City of Richmond

# Report to Committee

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| **To:** | Public Works and Transportation Committee | **Date:** | November 30, 2018 |
| **From:** | John Irving, P.Eng. MPA<br>Director, Engineering | **File:** | 10-6060-01/2018-Vol 01 |
| **Re:** | **Dike Master Plan – Phases 3 and 5** | | |

## Staff Recommendation

That the public and key external stakeholders be consulted as identified in the staff report titled "Dike Master Plan – Phases 3 and 5" from the Director, Engineering, dated November 30, 2018.

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

Att. 2

| REPORT CONCURRENCE | | |
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| **ROUTED TO:** | **CONCURRENCE** | **CONCURRENCE OF GENERAL MANAGER** |
| Parks Services | ☑ | |
| Roads & Construction | ☑ | |
| Real Estate Services | ☑ | |
| Sewer & Drainage | ☑ | |
| Development Applications | ☑ | |
| Policy Planning | ☑ | |
| Transportation | ☑ | |
| **REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE** | **INITIALS:** CJ | **APPROVED BY CAO** |

## Staff Report

### Origin

The Council endorsed 2008 – 2031 Richmond Flood Protection Strategy identified the need to prepare and implement a comprehensive dike improvement program. Dike Master Plan Phase 1, adopted by Council on April 22, 2013, focussed on Steveston and a portion of the West Dike south of Williams Road. Dike Master Plan Phase 2, adopted by Council on April 23, 2018 focussed on the north portion of Richmond's west dike between Williams Road and Terra Nova Rural Park and part of Richmond's north dike between Terra Nova Rural Park and No. 6 Road. Preparation of Dike Master Plan Phase 4, focusing on the North Dike between No. 6 Road and Boundary Road, is underway and will be brought forward to Council in early 2019.

This staff report presents the recommended dike upgrading concepts that are required to address climate change induced sea level rise along the following dike reaches:

- Dike Master Plan Phase 3
  - South dike between No. 2 Road and Boundary Road
- Dike Master Plan Phase 5
  - Sea Island between the Sea Island Connector Bridge to the south end of 3800 Cessna Drive, Mitchell Island and Richmond Island

On October 24, 2016, Council endorsed the City's submission to the National Disaster Mitigation Program requesting funding for Dike Master Plan Phase 3. The project was approved and is 100% funded through the grant to a maximum of $250,000. The funding deadline for completion of Dike Master Plan Phase 3 is March 31, 2019.

On December 11, 2017, Council approved $200,000 through the 2018 Capital Budget to prepare Dike Master Plan Phase 5 which was subsequently approved to be 100% funded by the Province of British Columbia through the 2017 Flood Risk Assessment, Flood Mapping & Flood Mitigation Planning Program. The funding deadline for completion of Dike Master Plan Phase 5 is March 31, 2019.

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.*
>
> *6.1. Safe and sustainable infrastructure.*

The purpose of this staff report is to present the recommended dike upgrading concepts to address climate change induced sea level rise for the reaches described in Dike Master Plan Phases 3 and 5 and seek Council's endorsement to engage the public and key stakeholders for feedback on the proposed concepts.

## Analysis

### Background

The City of Richmond is approximately 1.0 meter above mean sea level and protected by 49 kilometers of dike on Lulu Island, 1.1 kilometers of dike on Sea Island and 3.5 kilometers of flood protection structural works on Mitchell Island. Climate change scientists estimate that sea level will rise approximately 1.0 meters by the year 2100 and 0.2 meters of land subsidence is forecast during that same time period, for a combined 1.2 meters of relative sea level rise. The 2008 – 2031 Richmond Flood Protection Strategy identifies the perimeter dike system as the primary flood protection system to protect against climate change induced sea level rise. The City's target dike elevation for 2100 is 4.7 meters geodetic west of Nelson Road and increases linearly from 4.7 meters geodetic to 5.0 meters geodetic between Nelson Road and Boundary Road. All new dikes are designed for a further height increase of 0.8 meters to address sea level rise beyond 2100.

