



# City of Richmond

## Report to Committee

**To:** Public Works and Transportation Committee

**From:** Milton Chan, P.Eng.  
Acting Director, Engineering

**Re:** **Steveston Island Flood Protection Update**

**Date:** May 17, 2019

**File:** 10-6060-04-01/2019-  
Vol 01

### Staff Recommendation

That the staff report titled “Steveston Island Flood Protection Update”, dated May 17, 2019 from the Acting Director, Engineering, be received for information.

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

Att. 1

REPORT CONCURRENCE		
<b>ROUTED TO:</b>	<b>CONCURRENCE</b>	<b>CONCURRENCE OF GENERAL MANAGER</b>
Real Estate Services	<input checked="" type="checkbox"/>	
Parks Services	<input checked="" type="checkbox"/>	
Roads & Construction	<input checked="" type="checkbox"/>	
Sustainability	<input checked="" type="checkbox"/>	
<b>REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE</b>	<b>INITIALS:</b> 	<b>APPROVED BY CAO</b> 

## Staff Report

### Background

This report provides an update to Council on the status of dike planning along the dike alignment that utilizes Steveston Island.

It is projected that sea levels will rise approximately 1.0m and the City will subside by 0.2m by the year 2100. To maintain a high level of flood protection for the City, Richmond's flood protection system needs to be proactively planned and improved.

At the April 22, 2013 Regular Council Meeting, Council endorsed the work plan contained in the staff report titled "Dike Master Plan – Phase 1 Report". The Dike Master Plan Phase 1 report assessed and recommended flood protection measures for the west dike south of Williams Road and the south dike from Garry Point Park to No. 2 Road. Phase 1 identified a new dike on Steveston Island with structures and gates to enclose Steveston Harbour as the recommended long-term solution for flood protection in the Steveston area. The west dike portion of the Phase 1 assessment was recommended to maintain its current alignment with raising of the dike to a 4.7m dike crest elevation.

Subsequently, staff pursued the recommendations from Phase 1 to further develop the Steveston Island dike concept per the Council endorsed work plan (Attachment 1). In 2017, the City was awarded \$1.2 million through the National Disaster Mitigation Program to complete the Steveston Island Flood Risk Investigation, which includes geotechnical testing, sea gate concept evaluation, and updates to the Phase 1 report. The findings from this investigation are outlined in this staff report.

### Analysis

#### Project Site – Steveston

From a small fishing village, Steveston rapidly expanded in the early 1900's as workers came for jobs in the booming fishing industry. Today, Steveston is home to a vibrant community with famous historical buildings, rich cultural history, and an operating port with over 500 commercial fishing vessels. Harbour facilities are located at two distinct sites – the Gulf site and the Paramount site – managed by the Steveston Harbour Authority.

The current perimeter dike alignment runs through Steveston Village. Raising the dike on the current alignment would have major impacts to the existing properties, businesses, and infrastructure in the Steveston area. The Steveston Island dike alignment avoids many of these impacts. The proposed alignment also better supports future dike upgrades, provides more protection for the harbour, and is consistent with long term improvement plans from the Steveston Harbour Authority.

Figure 1 shows the general layout of the Steveston Island dike. The planned work area is primarily contained on Steveston Island and the Fraser River riverbed. This alignment ties into the existing dike at the eastern edge of Garry Point Park and at Dyke Road just east of London Heritage Farm.

