

COASTAL ADAPTATION PLAN

FRASER RIVER FORESHORE

Final Report
December 2018

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Executive Summary

This report summarizes the outcomes of the first phase of the City of Vancouver's Coastal Adaptation Plan (CAP) – Fraser River Foreshore. One of the first programs of its kind in Canada, CAP is a multi-year undertaking to determine the risk, consequences, vulnerability, and adaptation opportunities of Vancouver to future sea level rise. The objectives of the first phase of work in the Fraser River foreshore area were to:

- Increase awareness and educate stakeholders on climate change and the specific risks and vulnerabilities facing the Fraser River floodplain due to sea level rise and storm surge events;
- Engage stakeholders in a comprehensive, values-based discussion to ascertain what matters most to the people most affected; and
- Develop and review a set of guiding design principles and supporting attributes to carry forward into future project phases, which may include the development of flood management options, infrastructure design and policy.

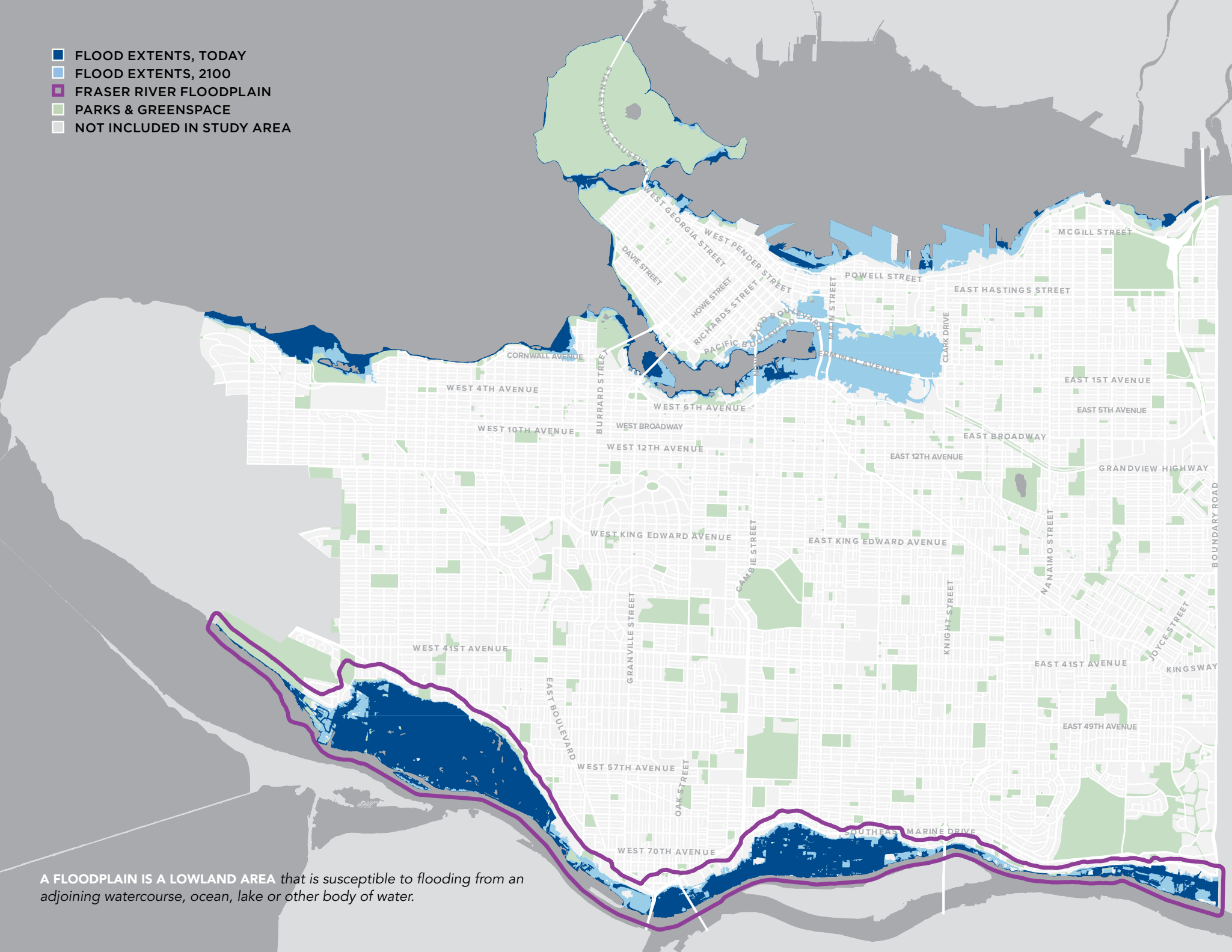
The Fraser river floodplain is the area most vulnerable to flooding in Vancouver. Running from Boundary Road in the east to Musqueam in the west, the Fraser River shoreline marks the southern boundary of several Vancouver neighbourhoods. It is home to residential areas, businesses, industrial areas, and critical habitat. In addition, it also encompasses critical "lifeline" infrastructure that Vancouverites rely on, including water, electrical, natural gas and communications systems.

Without flood management measures in place, areas in dark blue on the map on the next page are vulnerable to flooding due to a major storm (1-in-500 year storm) today and areas in light blue are vulnerable to flooding due to a major coastal storm (1-in-500 year storm) combined with 1 metre of sea level rise by approximately 2100.



Community open house at Dunbar Community Centre

- FLOOD EXTENTS, TODAY
- FLOOD EXTENTS, 2100
- FRASER RIVER FLOODPLAIN
- PARKS & GREENSPACE
- NOT INCLUDED IN STUDY AREA



A FLOODPLAIN IS A LOWLAND AREA that is susceptible to flooding from an adjoining watercourse, ocean, lake or other body of water.

FIGURE: Timeline of engagement

DEFINING OUR PROCESS

IDENTIFYING WHAT MATTERS MOST TO THOSE AFFECTED

CONFIRMING WHAT WE HEARD



Engagement Summary

The City of Vancouver launched the Fraser River Foreshore component of its larger CAP program in the spring of 2018. Using a participatory, values-based approach, the first phase of the project engaged residents, stakeholders, and other partners, including Musqueam First Nation, over a seven-month period¹. Multiple rounds of community and partner engagement events were organized in April, May, June and July. Engagement and communications included the following activities.

- Asset owners workshop.** A workshop for asset owners with facilities and linear utilities located within the Fraser River floodplain. The half-day workshop was held on April 15th at the Creekside Community Recreation Centre and engaged 25 asset owners and operators, including Metro Vancouver, BC Hydro, Fortis, TransLink, Telus, City of Vancouver, and Vancouver Park Board. The workshop identified a number of important assets in the study area, including critical lifeline infrastructure² whose damage or failure would pose a direct threat to public safety and wellbeing with potential for injuries and death. In addition to assessing the vulnerability of single assets (facilities and linear assets), workshop participants also explored the linkages to (and from) other impacted assets and subsequent ripple effects, or cascading impacts that could be expected from the failure of one asset.

- Musqueam staff and community workshops.** With a major reserve and community facilities located in the Southlands area, Musqueam First Nation is a key partner in the Fraser River CAP project. Recognizing their role in the project, the City of Vancouver and Musqueam developed a Letter of Understanding (LoU) to provide guidance for the City of Vancouver in engaging Musqueam in the CAP project through a separate but integrated part of larger project. A workshop was held on May 15th, 2018 for Musqueam staff members to identify staff concerns and values around flooding in Musqueam IR#2 and to plan a second engagement session with members. A second workshop was held on June 7th, 2018 for Musqueam community members. Approximately 20 staff members attended the first workshop, while about 15 community members attended the second event. Both workshops were held at Musqueam facilities.
- Community workshops.** Three community workshops were organized with residents, business owners, and community stakeholders to elicit community values around coastal flooding in the Fraser River foreshore area. The three two-hour workshops were held in different areas of the general study area and at different times to facilitate participation of business owners and residents from different neighbourhoods in the Fraser River Foreshore area.

1 The project was guided by an Engagement Framework that was consistent with City of Vancouver's core values for public participation and IAP2 participation standards.

2 Lifeline infrastructure are the systems and facilities that provide services vital to the function of communities and society and are critical to natural disaster emergency response and recovery.

With a focus on value elicitation, the objectives of these workshops were to introduce the project and the City of Vancouver's work leading up to it; summarize the risks and hazards of coastal flooding and sea level rise; learn about what matters most to those affected (their values); and to collect feedback on three general adaptation approaches (resist, accommodate, move). Over 140 people attended the three events.