Dike improvements are ongoing through the Council approved Capital Program and through development partnerships. Climate change forecasts have a high degree of variability in terms of timing and magnitude of sea level rise; the current forecasts indicate that dike raising will need to be completed in the next 25 to 75 years. This range will be refined over time as sea level rise is realized and climate change forecasts converge. Staff will continue to monitor actual sea level rise and climate change forecasts and report significant updates to Council as required.

The Dike Master Plan is intended to be a comprehensive guide to upgrade the City's dikes to:

- Protect Richmond from both storm surges and Fraser River freshet events;
- Adapt to sea level rise;
- Be seismically resilient;
- Integrate the Ecological Network Management Strategy principles and goals;
- Follow the five strategic directions of the City's 2009 Waterfront Strategy (Working Together, Amenities and Legacy, Thriving Eco-Systems and Community, Economic Vitality, Responding to Climate Change and Natural Hazards); and
- Prioritize dike improvement phasing to efficiently use resources.

Dike Master Plan Phase 1 and Phase 2 have been adopted by Council; preparation of Dike Master Plan Phase 4 is underway. Figure 1 shows the study areas of Dike Master Plan Phases 3 and 5 as described below:

- Dike Master Plan Phase 3
  - South dike between No. 2 Road and Boundary Road
- Dike Master Plan Phase 5
  - Sea Island from the Sea Island Connector Bridge to the south end of 3800 Cessna Drive, Mitchell Island and Richmond Island.