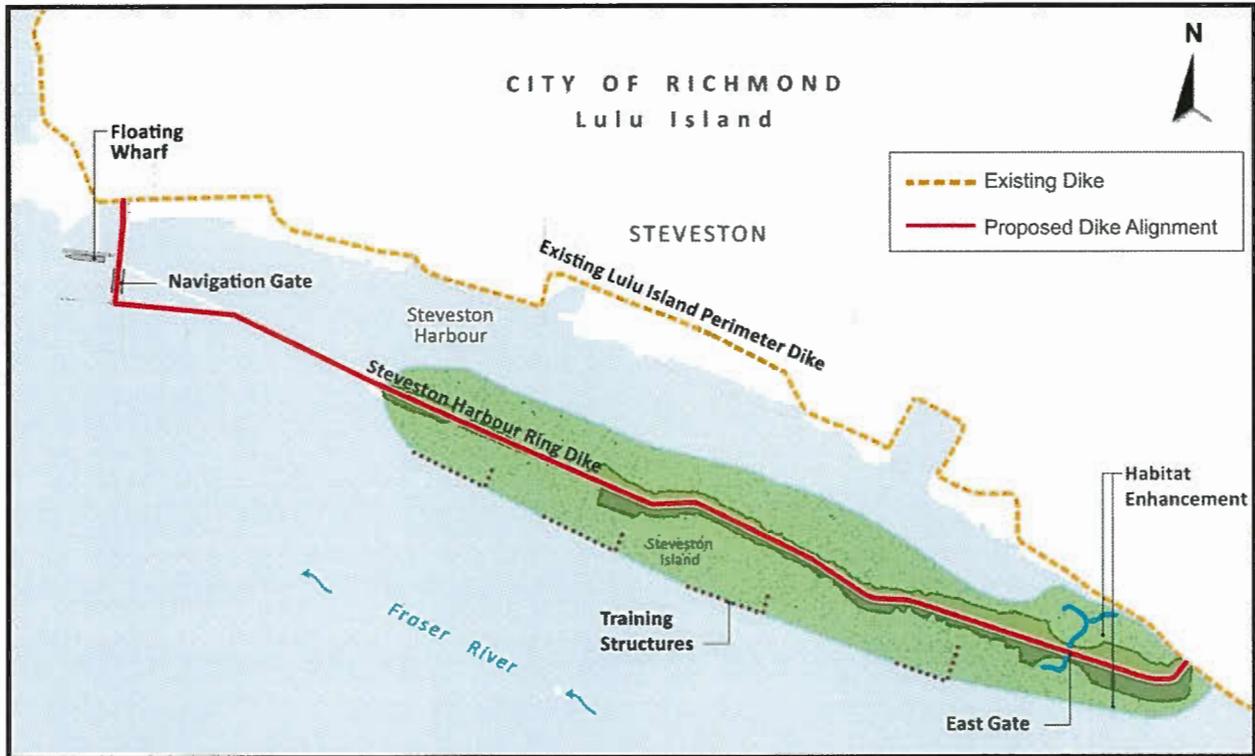


Figure 1. Conceptual Layout of Steveston Island Dike and Sea Gate

Flood Risk Assessment

With its location in the Fraser River, the primary flood risks for Steveston are related to climate change-induced sea level rise, storm surge, and post-seismic tidal events. Spring snowmelt freshets have a more significant effect on Lulu Island east of Nelson Road. Using the Provincially-adopted sea level rise guidelines, the City is preparing for 1.0m of sea level rise by year 2100 and 2.0m by year 2200. Storm surge, wind effects, and subsidence are further considerations for risk evaluation and are addressed as a part of the City’s Flood Protection Management Strategy and Dike Master Plans.

As recommended in Phase 1, implementing the Steveston Island dike and sea gate would provide relief from sea level rise and storm surge effects for Steveston. This would allow gradual improvements and land raising in Steveston, which could be phased with development to minimize disruption to the existing businesses, heritage and infrastructure.

The proposed Steveston Island dike and sea gate concept will be designed to meet the Provincial flood elevation guidelines and the BC Building Code where applicable.

Steveston Island Dike and Sea Gate Concept

The Steveston Island dike and sea gate concept is based on the recommended dike alignment from Dike Master Plan Phase 1, endorsed by Council. Staff have completed geotechnical investigations, expert consultation, stakeholder engagements, and concept review to develop the recommended concept plan. The primary objectives of the Steveston Island dike concept are:

- Flood Safety – decrease the risk of flooding in Steveston (and the rest of Richmond) from extreme ocean tide and storm surge water levels, with consideration for sea level rise;
- Harbour Operations – provide safe harbour and expanded moorage for the fishing fleet while improving traffic flow in and out of the harbour;
- Environment – protect and enhance important riparian and aquatic habitat while maintaining or improving water quality within the harbour; and
- Parks / Public Amenities / Events – provide opportunities for public education on flood protection and encourage meaningful engagement between the public and natural habitat.