- **Community open houses.** Two, drop-in style, community open houses were organized with residents, business owners, and community stakeholders. The objectives of the two open houses were to present back, confirm and validate community values and coastal flooding issue areas from community workshops and other engagement; continue to collect feedback on general adaptation approaches (resist, accommodate, move); and present and collect feedback on preliminary draft coastal flood management principles. The open houses were held on July 24th at the Scottish Community Centre (7:30 to 9:30am), and on July 26th at the Dunbar Community Centre (5:30 to 7:30pm). Over 140 people attended the two events.
- **Community surveys.** Two TalkVancouver surveys were coordinated around, first, the community workshops, and, second, to coincide with the two project open houses in July. Approximately 118 people completed the first survey, while 907 completed the second.
- **Other outreach and communications.** The City of Vancouver supported community outreach and engagement with two key communications pieces:
 - an introductory sea level primer, *Vancouver's Changing Shoreline: Preparing for Sea Level Rise*
 - a CAP project website to host project materials, including reports, presentations, and workshop materials (e.g., maps, posters)Several earned media events also took place, including CBC radio morning and afternoon shows. The City of Vancouver's "Greenest City" social media channels were also used to promote project events.
- **City staff workshop.** A three-hour, multi-departmental workshop was held with senior City staff on September 13th at City offices. The workshop presented the final outcomes of project public engagement and provided staff the opportunity to work through project materials themselves as part of a high-level gap analysis. Staff found no gaps and largely confirmed and agreed with project recommendations and considerations going forward.



Asset owners workshop



Community workshop at Oakridge Community Centre

Community Values

Collectively, community engagement helped identify many consistent and broadly-shared values. Values are the community concerns and desires that represent what residents and other stakeholders care about most in the Fraser River Foreshore area. Values were first identified during community workshops and then organized into seven thematic categories with related sub-concerns that were confirmed, validated and prioritized through community open houses and surveys.

In future project phases, measures will be developed for the community values so that the values can be used along with more technical engineering criteria in future project phases to help evaluate potential adaptation options. Similar measures can also be developed for sub-values and used as evaluation criteria of future adaptation options. The use of community values in the evaluation of adaptation options will help ensure that the potential flood options incorporate community concerns. They will also help support future conversations around potential trade-offs within and between community values. They are presented in general order of priority and importance based on community feedback.

- **Communities and People:** The Fraser River Foreshore area is home to multi-family housing units in the eastern part of the floodplain, mostly detached homes in the Southlands neighbourhood towards

the west, and a mix of dwellings within Musqueam's principal reserve, which is also home to large number of leaseholder homes. Future flood management approaches must consider impacts on communities and people, and, where practical and feasible (technically, in terms of risk tolerance, etc.), minimize permanent displacement of residents. Minimizing negative impacts on communities and people was the overarching key message from all engagement. The top sub-concerns identified through community engagement were:

- *Property value losses*
- *People permanently displaced due to flooding*
- **Environment:** The Fraser River Foreshore includes marine, intertidal and terrestrial habitat areas of various sizes, condition and connectivity. Individually and collectively, they provide critical habitat for juvenile salmon and migratory birds, as well as function as wildlife corridors along Vancouver's southern border. Future flood management approaches should, where practical, minimize negative impacts to wetland, freshwater and riparian habitats, while seeking opportunities to enhance and expand them. The top sub-concerns identified through community engagement were:
 - *Contaminants released into the environment from flooding*
 - *Damage to, and loss of, intertidal habitats (mud flats, salt water marsh)*

- **Health and Safety:** Public safety and wellbeing are critical community concerns that only become heightened during an emergency (i.e., flooding). While flood events pose life safety concerns, recovery from flood events can also pose significant health and safety challenges. Future flood management approaches should minimize health and safety impacts and integrate with existing emergency response planning. The top sub-concerns identified through community engagement were:
 - *Disruptions to lifeline infrastructure and services (power, water, roads, communications)*
 - *Contaminants released into environment from flooding*
- **Infrastructure and Transportation:** From lifeline services supporting both the local area and larger city (e.g., natural gas, hydro, communications, water, sewer) to important transportation corridors (Kent Street) and the TransLink Transit Centre, the Fraser River Foreshore area is home to a range of critical infrastructure and services. Future flood management approaches should minimize service disruptions where possible. The top two sub-concerns identified through community engagement were:
 - *Damage to and disruption of infrastructure services (water, sewer)*
 - *Damage to disruption of power infrastructure (electrical, natural gas)*
- **Local and Regional Economy:** The Fraser River Foreshore area is home to about 280 industrial, warehouse and commercial buildings, concentrated within the floodplain area south of Marine Drive. This area is home to approximately 700 businesses. There are also a number of businesses located there that rely on access to the Fraser River for their operations. Future flood management approaches should, where practical and feasible (technically, in terms of risk tolerance, etc.), minimize permanent displacement of businesses and/or loss of employment lands. The top two sub-concerns identified through community engagement were:
 - *Business interruptions and damage to assets (buildings, inventory, etc.) from flooding*
 - *Disruption to regional services, supply chains and goods movement*



Musqueam Creek near the Fraser River is one of Vancouver's last salmon-bearing creeks

- **Culture and Heritage:** From sites of spiritual, historic and archeological significance to the Musqueam People, such as middens and ceremonial sites, to the unique agricultural character of the Southlands, culture and heritage are deeply rooted along the Fraser River Foreshore. Additionally, Musqueam members use some foreshore areas near their reserve for traditional use activities (e.g., fishing, gathering). Future flood management approaches should recognize the importance of cultural and traditional use sites and strive to retain these sites as much as possible. The top two sub-concerns identified through community engagement were:
 - *Damage to and loss of traditional use areas*
 - *Damage to archeological sites*
- **Recreation:** From trails to and along the Fraser River for walking, cycling, horseback riding, bird watching and the like, to three golf courses and many horse stables, the Foreshore area is also home to multiple recreational opportunities. CAP Fraser River Foreshore flood management approaches should, where practical and feasible (technically, in terms of risk tolerance, etc.), maintain and where possible increase the diversity of recreation opportunities in the area. The top two sub-concerns identified through community engagement were:
 - *Loss of access to Fraser River*
 - *Loss of access to trail network*



Community open house at Scottish Culture Centre

Common Community Issues

In addition to community values, other common issues and questions included:

- **Limited awareness.** Many participants had limited awareness of the present-day risks associated with living in an active and largely unprotected (i.e., non-diked) coastal floodplain.
- **Current impacts.** There are existing impacts and concerns, including nuisance flooding, poor street drainage, and shoreline erosion that were also identified, along with concerns about how existing impacts and concerns will be impacted by, and likely exacerbated by, sea level rise.
- **Adaptation approaches.** There was a general understanding of the challenge at hand and the need for adaptation planning, but less agreement over which approaches could be feasible and why. While some residents were quick to dismiss the “move” approach, others became more supportive of it throughout the session as their understanding of the complexity of the challenge at hand deepened.
- **Seismic concerns.** Geotechnical issues are a major concern, particularly as resist approaches (i.e., dikes) cannot withstand all seismic events and could fail in the event of an earthquake. Going forward, future adaptation options will need to clearly communicate seismic performance and risk.
- **Risk.** While many participants favour a resist approach, an equal number of people questioned the long-term efficacy of such an approach. In particular, many participants raised concerns over how diking would hold up over the long-term (e.g. with more than 1 meter of sea level rise), or during events like earthquakes or tsunamis. Some participants were also concerned how a resist approach would create a “bathtub” scenario that would actually increase risk for people living behind dikes.
- **Current development concerns.** Given the long-term challenges discussed over the course of engagement, many participants also had questions about the City continuing to allow new development in the floodplain (e.g., East Fraser Lands), even with existing Flood Construction Levels (FCLs).
- **Process support and future engagement.** Community members, businesses, Musqueam, and asset owners all expressed strong support for the process and indicated interest in remaining actively engaged in future project phases.

Values and Future Option Evaluation

In future project phases, measures will be developed for the community values so that the values can be used along with more technical engineering criteria to help evaluate potential adaptation options. The use of community values in the evaluation of adaptation options will help ensure that the potential flood options incorporate community concerns but will also help support future conversations around potential trade-offs within and between community values.

Any future values assessment would be supported by a technical and risk assessments, which will likely include a summary of how well the option would perform during an earthquake, a large flooding event (i.e., 1-in-500 year storm) and the option's ability to manage stormwater runoff and drainage.

Recognizing that all flood protection options would carry some risk of failure, future work would include an analysis of the anticipated impacts to community from a failure of an option. For each option, a detailed description of the anticipated impacts to community values would be provided, likely using a scale from Very Low to Very High. The impact of a failure on a community value would then be assessed against the likelihood of failure of an option to provide a risk assessment (i.e., against each value and overall for the option).



Design Principles

Based on feedback from community members and stakeholders, the project consultant team developed a list of high-level design principles. The foundational guidelines also reflect the accumulated knowledge and experience of the City and consultant team with coastal flood management. The draft principles were presented to the community at the two open house events and through the second community survey for feedback and refinement.

The principles will provide direction for future phases of CAP work, including the development of flood management options, infrastructure design and policy.



Design for adaptability: Develop flexible options that can adjust to a wide range of future conditions, including the pace of sea level rise, the height of sea level rise, and future land uses.



Design for co-benefits: Ensure that new approaches support multiple community values (e.g., recreation, health and wellbeing, communities and people).



Design for nature: While the study area is heavily urbanized, the Fraser River is the most significant salmon river in BC. It is also home to other threatened species (e.g., sturgeon) and regionally critical and rare estuary habitats.



Design for safe-to-fail infrastructure systems: Ensure risks to lifeline infrastructure and services are minimized, and that redundant systems are in place in case of failure.



Design for safety and public health: Ensure public safety risks are minimized, and that public health and wellbeing are protected.