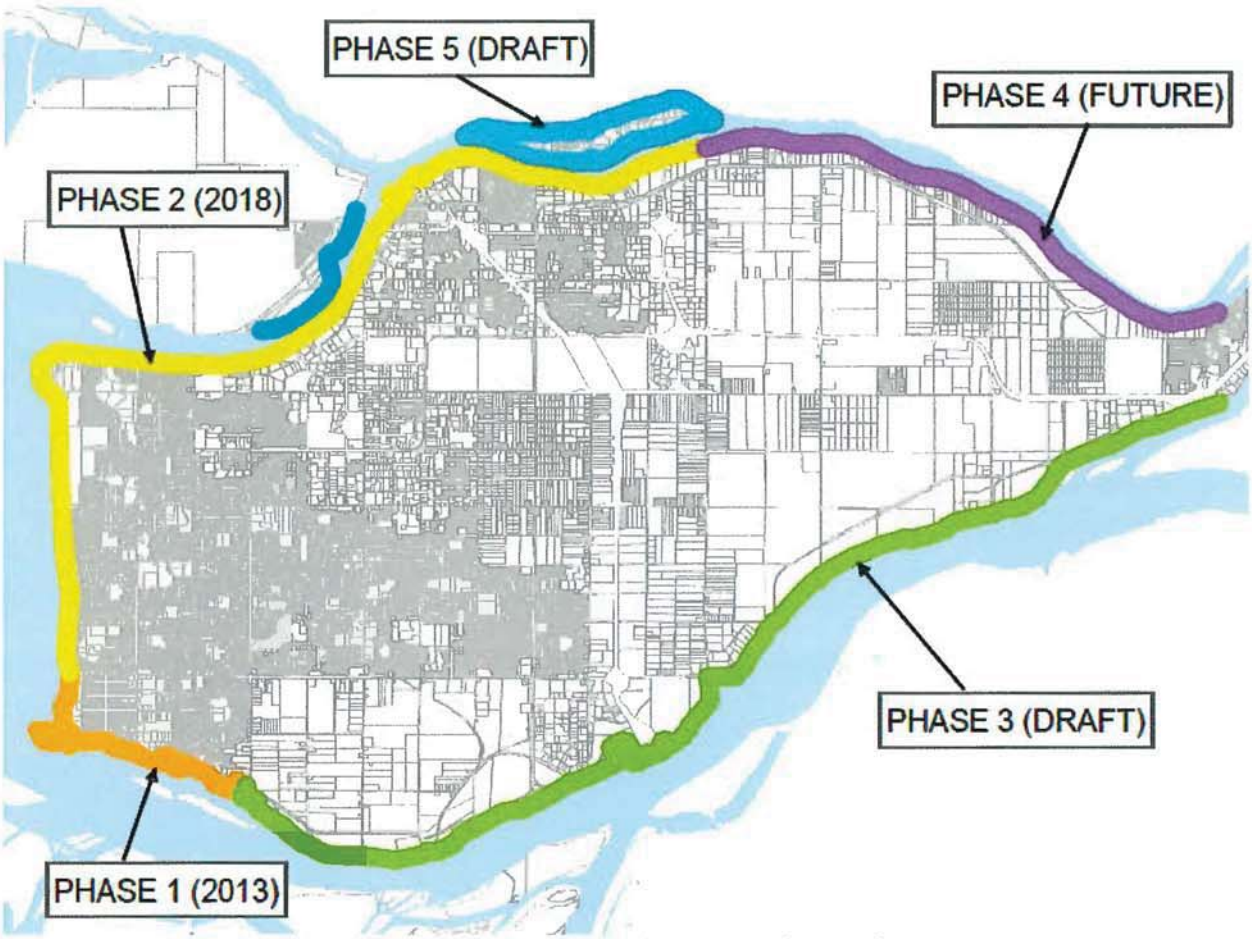



Figure 1: Dike Master Plan Phases 3 and 5 Study Areas

The City engaged Kerr Wood Leidal (KWL) as the lead consultant to complete Dike Master Plan Phases 3 and 5 (Attachments 1 and 2). In order to meet grant funding conditions, the final report for Dike Master Plan Phase 3 is due to the Province of British Columbia and Public Safety Canada no later than March 31, 2019. Similarly, the final report for Dike Master Plan Phase 5 is due to the Province of British Columbia through the Union of BC Municipalities (UBCM) on March 31, 2019 to meet grant funding conditions.

## Typical Dike Upgrade Options

The Dike Master Plan recommends diking improvements based on a number of factors including adjacent land use, available land for diking, environmental conditions, and potential amenity improvements. Dike configurations generally fall within 3 categories: dike with roadway, dike with development or planned development, and standard dike (no roadway). The following are typical dike upgrade concepts recommended in Dike Master Plan Phases 3 and 5.

### *Separated Dike and Road*

There are a significant number of dike reaches on Lulu Island where a roadway is currently situated on top of the dike. Staff generally recommend separating the road from the dike as an objective of the dike upgrading program identified in Dike Master Plan Phases 3 and 5 (Figure 2). This option relocates the road from the top of the dike to a location inland, adjacent to the dike.

Road elevations can be adjusted to facilitate access to adjacent properties or be at a similar elevation as the improved dike, which would provide additional stability for the dike.

Advantages to this option include:

- improved dike stability;
- the ability to develop the new road in advance of upgrading the dike, which significantly lowers the impact to vehicle traffic during construction;
- allows for future dike upgrading without impacting the road;
- the ability to adjust road elevation to facilitate access to existing adjacent properties;
- an opportunity to separate cyclists and pedestrians from roadway traffic;
- aligns with the 2010 Richmond Trail Strategy; and
- removal of utilities from the dike core for improved dike reliability.

Disadvantages to this option include:

- higher capital cost; and
- larger land requirement.

