Mutual Aid Agreement for Major Emergencies. This agreement lays out the terms under which cities who agree to join will share public works related resources with other impacted local authorities. Support would be limited to situations where a local authority's response capabilities are exceeded, and other local authorities who are parties to the agreement are able to provide needed support. Resources could include equipment, personnel and facilities. Richmond is a party to the existing agreement, which was developed in 2000. An updated agreement is nearing completion and staff expect to be in a position to bring the agreement forward to Council for consideration in the second quarter of 2022.

## Financial Impact

None at this time. Staff are evaluating the current resources available for responding to events such as this and will prepare budget submissions for Council's consideration accordingly.

## Conclusion

The November 2021 atmospheric river events caused major flooding and damage throughout the Province. In comparison, Richmond's long term planning and investment in critical infrastructure resulted in much less damage and flooding than in other areas of the region. The City's Flood Protection Management Strategy, Integrated Rainwater Resource Management Strategy, and Dike Master Plan will continue to be updated as climate change science evolves to ensure that residents and businesses remain protected.

Suzanne Bycraft
Director, Public Works Operations
(604-233-3338)

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