The Steveston Island dike and sea gate concept can be considered in three primary components: the Navigation Sea Gate (West), Steveston Island earth-filled dike and sheet pile wall, and the East Gate. Each component of the concept contributes toward the objectives listed above and are outlined in this report.

#### Navigation Sea Gate (West)

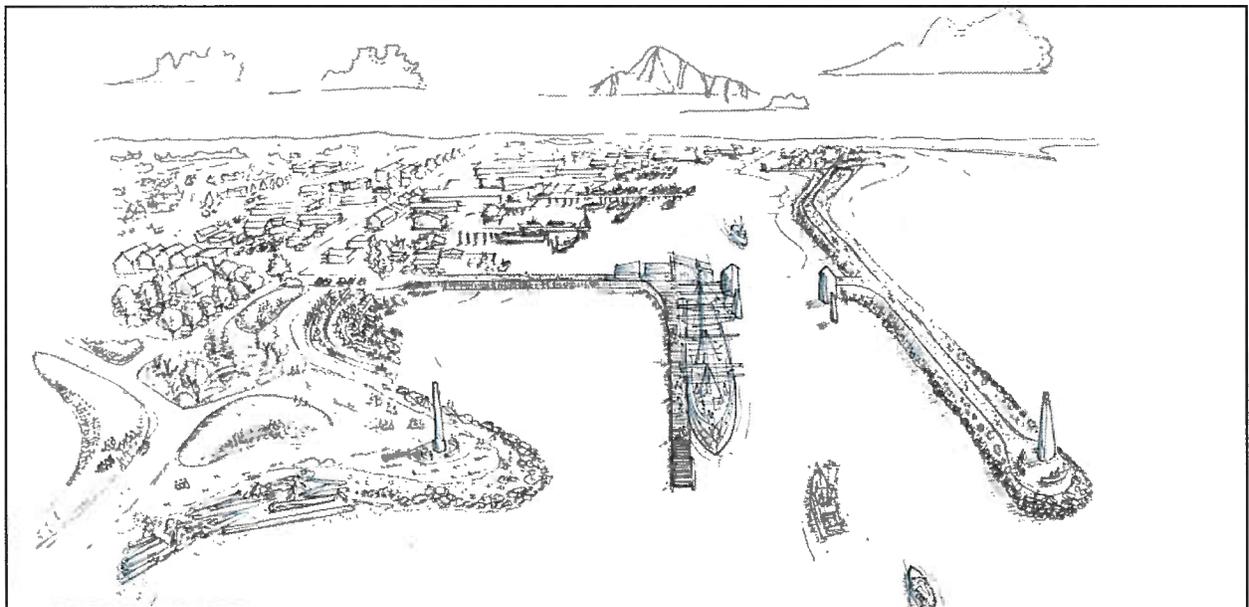


Figure 2. Artistic Perspective of the Navigation Sea Gate (Looking East)

The Navigation Sea Gate concept was developed based on an assessment of current conditions, economic value and stakeholder requirements from groups including the Steveston Harbour Authority, the Port of Vancouver and Fisheries and Oceans Canada. The proposed type of gate for the Navigation Sea Gate is a horizontal axis sector gate, as shown in Figures 3 and 4. Level of protection from storm surge and high tide events would be determined during detailed design. Figure 3 shows the closed Navigation Sea Gate with an upper gate elevation of 5.5m to accommodate for anticipated sea level rise beyond the year 2100.



Figure 3. Closed Horizontal Axis Sector Gate (Looking West) Rendering

Similar gates have been used in applications such as the Thames Barrier in London, England.