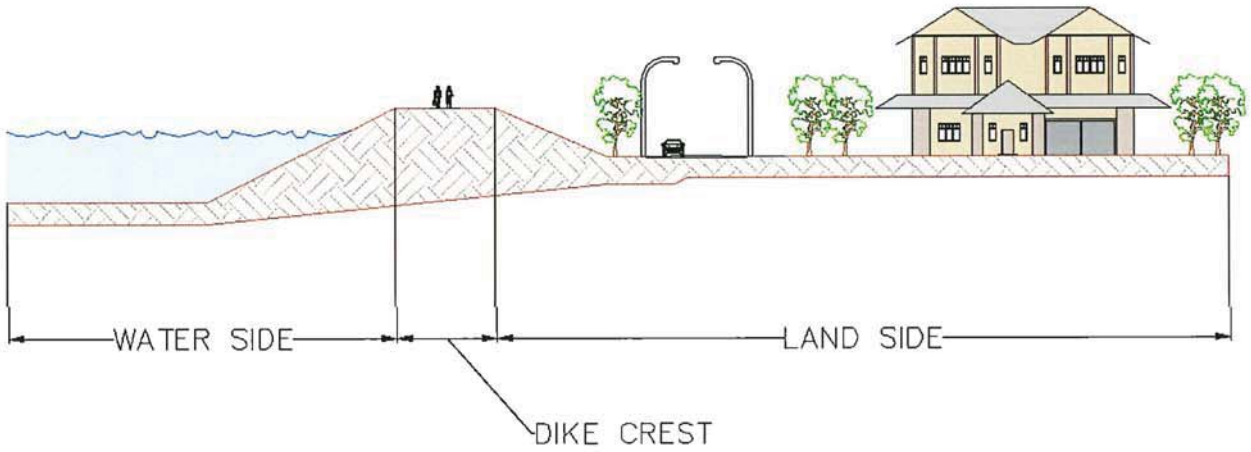



Figure 2: Separated Dike and Road

*Superdike*

Superdikes are dikes where the land behind the dike is built up to the same elevation as the dike. The City has been successful in implementing superdikes through development and superdikes are recommended where land adjacent to the dike is likely to re-develop.

Advantages to this option include:

- robust and wide dike crests;
- multi-functional landscapes that can be tailored to area requirements including industrial, multi-family, and commercial developments;
- can accommodate separated road and dike;

- aligns with the 2010 Richmond Trail Strategy;
- lower impact and fewer visual obstructions to development when implementing future dike upgrades; and
- reduced grading issues.

Disadvantages to this option include:

- requires significant design and planning to customize for each eligible site; and
- dike upgrades need to be timed with development and lease agreements for eligible properties.