Design for access: Improve access to and around the Fraser River and include recreational and interpretive opportunities where feasible.

In addition to the design principles, the following planning principles were also developed to support internal City planning and future project work. They were reviewed by City project staff, but not presented to the public. They are not presented in any hierarchy.

- **Plan for integration:** Integrate flood management strategy with relevant City-wide plans (e.g., *Citywide Integrated Rainwater Management Plan*) and local level, neighbourhood plans (e.g., *Marpole Neighbourhood Plan*), and where required, provide direction on necessary amendments (e.g., zoning changes). Coordinate with other relevant municipalities and government agencies.
- **Plan for reconciliation:** Specifically address Musqueam, cultural values (hunting, gathering, ceremony sites), and cultural/archeological sites (e.g., *Marpole Midden*). Incorporate City of Reconciliation policy and related emerging City of Vancouver protocols, procedures and plans.
- **Plan for transparency (education):** Flood management approaches should include educational and awareness building components that openly communicate flood risks facing the area, as well as the City's decision-making and management processes.
- **Plan for cost-sharing:** work with all levels of government, asset holders and other stakeholders to implement short-, medium-, and long-term flood control infrastructure measures and maintenance efforts.

Design Attributes

Attributes are a subset of design principles that provide more detail about design considerations and elements intended to operationalize and support the principle(s) under which they are organized. The attributes were developed by project consultants and presented to community members, stakeholders and City staff for feedback and refinement. Multiple attributes can be employed across adaption approaches to help ensure that co-benefits across both principles and community values area achieved.



Design for adaptability

- Prioritize options that can be phased with increasing levels of sea level rise
- Prioritize options that continue to be feasible with more than 2 meters of sea level rise
- Areas where flooding would have higher consequences should be protected to higher standards than areas with lower consequences (e.g., golf courses and associated community amenities may not be protected to the same standards)
- Resist features (e.g., dikes, flood walls) phased over time with increasing sea level rise
- Tiered development with flood tolerant uses, such as pathways, at lower elevations
- Flood Construction Levels (FCLs) raised over time
- Sponge parks or flood parks
- Raise roads
- Relocate over time
- Flood tolerant building techniques (e.g., stilts, floats, wet-proof, dry-proof)



Design for nature

- Restore, rehabilitate or create new foreshore habitat areas where practical
- Address overland flooding hazards by prioritizing green infrastructure solutions for storm water retention, detention, and infiltration.
- Where feasible allow for river channel migration or expansion to accommodate additional flows (riverine, freshet flooding hazard)
- Work with the natural water dynamics
- Utilize Green Shores³ techniques for resist approaches
- Flood wall with habitat features
- River channel migration
- Expanded riparian areas
- Remove sea walls and barriers and restore foreshore habitat



Design for safe-to-fail infrastructure systems

- Relocation of lifeline infrastructure and services out of the floodplain should be the first consideration
- Where relocation is not possible, lifeline infrastructure should be protected to higher standards (e.g., 1-in-10,000) than non-lifeline infrastructure
- Where relocation is not possible, robust strategies to reduce the consequence of failed lifeline infrastructure should be developed and implemented to ensure continuity of critical services
- Wet proof/ dry proof strategies

3 Green Shores is a program of the Stewardship Centre for BC. It provides science-based tools and best practices to help communities and people minimize the impacts of new developments, and to restore shoreline ecosystem function of previously developed sites. Projects can also receive certification through our credits and rating system.

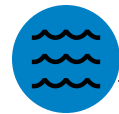


Fraser River walk



Design for safety and public health

- Adaptation strategies should first focus on seeking opportunities for relocation
- Where risk to public health and safety is high (e.g., higher density, community amenities, brownfield sites) and relocation is not feasible, build in redundancy through the incorporation of multiple structural and non-structural flood management approaches (e.g., protective dike, building wetproofing, emergency warning system, public education and communications), as well as build to higher flood protection standards
- Ensure floodplain can be preventively evacuated within 24-hours. If this is not feasible, ensure safe havens (areas inside the threatened zone that will not be affected) are built to high safety standards
- Flood management approaches developed on brownfields should minimize risk of water contamination during construction and flood inundation
- Seek strategies that lower the vulnerability of at-risk and vulnerable populations and coordinate with emergency response planning
- Built in redundancy, such as wet proof buildings
- Flood tolerant land uses, such as parking or other non-habitable uses below the FCL
- Elevate or raise critical access roads
- Remove contaminants from flood zones
- Relocate homes from flood zone where possible



Design for access

- Integrate shoreline access and trails into flood management approach
- Ensure accessibility of shoreline access and trails
- Seek opportunities to improve trail connections and shoreline access
- Maintain opportunities for fishing and hunting along foreshore and intertidal lands
- Trails on flood management features (e.g., trails on dikes)
- Improve shoreline access
- Improved access to recreation (e.g., nature watching, fishing, paddling)

Recommendations

The following recommendations were developed by the project consultant team and City staff based on an analysis of project outputs and feedback from residents, business owners, asset owners and operators, and other project stakeholders. They are intended to help ensure that valuable lessons learned from first phase of the Fraser River Foreshore CAP are carried forward to help guide future project phases.

- **Continue to refine and validate community values in future project phases.** The community values identified during the first phase will be a critical component of future option development and option evaluation. Residents, business owners and other stakeholders who did not participate in the first phase of the project may become engaged in future phases, particularly as potential flood adaption options are developed and evaluated. To ensure there are as few gaps as possible, and to fully engage new participants, it is important to continue eliciting, refining and prioritizing community values in future project phases. Furthermore, over time, and with growing awareness of the challenges posed by climate change, sea level rise, and coastal flooding, community values and priorities may shift.
- **Maintain value-based, participatory process through future project phases.** Participant feedback from the open houses, workshops and other outreach indicates that the City's commitment to participatory, values-based planning was strongly supported. Given that trade-offs and difficult conversations will be inevitable as the project moves forward into future phases, maintaining this commitment going forward will be a critical component of ongoing relationship building with residents and key project partners. A continued focus on a values-based, participatory process will help make some of the conversations less divisive.
- **Continue public education around the existing coastal flood risk.** Even without climate change and sea level rise, the Fraser River floodplain is at risk from coastal flooding; however, most residents, asset operators and businesses who participated in the project did not know this. Continued public education and awareness building on the part of the City is required to address this issue and improve community resilience in the area.
- **Address existing emergency alert and response issues.** Engagement confirmed that many (if not most) participants had limited awareness of the existing flood risk posed by ocean-driven storm events. Engagement also confirmed limited awareness around the existing lack of protective infrastructure (dikes, pumps) in the Fraser River Foreshore area. The City of Vancouver should develop and implement an emergency alert system for ocean-driven storm events and a corresponding emergency response and management system.
- **Continue to work with and collaborate with Musqueam as a key partner.** The City of Vancouver should continue building relationships with Musqueam staff and community members in future phases of the project. Engagement with Musqueam confirmed a strong desire to pursue further joint planning and action with the City. Of particular note, Musqueam staff were also concerned that the City of Vancouver's timeline for planning and implementing flood management options does not align with Musqueam Capital Corporation's (MCC) intent to develop a large parcel of land on IR#2 on the existing Musqueam golf course. MCC's development timeline is relatively short and staff were concerned that the development may be impacted by the City of Vancouver's future flood management approach for adjacent lands in Southlands.
- **Continue to engage asset owners and operators.** The Fraser River Foreshore is home to major infrastructure, including critical lifeline infrastructure. Feedback from a workshop for asset owners with facilities and linear utilities located within the study area confirmed a strong desire to stay engaged in the Fraser River Foreshore process and to build on the preliminary vulnerability assessment carried out in the workshop. The event also underscored the need for the City to continue building relationships with the asset owners going forward into future phases of the project, particularly for those areas where highly sensitive facilities and critical lifeline infrastructure are clustered.



Musqueam community workshop

Considerations Going Forward

The following considerations were developed by the project consultant team and internal discussions with the City project team based on the understanding and recognition that the City is still working to detail the path forward on this complex and challenging issue. They are framed as questions and intended to support conversations around the scoping and phasing of future Fraser River Foreshore project phases.

- **How can the City best maintain project momentum and address expectations around future work with phase one participants?** The Fraser River Foreshore CAP project represents significant *'engagement investment'* for the City of Vancouver in the development of community awareness around existing and future coastal flood risks in the area. With participants now better understanding the present-day risks, engagement activities have also resulted in expectations from project participants (Musqueam, asset owners, residents, etc.) around future phases (i.e., there is a risk *today*, and a matching desire for action today to mitigate the risk). Related to these outcomes, the project has also created some momentum for future project phases which would need to be leveraged and harnessed in the shorter-term to be maintained. How can the City effectively maintain project awareness and momentum? How can the City best address project expectations, while not eroding the "good will" that has developed due to

phase one activities? In the short term targeted external project communications with key partners and stakeholders will be key to maintain project momentum and address expectations around future work.