Advantages of this type of gate include:

- No overhead structure to limit clearance for taller vessels;
- Can provide full draft within harbour at the gate entrance;
- Gate sits within a robust and rigid structure that can resist differential movement during an earthquake;
- Operated using a relatively simple single action hydraulic piston;
- Major components can be accessed without underwater equipment if necessary;
- Gate operation is not usually impacted by sedimentation; and
- Gate can be fully rotated out of the water for more extensive maintenance and inspection.

The structure consists of a steel gate attached to a circular section which is rotated vertically to close and down flat horizontally when the gate is opened. The gate opening would be approximately 50m wide to allow for two-lane ship traffic (or single-lane for the largest vessel, a dredger, that uses the channel) to access the harbour.

A causeway would extend from the existing Lulu Island perimeter dike in Garry Point Park to the north side of the gate structure. The causeway would provide pedestrian and vehicular traffic access to the sea gate, and could be raised in the future to accommodate further sea level rise.



Figure 4. Open Navigation Sea Gate Rendering (Looking East)

#### **Steveston Island Earth-Filled Dike and Sheet Pile Wall**

The earth-filled dike along the Steveston Island alignment is proposed to have a trapezoidal cross-section, similar to a conventional dike, and be resilient to seismic activity and seepage due to shallower side slopes and a wide dike core. Dredged material from the Fraser River could be used to construct the earth dike, providing greater economic viability, local sourcing of materials, and the potential for habitat enhancement. Dredged material could potentially be acquired through partnerships with agencies such as the Port of Vancouver.

A sheet pile wall would be used to connect the earth-filled dike to the navigation sea gate. A narrow footprint would be required to limit impact to navigation and river habitat. The sheet pile wall would generally follow the alignment of the existing Steveston Harbour breakwater and could be designed to allow pedestrian access.

Once land use rights-of-way are established, the next step of the recommended approach is to complete the design of the earth dike and east gate in coordination with the Steveston Harbour Authority and the Port of Vancouver. It may take several years to accumulate the required material so it is recommended that this work commence in advance of the other project phases.

## East Gate

The East Gate provides flushing and fish access which is beneficial for maintaining the health of the aquatic ecosystem in Steveston Harbour. For flood protection, the proposed concept is a stop-log type system with upper pedestrian and vehicle crossing that can be closed during high tide or storm surge events. The East Gate and related earthworks would be completed in the early phases of the project as they provide sediment control and construction access to Steveston Island.



Figure 8. Open East Gate Rendering (Looking North)

## Environmental Considerations and Public Programming

Preliminary design concepts for the Steveston Island Dike and Sea Gate Concept will affect the intertidal sand and mudflats in the area. Staff have identified potential enhancement opportunities within the project that may help to offset any construction-related impacts and support the environmental permitting process. Staff will continue to assess these opportunities through detailed assessment and work internally to secure all environmental permitting requirements based on the final design.

Public programming has not been evaluated in detail. Coordination with the City's Parks department, stakeholders and the public will further inform the layout and desired amenities on Steveston Island. The current concept includes optimized space for public events, trails, and viewpoints. The 2022 Parks and Open Space Strategy as well as the 2009 Waterfront Strategy will be used as guides during all parts of the project.

### **Estimated Project Costs**

The high-level estimated cost of the Steveston Island dike and sea gate project, excluding programming and public art, is approximately \$170 million to be incurred progressively in established project phases. The estimated cost to raise the dike in Steveston along the existing alignment through the village is similar, but would result in major disruptions to existing properties, commercial and heritage buildings, and infrastructure in Steveston. It would also potentially impact the character of the existing waterfront area.

The currently estimated costs are significantly higher than the preliminary \$55 million estimated in 2013. The main reasons for the increased estimate are increased seismic mitigation and regulatory requirements, along with significant increases in construction costs due to market conditions. As the design progresses and market conditions continue to evolve, the cost estimates will be further refined.