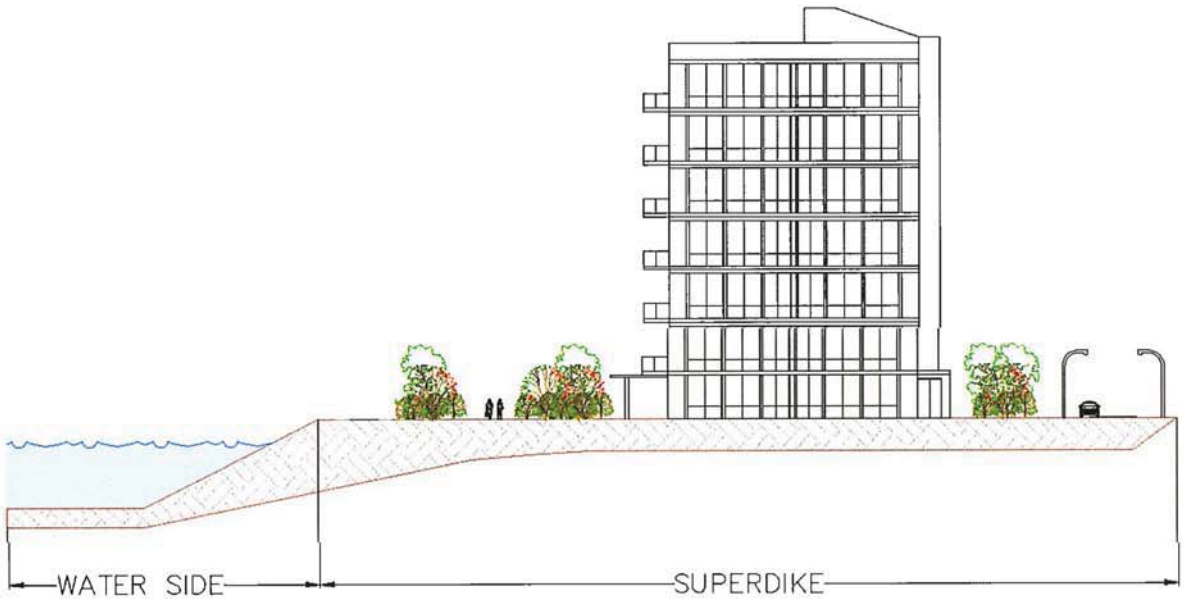



Figure 3: Superdike

*Standard Dike*

This concept is recommended where there is no road on top of the dike. A standard dike raises the dike crest to design elevation and extends the footprint to either the land side or water side. Standard dikes can incorporate multi-use pathways and green space.

Advantages of this option are:

- lowest site preparation and installation cost compared to other long term options;
- established construction procedures with City crews who are familiar with the work;
- easiest to repair due to the lightest infrastructure footprint and land usage out of the recommended long term options; and
- aligns with the 2010 Richmond Trail Strategy.

Disadvantages of this option are:

- limited development and construction options on the dike; and
- larger grade differences adjacent to the dike when upgrades occur.

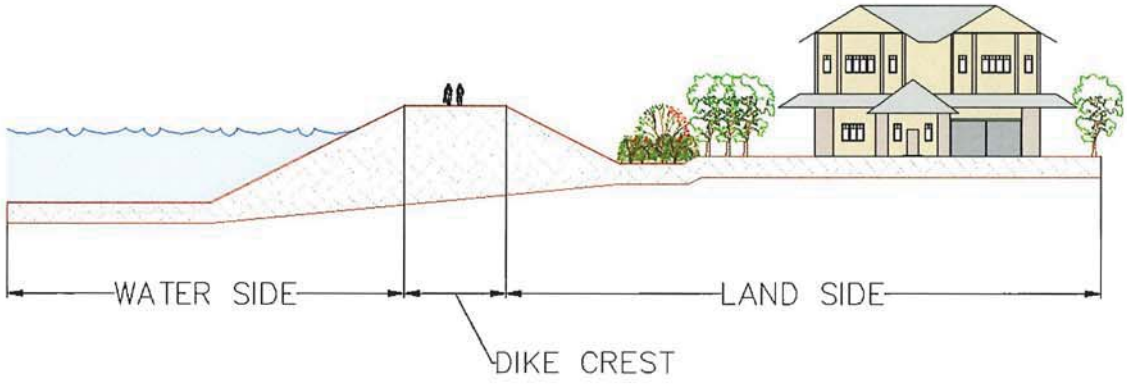



Figure 4: Standard Dike

*Interim Dike Upgrade*

Interim dike upgrade options are considered in areas where there is not enough space (due to existing land use) to build one of the other options listed above. They are intended to function as medium term temporary measures until land becomes available or re-development occurs. The two interim options include setback sheet pile walls (Figure 5) and riverside sheet pile walls (Figure 6).