- **How can the City best address internal awareness gaps and bridge departmental silos?** Climate change adaptation is a complex and crosscutting issue with relevance to many City departments and organizations. While City staff from some departments were engaged (Planning, Urban Design, and Sustainability; Engineering Services; Parks and Recreation) at different junctures throughout the project, their engagement was not consistent and also highlighted varying degrees of awareness around existing coastal flood risks and future coastal flood risks, both in the Fraser River Foreshore area and across the city. In future project phases, it may be advisable to more formally engage City staff and other relevant departments (Fire and Rescue and Emergency Management; Real Estate and Facilities Management; Finance, Risk, and Business Planning) as a project steering committee or advisory group to provide project input, improve issue awareness, and help ensure that that every department with a role to play in addressing the challenges ahead are at the same planning table.

Background

As a west coast city located on the shore of the Salish Sea, Vancouver's past and future are strongly tied to both the ocean and the Fraser River.

As the global climate continues to warm, the Salish Sea and the waterways and rivers that connect to it are changing. Increasing temperatures are melting glaciers and polar ice caps, feeding more fresh water into the ocean. Climate change is also driving up the average temperature of ocean waters, causing them to physically expand in volume. The combined effects of these events is causing sea level rise. Based on sea level rise observations and computer modelling, the Province advised municipalities in 2011 to plan for 1 metre (3 feet) of sea level rise by 2100, and 2 metres (6 feet) by 2200.

The shorelines where Vancouverites work, live and play are already experiencing sea level rise and increased episodes of coastal flooding. To date, observed sea level change in Vancouver over the past century (1910 – 2017) has been 3.7 cm (Environmental Reporting BC).

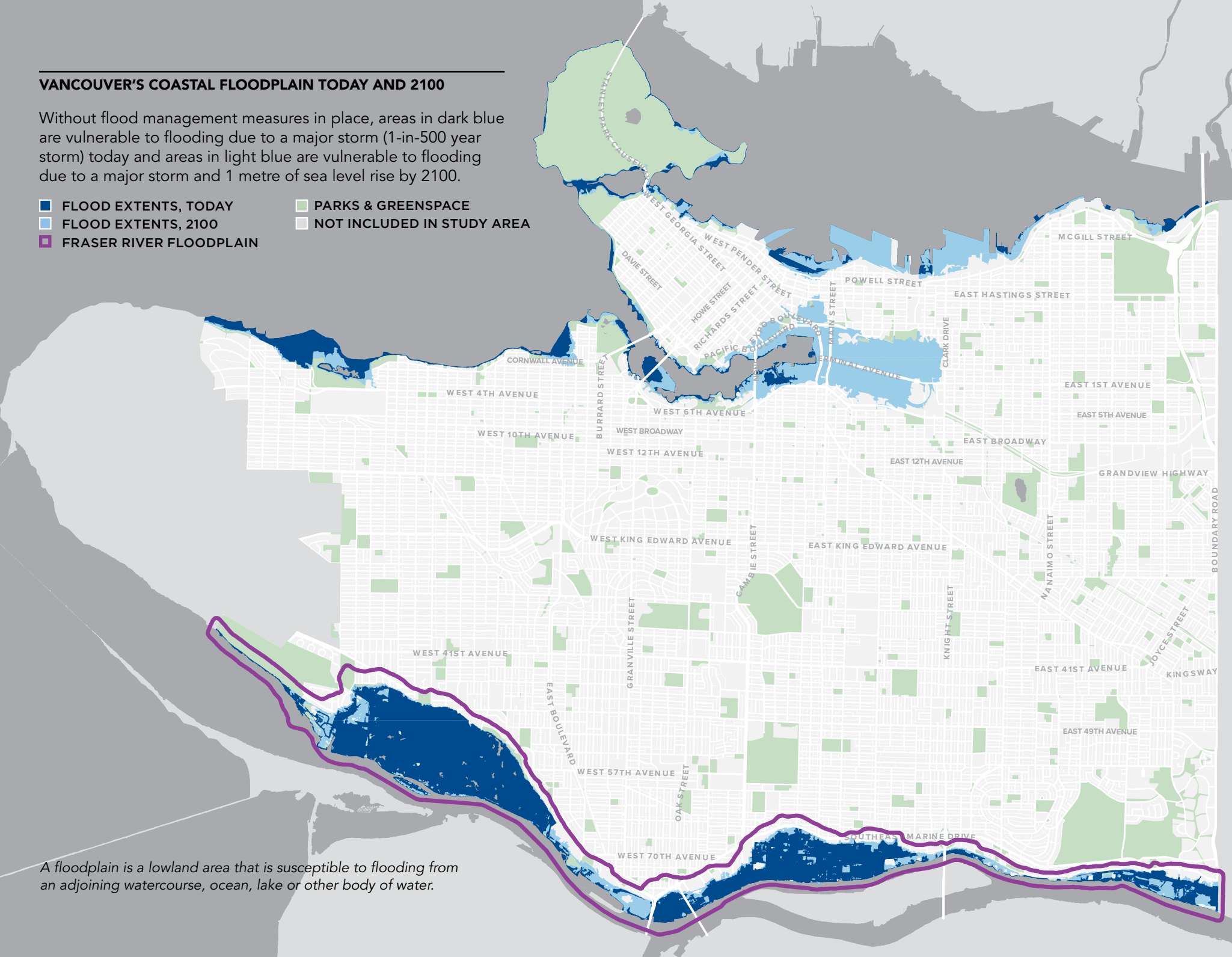
Historic sea level rise cannot be used to predict future increases given the increasing pace of climate change. It is clear, however, that higher sea levels in the future will erode beaches, damage or destroy buildings and infrastructure in low-lying coastal areas, and permanently inundate some locations. Beaches and critical coastal ecosystems will be lost, and areas near the coast will experience soil salinization resulting from salty ocean water pushing up into the groundwater table.



VANCOUVER'S COASTAL FLOODPLAIN TODAY AND 2100

Without flood management measures in place, areas in dark blue are vulnerable to flooding due to a major storm (1-in-500 year storm) today and areas in light blue are vulnerable to flooding due to a major storm and 1 metre of sea level rise by 2100.

- FLOOD EXTENTS, TODAY
- FLOOD EXTENTS, 2100
- FRASER RIVER FLOODPLAIN
- PARKS & GREENSPACE
- NOT INCLUDED IN STUDY AREA



A floodplain is a lowland area that is susceptible to flooding from an adjoining watercourse, ocean, lake or other body of water.



Stanley Park seawall damage, 2012

CLIMATE CHANGE AND COASTAL FLOODING

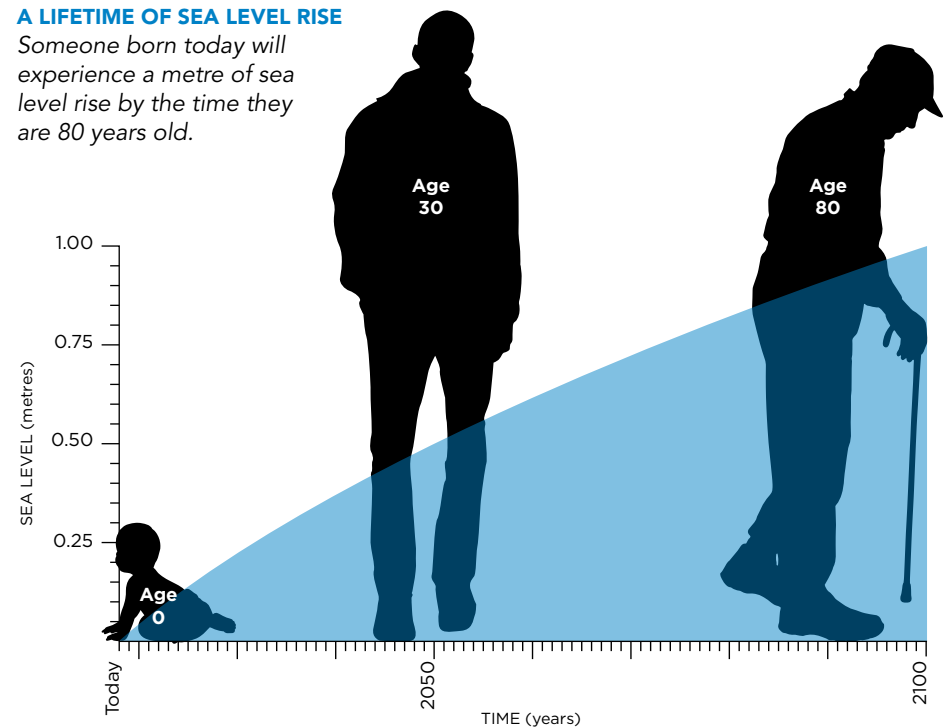
With the changing climate, a consensus of scientists and climate experts expect more extreme weather conditions. Vancouver is expected to experience more frequent and severe winter storms with heavy precipitation.

These winter storms will create powerful storm surges, driving more water up onto our shorelines and flooding low-lying areas. Unexpectedly large storm surges have already damaged some of Vancouver's most treasured places, including the seawall in Stanley Park, which was closed for repairs after storm surges during the winters of 2012 and 2015.

Vancouver's new *Citywide Integrated Rainwater Management Plan* will guide how we can better manage future heavy precipitation and use rainwater in Vancouver. The strategy's goal is to capture and treat 90% of the rainwater that falls in Vancouver using a combination of green infrastructure and conventional pipe systems, which will help minimize overland flooding.