### **Next Steps**

Per the Council endorsed work plan, staff will complete further assessments to negotiate land use and rights-of-way on Steveston Island, continue design work in preparation for concept implementation, and work with key stakeholders to establish strategic partnerships that can be leveraged to reduce construction costs and seek funding from senior government.

The Steveston Island dike and sea gate project is a long-term initiative and has a multi-decade timeline for implementation. Advance planning and proactive engagement of stakeholders allows the City to strategically implement this upgrade through grants and partnerships, and accelerate the construction schedule should funding opportunities or changes in climate change science arise.

### **Financial Impact**

None.

Capital projects will be brought forward for Council consideration as part of the Capital Budget process. Staff will also continue to pursue funding from senior government to support the City's dike raising efforts.

**Conclusion**

Staff have completed concept assessments with the assistance of experts in geology, climate change, and flood protection. The design concept outlined in this staff report includes a navigation sea gate, sheet pile and island earth-filled dike, and a stop-log access gate as core components. Staff are continuing to implement the work plan from Dike Master Plan Phase 1.



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JH: cc

Att. 1: Dike Master Plan Phase 1 Work Plan (Southern West Dike and Steveston Dike)

Dike Master Plan Phase 1 Work Plan (Southern West Dike and Steveston Dike)

- a. Secure the land and rights to construct the Steveston Island Dike. This includes:
  - i. Apply to the Ministry of Forests Lands and Natural Resource Operations for an Investigative License to identify land management jurisdictions and to permit geotechnical or other investigations. This may require a new survey to confirm boundaries and jurisdiction.
  - ii. Request for the Ministry to liaise with Federal Government Agencies (e.g. Port Metro Vancouver, Department of Fisheries and Oceans/Small Craft Harbours, and Public Works Canada ) to process a Statutory Right of Way application.
  - iii. Liaise with First Nations group prior to Ministry investigations and associated consultations.
- b. Complete preliminary designs and related investigations to assist with securing the land and obtaining regulatory approvals. Work is expected to include:
  - i. A preliminary design that establishes the extent of land required for earth fill and related structures.
  - ii. A geotechnical investigation that defines the extent of soil improvements required, and therefore the extent of the land required.
  - iii. An environmental investigation to determine the impact and potential habitat improvements associated with creating additional intertidal and marsh areas along the proposed alignment. Approvals will be required from external agencies (e.g. DFO, MoE, PMV etc.).
  - iv. A hydraulic study to assess the impact on sedimentation patterns and water quality.
- c. Coordinate the design and construction of the Steveston Island dike with compatible Steveston Harbour Authority (SHA), City Parks, and Port Metro Vancouver (PMV) plans, including:
  - i. Coordinate with the Steveston Community Fishing Harbour development plan which includes narrowing the entrances to the harbour at both ends.
  - ii. Coordinate with Parks plans to create a sheltered space for the marine oriented public events like the Tall Ships Festival, and other improvements to the park and trail network.
  - iii. Work with PMV who are seeking environmental compensation and land reclamation opportunities similar to the intertidal habitat that may be created with the Steveston Island dike.

- iv. Seek opportunities to coordinate fill activities with adjacent PMV dredging operations.
  - v. Support PMV improvements to the Albion dike and other Roberts Bank structures and habitat creation that result in improved breakwater effects for Steveston.
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- d. Once the Steveston Island Dike alignment is secured, revise the dike standard behind the Steveston Island Dike to a consistent but relaxed standard that is more compatible with the surrounding property accesses. A 4.1m dike crest elevation is suggested as a starting point for discussion. This would be the current designated flood level of 2.9m plus a 1.2m allowance for sea level rise.
  - e. Continue to plan for construction of the Southern West Dike to a 4.7m crest elevation.
  - f. Develop a two dimensional wave and storm surge model for the Sturgeon Bank, to arrive at wave run-up estimates to confirm optimum barrier island configurations.
  - g. Confirm constructability of the barrier islands using dredge sand.
  - h. If justified by observed sea level rise, proceed with design and construction of offshore wave dissipation structures to minimize required onshore crest level increases.