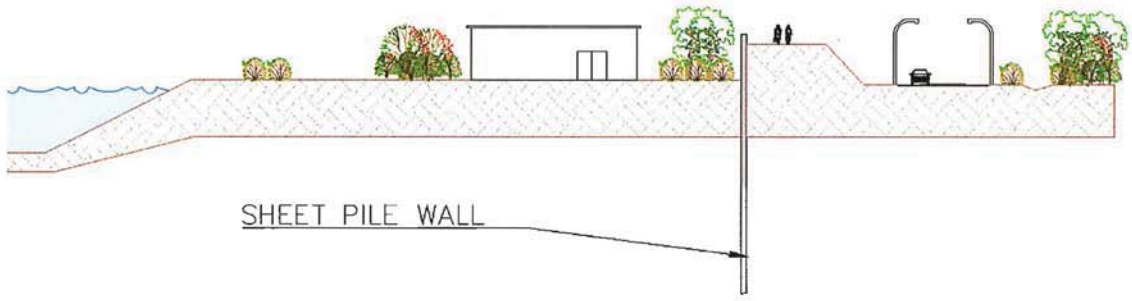



Figure 5: Setback Sheet Pile Wall

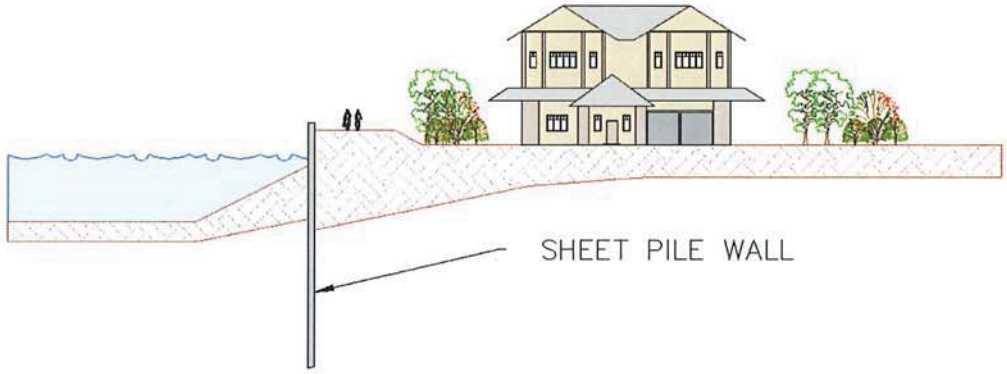



Figure 6: Riverside Sheet Pile Wall

Dike Master Plan Phase 3

The Dike Master Plan Phase 3 study area is from No. 2 Road to Boundary Road along Richmond's south dike. Land use adjacent to the dike in Phase 3 includes single and multi-family residential, industrial and agricultural. There are marine-based industries along the Phase 3 study area that either require access to the river over the dike or may be outside of the City's dike. The adjacent land use in the Phase 3 study area is:

- residential from No. 2 Road to Gilbert Road;
- parks and agricultural land from Gilbert Road to No. 5 Road; and
- industrial from No. 5 Road to Boundary Road.

Staff recommends a separated dike and road from No. 2 Road to Highway 99 and from Graybar Road to Boundary Road as these segments are currently road on dike. The separated dike and road will facilitate improved traffic safety for motorists, cyclists and pedestrians along these sections.

Between Highway 99 and Graybar Road, there are a number of sites that require specific, non-standard strategies. These locations and the recommended strategies are outlined in Table 1below.

**Table 1: Phase 3 Non-Standard Reaches**

| Location | Interim and Long-Term Dike Upgrade Solution |
|---|---|
| Crown Packaging | The recommended interim dike upgrade solution is a combination of earth dike and sheet pile walls that allow continued operation of the current business. Crown Packaging's lease on the property expires in 2035 and the site will likely re-develop at that time. Staff recommends pursuing a superdike as part of future re-development. A separate Report to Council on this matter is forthcoming. |
| Finn Slough | There are a number of buildings on and outside of the dike at Finn Slough. The recommended interim dike upgrade solution is to build a sheet pile wall along the south edge of the dike crest, parking on the land side of the dike and pedestrian access to Finn Slough. |
| Mainland Sand and Gravel | Mainland Sand and Gravel have an agreement with the City to maintain a given elevation of material on their property to provide flood protection. The City will set higher elevations for this site ahead of sea level rise and require Mainland Sand and Gravel to achieve those elevations through the current agreement. Should Mainland Sand and Gravel cease operation or refuse to improve the site when requested, a standard dike with a 4.7 m crest elevation will be built in the City's existing road dedication. |
| Deas Dock (BC Ferries) | Staff have been working with BC Ferries on their long-term redevelopment strategy which includes a flood protection strategy. |