A LIFETIME OF SEA LEVEL RISE

Someone born today will experience a metre of sea level rise by the time they are 80 years old.



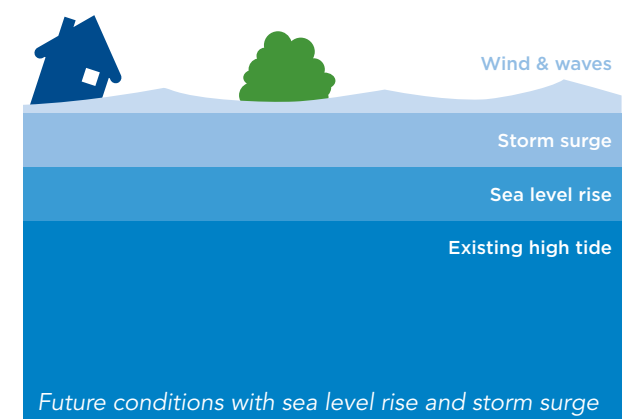
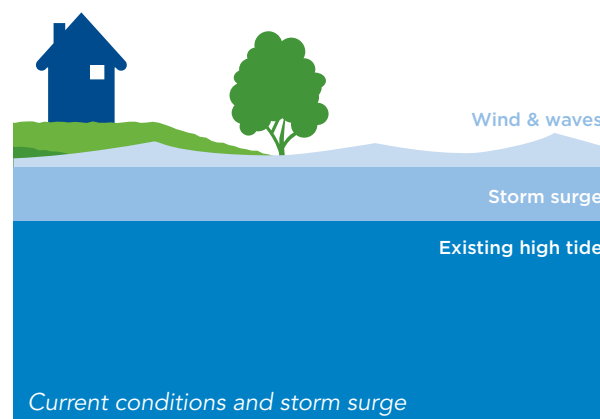
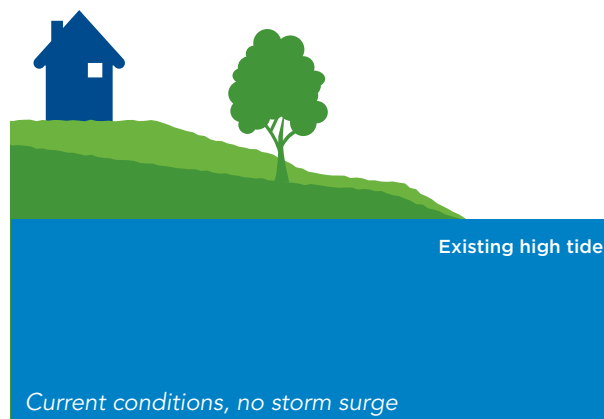
Storm Surges and King Tides

From December to February, Vancouver regularly experiences winter storms whose winds can push water levels up anywhere from 50 cm to 100 cm above normal levels. These events are called storm surges and can generate problems when they coincide with high seasonal tides, called king tides. King tides occur three or four times a year during the winter months and are 50 cm to 100 cm higher than regular high tides.

King tides offer us a chance to see what normal sea levels may look like in the future as they rise due to climate change. By 2050, when sea levels are expected to be 50 cm higher than today, our regular sea levels could look like some of today's king tides.



Coastal flooding at Locarno Beach, 2012





Vancouver's few remaining areas of natural shoreline, like this stretch between Kitsilano Beach and Jericho Beach, are at risk of being permanently lost due to sea level rise.

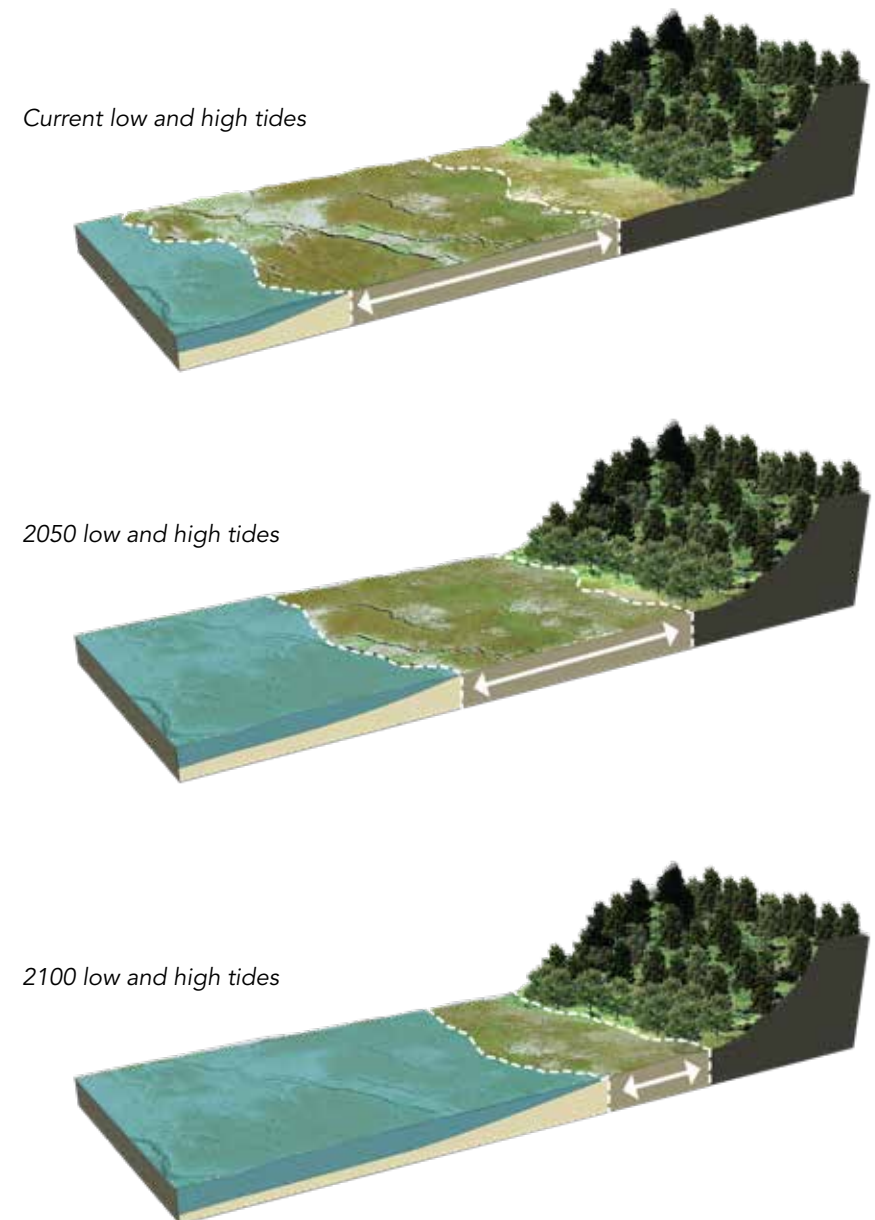
Coastal Squeeze

From heavily industrial waterfronts along Burrard Inlet, to relatively natural ocean shorelines between Kitsilano Beach and Jericho Beach, and along the Fraser River estuary from Boundary Road to the marsh flats near Musqueam, Vancouver's coastline is as varied and dynamic as the city it surrounds.

It is Vancouver's more natural coastlines, and the important intertidal areas they are home to, that are particularly at risk due to climate change. These intertidal ecosystems will be impacted, reduced, and *squeezed* over time as they face permanent inundation due to rising sea levels and increased development pressure on land.

The City of Vancouver is keenly aware of the many places, people and habitats at risk, and are aware that if action is not taken to manage the impacts of sea level rise, there will be properties damaged, communities displaced, human health put at risk, and critical shoreline ecosystems lost.

FIGURE: Coastal squeeze





Spanish Banks at low tide

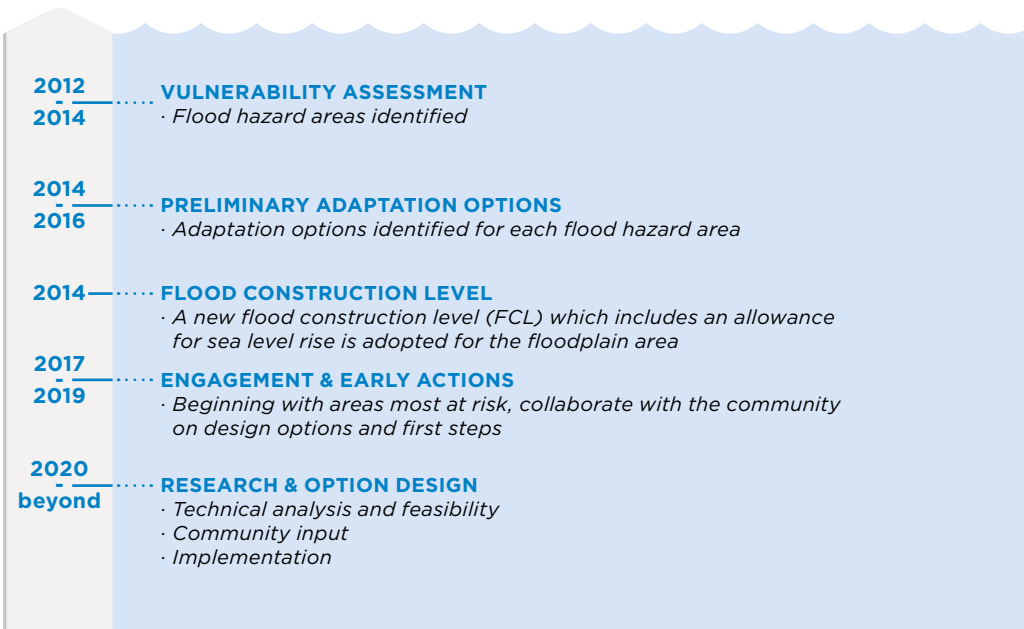
PLANNING FOR CHANGE

Vancouver has long recognized the need to plan for future sea level rise and to help vulnerable neighbourhoods, communities and businesses along the shoreline become more resilient to the coastal flooding challenges ahead. In 2012, City Council approved a Climate Change Adaptation Strategy, which recommended several priority actions for the City. As one of the priority actions, a program was launched shortly afterwards to address sea level rise and its impacts on the City of Vancouver.