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| George Massey Tunnel | The George Massey Tunnel Replacement project is on hold with an announcement expected before the end of 2018. Staff will continue to work with the Ministry of Transportation and Infrastructure to ensure future dike improvements are consistent with the future George Massey Tunnel transportation solution. |
| Canadian Fishing Company | The interim dike upgrade solution is to build a dike using a setback sheet pile wall. This will allow the property to maintain business operations and use of their docking facility. The long-term diking solution here is to raise the property through redevelopment and build a superdike. |
| Fraser Wharves (Port of Vancouver) | The property is an active works yard and barge facility. The dike is located in an active port facility and has restricted maintenance access. The dike will be raised through redevelopment. |
| Lafarge | The City is actively working with Lafarge to coordinate dike upgrades fronting the property. In 2018, City crews performed maintenance activity along approximately 600 meters of dike fronting Lafarge. City crews will be raising the dike along this same stretch by 1.3 meters in 2019. |

## Dike Master Plan Phase 5

The Dike Master Plan Phase 5 study area includes Sea Island from the Sea Island Connector Bridge to the south end of 3800 Cessna Drive, Mitchell Island and Richmond Island. Each of these islands has distinctly different diking issues and are individually addressed below.

### *Sea Island*

The City shares flood protection responsibility on Sea Island with the Vancouver Airport Authority. The City's is responsible for the dike on the eastern edge of Sea Island between BCIT (3800 Cessna Drive) and the Airport Connector Bridge.

The dike adjacent to the Pacific Autism Centre at 3600 Lysander Lane was improved to the 4.7 m geodetic standard through a recent development, and the dike adjacent to the BCIT Aerospace Campus was upgraded to 4.0 m through development.

A standard dike upgrade is recommended for the majority of dikes on Sea Island as there is enough space for this option on the land side. The dike adjacent to the Pacific Gateway Hotel is an exception, given the existing hotel's location and connection to a marina. The recommended interim solution for the hotel frontage is a sheet pile wall that will be in place until such time as the hotel re-develops, with a superdike to be secured should the hotel re-develop.

The Moray Bridge deck is below the recommended 4.7 m geodetic dike level and will need to be considered as part of the dike raising program. The bridge belongs to the Ministry of Transportation and it is recommended that the City pursue replacement of this bridge with the ministry.

*Mitchell Island*

Ground level on Mitchell Island is currently above typical King Tide/storm surge high water levels (2.2 m geodetic) and does not currently have a protective dike. However, there are a number of properties on the island that are below the City's flood elevation level (3.5 m geodetic) and are prone to flooding during long return period high water level events.

Development of a standard dike on Mitchell Island would require significant land acquisition around the perimeter of the island, which would significantly reduce the amount of property available for industrial or commercial utilization. Additionally, most of the properties are water front properties and some businesses on Mitchell Island use the waterfront to support their business activities. Separating these businesses from the water could be detrimental to their economic activity.

Given the type of activity on Mitchell Island, the size of the island and the current lack of a protective dike, staff's recommended Mitchell Island climate change induced sea level rise adaptation program includes raising Mitchell Island to 4.7 m geodetic and acquiring right of ways that will facilitate a future dike to 5.5 m geodetic through re-development. The current flood construction level required by Bylaw 8204 for Mitchell Island is 4.35 m geodetic. Should Council endorse Dike Master Plan Phase 5, staff will bring forward an amendment bylaw that updates this level to 4.7 m geodetic. Staff further recommends maintaining the roadways on Mitchell Island at an elevation that is above the flood plain and maintaining access to all of the properties on the island regardless of the state of re-development of each individual property.