The sea level rise program, a first program of its kind in Canada, is a multi-phase undertaking to determine the risk, consequences and vulnerability of Vancouver to future sea level rise and storm surge scenarios. The first phase of work identified flood hazard “zones” in Vancouver, each one distinct in terms of its community features, facilities, environmental features, topography, and exposure to tides and weather (wind and waves).

The Fraser River shoreline, which runs from Boundary Road in the east to Musqueam in the west, was identified as the most vulnerable area. Low lying areas around Jericho and Locarno beaches followed, along with some areas in the Port of Vancouver, which are under the jurisdiction of Port Metro Vancouver.

FIGURE: Project timeline



As part of the second phase of the City's sea level rise program, a number of preliminary adaptation options were identified for each of the flood hazard zones. The pros and cons, estimated costs, and likely trade-offs for each option were evaluated as part of the study. This information provided the City with a starting point for conversations with residents, businesses and experts about flood management options in each of the areas, as well as how each option or combination of options supports local community values (e.g., aesthetics, access to recreation).

The adaptation options that were assessed can be organized into four general approaches:

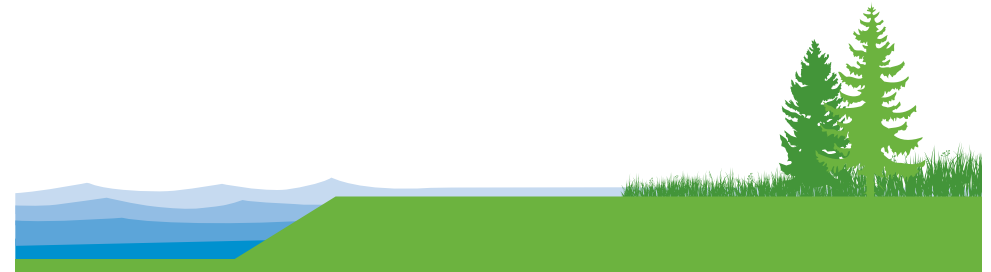
- **Resist:** Build structures to keep floodwater out and protect areas and community assets. Common approaches here include shoreline and inland dikes or offshore features to help reduce wind and wave action (which can help push more water ashore during storm surges).
- **Accommodate:** Rather than keeping floodwater out, these flood management options aim to keep community assets dry when flooding occurs. Examples include raising buildings and infrastructure or designing them so that they can accommodate temporary flooding and stay dry when flooding occurs (e.g., "wet-proofing," "dry-proofing").
- **Move:** Plan for the eventual relocation of people and/or facilities and buildings in high exposure, high risk areas of the city. This approach often includes returning portions of land to pre-development conditions (i.e., "naturalizing").
- **Combination:** Use of a combination of approaches in a flood hazard area (i.e., resist, accommodate, move) to achieve a range of community values, like habitat conservation, recreation, and livability.



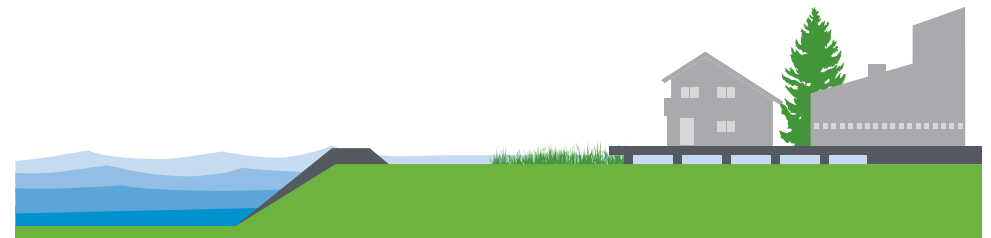
RESIST



ACCOMMODATE



MOVE



COMBINATION



Fraser River at Southlands

COASTAL ADAPTATION PROJECT - FRASER RIVER FORESHORE

The Coastal Adaptation Plan (CAP) - Fraser River Foreshore marks the next stage of Vancouver's climate work. Launched in the spring of 2018, the initiative is designed to build on earlier work and help communities and businesses along the City's shoreline identify potential management solutions that will support greater resiliency in the face of the coming challenges. The City is focusing first on the Fraser River Foreshore area (as shown on the map), which has been identified as the most vulnerable area in the City.

For the first phase of this project, the City engaged with residents, business owners, and other stakeholders over a four-month period, focusing on:

- **Educating** affected communities and stakeholder groups about climate change and its effects; the outputs of previous sea level rise and coastal flooding studies; high-level flood management approaches; and the larger Coastal Adaptation Plan process for the City of Vancouver.
- **Value-elicitation** to learn from affected communities, project partners and stakeholder groups about what concerns them, what they care about, and what they would like to see considered in the context of flood management in their community or neighbourhood.

- **Developing design principles and attributes** for use in the planning and design of future adaptation options and seeking public feedback on them.
- **Strengthening relationships** and building social capital among affected communities and stakeholder groups.

Future project phases will start rolling out in 2019 and will refine emerging options with the public and local communities, experts and staff. This work will be undertaken systematically, beginning with the most vulnerable areas along Vancouver's Fraser River shoreline. There will be multiple opportunities for the public to shape this work.



UNIVERSITY OF
BRITISH COLUMBIA

STANLEY PARK

BURRARD INLET

FALSE CREEK

VANCOUVER
HARBOUR

MUSQUEAM

SEA ISLAND -
YVR

VANCOUVER

MITCHELL ISLAND

FRASERVUE
GOLF COURSE

FRASER RIVER

RICHMOND

LULU ISLAND

FRASER RIVER FORESHORE

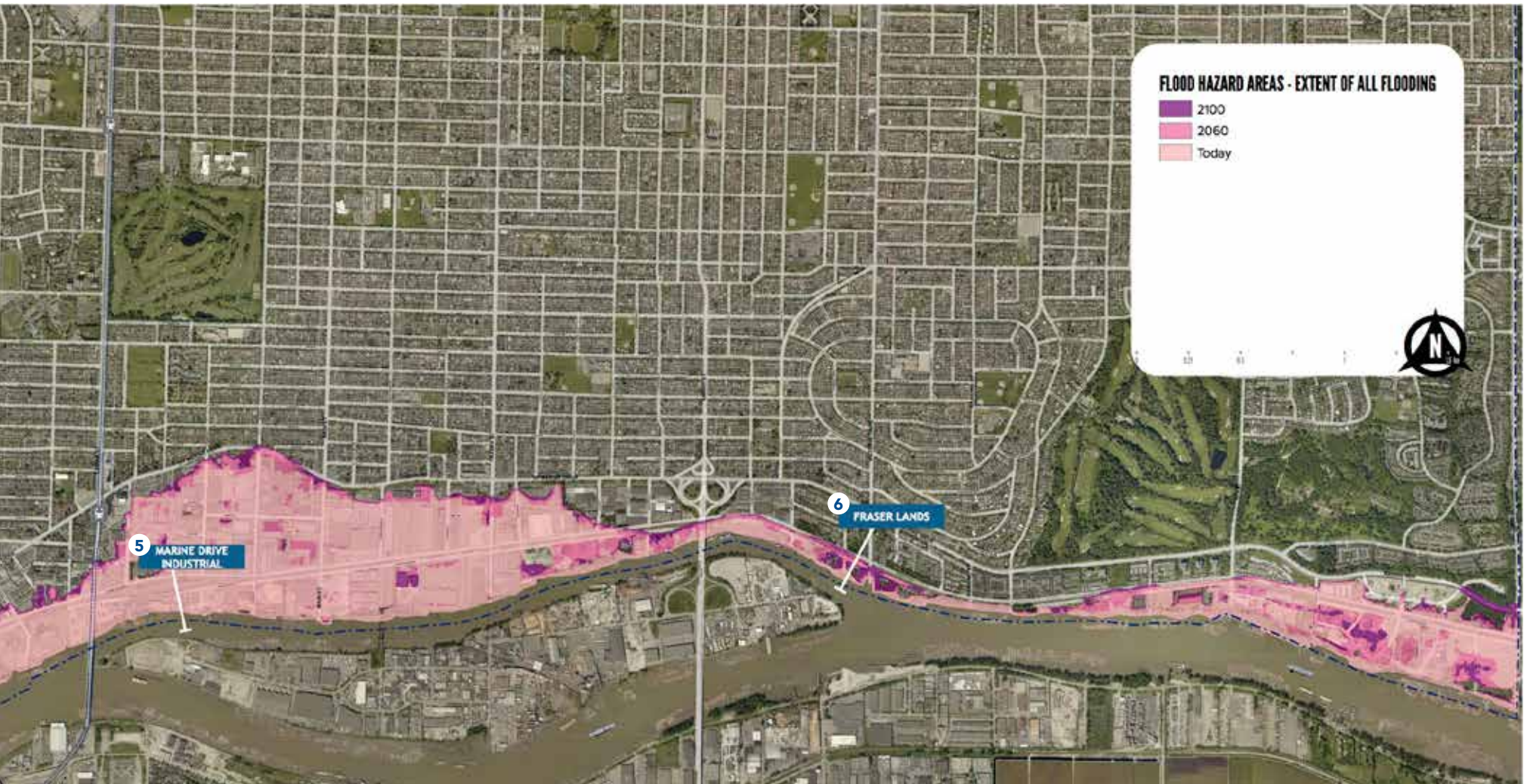
FIGURE. Flood hazard areas



FLOOD HAZARD AREAS OF THE FRASER RIVER FLOODPLAIN OVER TIME

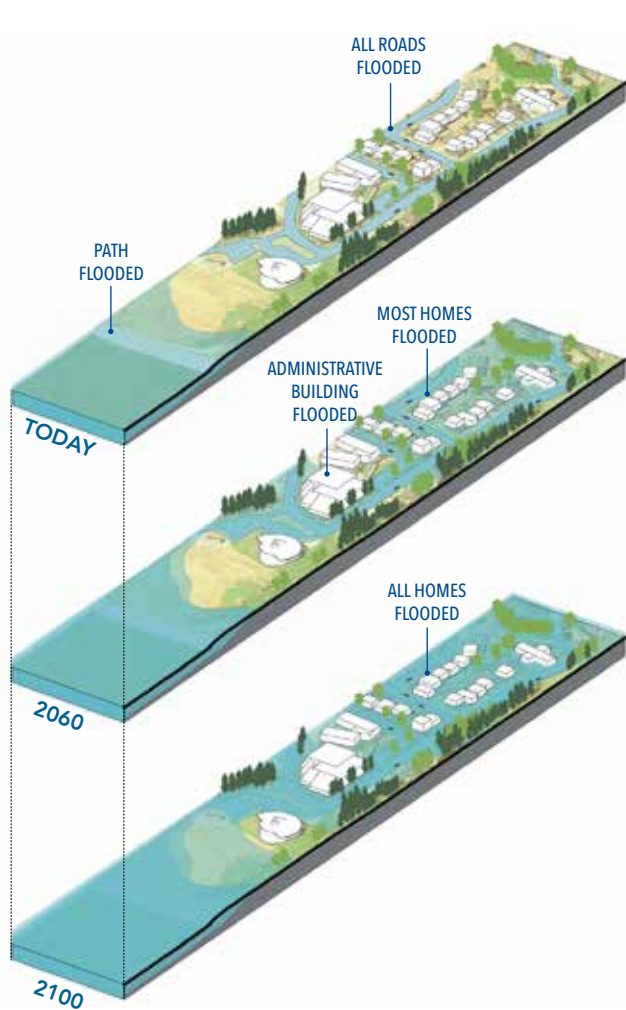
The map illustrates the extent of flooding the Fraser River Foreshore could expect today (light pink) if a 1-in-500 year coastal flood event were to occur. Without flood management measures in place, the areas in dark pink illustrate the areas that would be at risk of flooding due to a major 1-in-500 year storm event by 2060, while the dark purple areas show the areas that would be at risk by 2100.

On the next pages, these flood hazards over time are illustrated on six cross-sections, each representing a different kind of land use mix in the Fraser River floodplain area. The white line marks the transect used for the cross-sections.

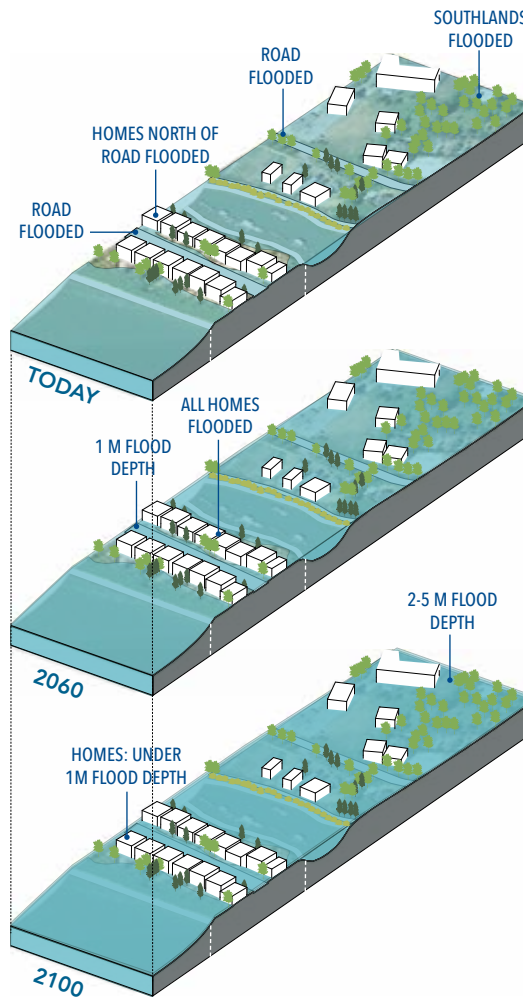


FLOOD HAZARD CROSS-SECTIONS

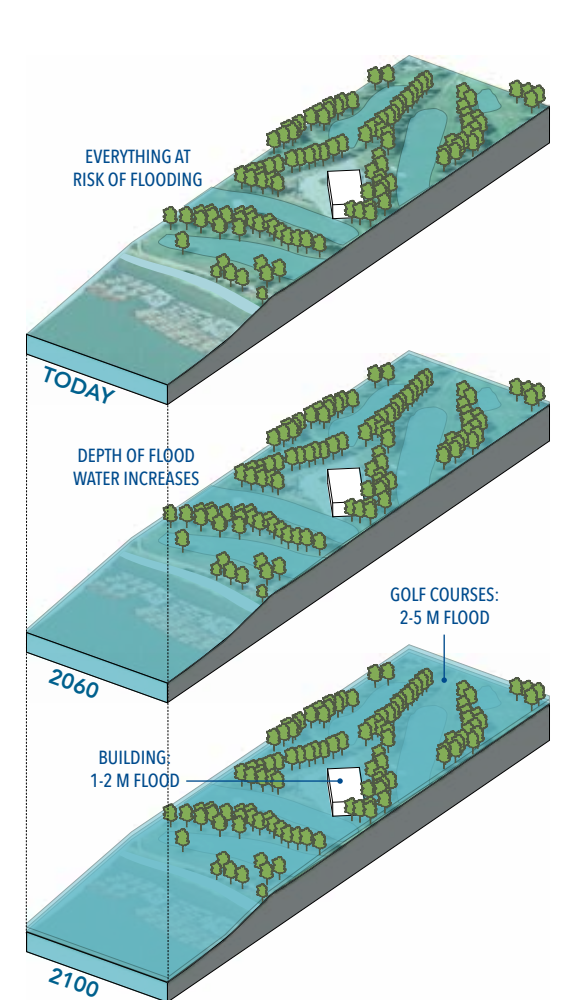
The following six cross-sections illustrate flood extent risks over time. Each illustrates a different kind of land use mix found in the Fraser River floodplain area. The cross-sections correspond to the numbered white transect lines on the previous map.