*Richmond Island*

Richmond Island is above the City's current and 100 year flood elevation of 4.7 m. The island is a single lot owed by North Fraser Terminals Inc. and leased to Milltown Marina & Boatyard Ltd. There is a registered covenant on title that acknowledges the risk of flooding and erosion on Richmond Island, identifies that the City has no plans to protect the island from flood and erosion and releases the City from any damage or losses caused by flooding or erosion.

Land Acquisition

There are a number of areas where the existing dike corridor is confined on both sides by private property and will likely require land acquisition to facilitate dike raising. Land acquisition will primarily be achieved through re-development, however, where re-development does not occur; Staff will recommend strategic land purchases to advance the necessary flood protection measures. The Dike Maintenance Act allows the City, through the Provincial Inspector of Dikes, to access the entire dike protecting Lulu Island for the purpose of dike maintenance or improvement, regardless of land ownership. However, long term strategic acquisition of land and cooperative work with the development community will reduce the impact of dike improvements on the community as compared to reliance on the Dike Maintenance Act.

Public Consultation - Next Steps

Staff recommend consultation with key external stakeholders and the public on the preferred diking upgrade concepts in the Phases 3 and 5 study areas. Key stakeholders include:

- Adjacent residences and the general public
- Agricultural Advisory Committee
- CN Rail
- Environment Canada
- Port of Vancouver
- Department of Fisheries and Oceans
- BC Inspector of Dikes
- Advisory Committee on the Environment
- Urban Development Institute
- Lafarge
- BC Ferries
- Ministry of Transportation and Infrastructure
- City of New Westminster
- Crown Packaging
- Canadian Fishing Company
- Finn Slough Heritage & Wetland Society
- Mitchell Island Businesses
- Vancouver Airport Authority
- Milltown Marina
- Translink
- City of Vancouver
- Sea Island Community Association

The key external stakeholder group will be engaged through ongoing meetings, social media, and LetsTalkRichmond.ca. Public consultation will include two public open houses. The results of external stakeholder consultation and any updates to Dike Master Plan Phases 3 and 5 will be presented to Council in a subsequent report for Council's consideration.

Flood Protection Financing

The City has three basic sources for funding the implementation of the Dike Master Plan:

- The Drainage and Diking Utility;
- Senior government grant funding; and
- Development.

The City's Drainage and Diking Utility currently dedicates $11.9 million per year for drainage and diking improvements. Staff will continue to assess utility funding requirements through ageing infrastructure studies and the utility rates budgeting process and provide recommendations to Council for consideration on an annual basis.

The 2008-2031 Richmond Flood Protection Strategy indicates that the City should pursue a minimum of 50% funding for dike raising from senior government to assist with this program. The

City has successfully secured over $18 million in senior government grants in the last three years for drainage and diking improvements. Staff will continue to pursue senior government grants as they become available.

The City has successfully partnered with a number of developments to build superdikes. Staff estimates that up to 20% of Dike Master Plan implementation will be completed through development.

### Financial Impact

Project costs will be presented for Council consideration as individual initiatives and programs through the annual budget process. Funding for this program will be dependent on how quickly climate change induced sea level rise occurs through the year 2100.

### Conclusion

Consistent with the City's 2008 – 2031 Richmond Flood Protection Strategy, Phases 3 and 5 of Dike Master Plans has been drafted to address climate change induced sea level rise. Dike Master Plan Phases 3 and 5 present the City's preferred dike upgrade concepts for:

- the south dike from No. 2 Road to Boundary Road;
- Sea Island from the Sea Island Connector Bridge to the south end of 3800 Cessna Drive;
- Mitchell Island; and
- Richmond Island.

Staff request Council's endorsement to consult public and external stakeholders regarding the recommended dike upgrading concepts and obtain their feedback. Feedback will be utilized to update and finalize the Dike Master Plans, which will subsequently be presented to Council for consideration.

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BN:cc

Att. 1: Dike Master Plan – Phase 3 Draft
Att. 2: Dike Master Plan – Phase 5 Draft