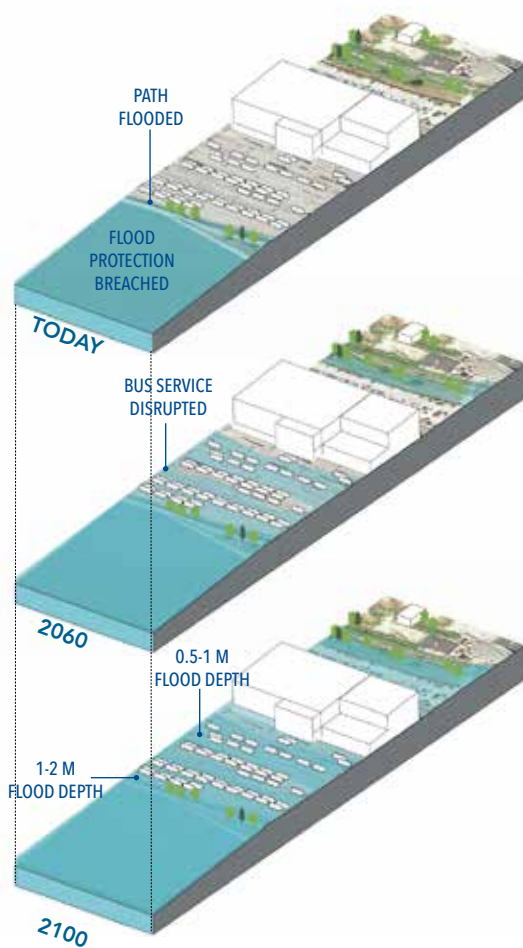
1 MUSQUEAM
Mixed Use



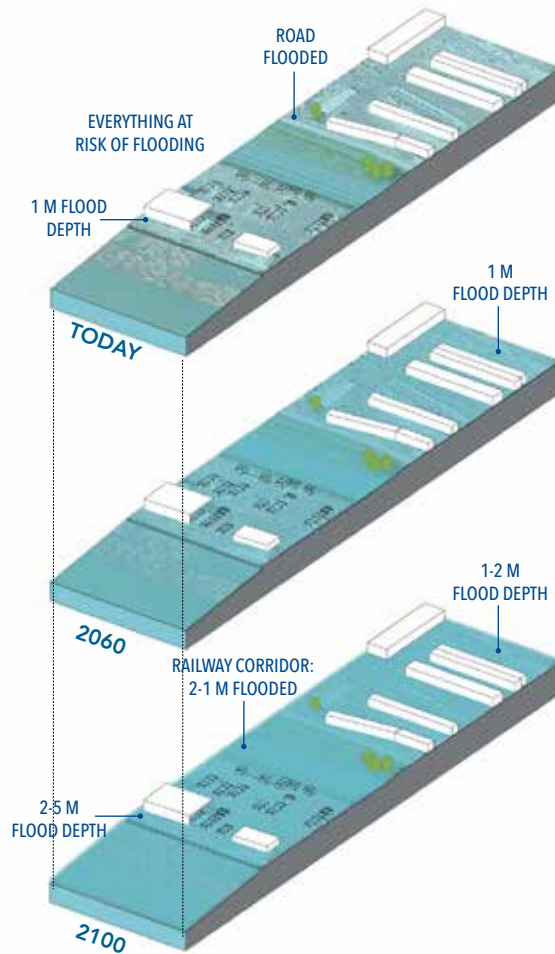
2 DEERING ISLAND
Single Family Residential



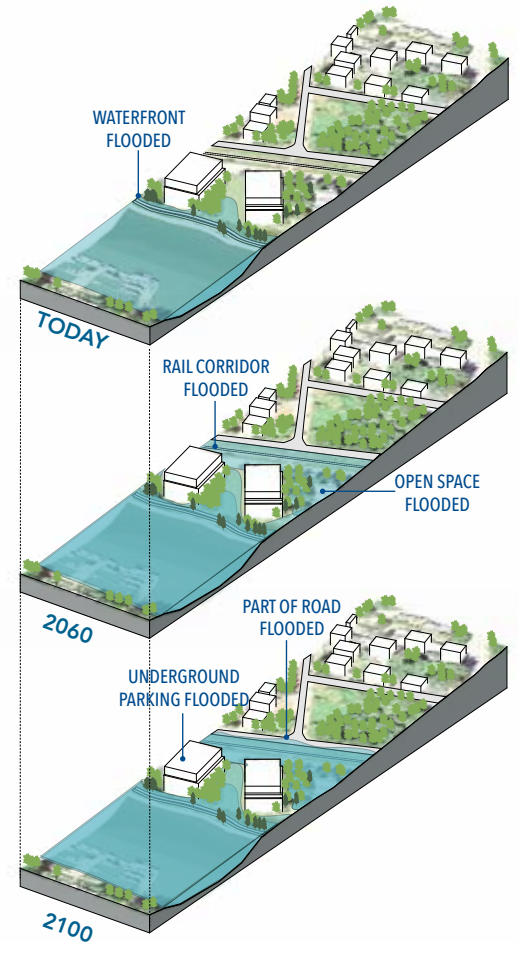
3 SOUTHLANDS
Parks and Recreation



4 MARPOLE INDUSTRIAL
Infrastructure and Transportation



5 MARINE DRIVE INDUSTRIAL
Industry and Warehouse

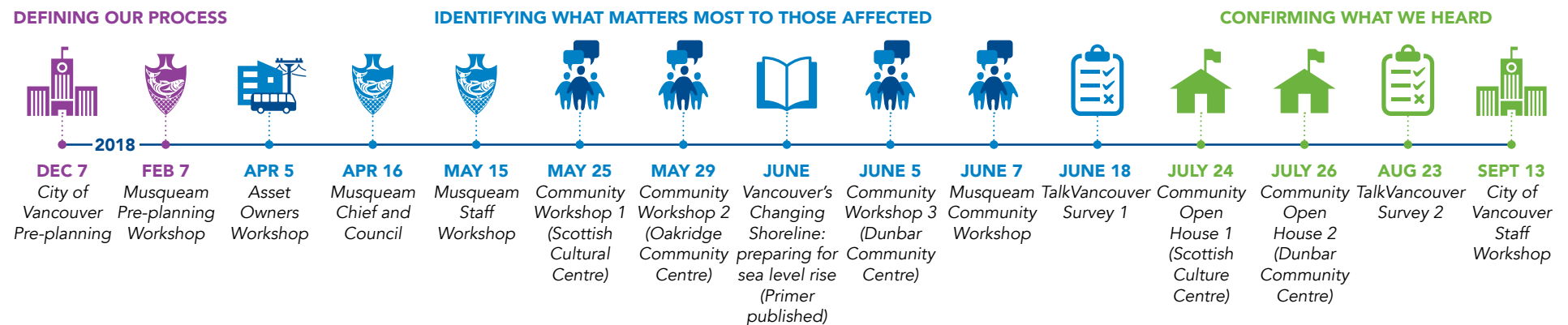


6 FRASER LANDS
Mixed Residential Neighbourhood

Community Engagement and Outreach

This section provides a summary of community engagement and outreach activities carried out as part of the first phase of the Fraser River CAP project. Activities are organized in basic chronological sequence, although it should be noted that two rounds of TalkVancouver surveys were conducted.

FIGURE: Timeline of engagement



ASSET OWNERS WORKSHOP

The City organized a workshop for asset owners with facilities and linear utilities located within the Fraser River floodplain. The half-day workshop was held at the Creekside Community Recreation Centre on April 15th and engaged 25 asset owners and operators, including Metro Vancouver, BC Hydro, Fortis, TransLink, Telus and the City of Vancouver (Engineering, Park Board, Sustainability). The objectives of the workshop were to:

- Build awareness and education about sea level rise and coastal flooding in the Fraser River Foreshore study area with asset owners;

- Identify critical assets in the floodplain and their sensitivity to flooding (limited flood, major flood, extreme flood);
- Explore and assess the consequences of failed/damaged critical assets, including both direct impacts and ripple effects, or cascading effects; and,
- Assess the adaptive capacity of assets in the area (e.g., could they be moved out of the hazard area or retrofitted to accommodate flooding?).

The workshop identified a number of important assets in the study area, including critical lifeline infrastructure⁴ whose damage or failure would pose a direct threat to public safety and wellbeing with potential for injuries and death. These critical assets include:

- A major BC Hydro Substation (Kidd 1 Substation);
- A major Fortis natural gas distribution facility (Fraser Gate);
- Metro Vancouver sewer and water infrastructure (pump stations, combined outfalls, Highbury Diversion Chamber, Highbury Interceptor Air Management Facility);
- Telus communications facility and equipment (including 911 service centre);
- The Coast Mountain Bus Company (Vancouver Transit Centre); and
- Multiple City of Vancouver assets (South Vancouver Transfer Station, Manitoba Works Yard, roads, parks).

In addition to assessing the vulnerability of single assets (facilities and linear assets), workshop participants also explored the linkages to (and from) other impacted assets and subsequent ripple effects, or cascading impacts that could be expected from the failure of one asset. Through this activity, participants narrowed their focus down to a few priority assets considered to be of most consequence if they failed due to a flood event. The potential loss of electricity from the flooding of BC Hydro's Kidd 1 Substation emerged as the most consequential cascading impact. While there is some redundancy in BC Hydro's network, a power outage would have direct impacts on other key assets, including the natural gas network (Fraser Gate Station and local distribution), Metro Vancouver pump stations (sewer), Telus communications hubs, the Vancouver Transit Centre and other linear transportation assets.

Though several assets have some adaptive capacity (e.g., BC Hydro reported that the Kidd 1 Substation could be moved out of the

flood area), realizing or developing this capacity will not be easy or inexpensive, and will likely require significant planning support from the City of Vancouver to phase and implement. Given the complexity of the issue, and the need to build on the preliminary vulnerability assessment carried out during this workshop, the event also underscored the need for the City to continue building relationships with the asset owners and working with them to carry out more detailed vulnerability assessments. Workshop participants themselves expressed a strong desire to continue their engagement in the CAP process, including other study areas, and most indicated that the workshop helped them better understand the flood hazard risk in the area and the vulnerability of their assets.

Analysis of workshop feedback helped identify areas where highly sensitive facilities and infrastructure are clustered. These areas containing lifeline infrastructure will require special consideration during future CAP Fraser River Foreshore phases.



Asset owners workshop

⁴ Lifeline infrastructure are the systems and facilities that provide services vital to the function of communities and society, and are critical to natural disaster emergency response and recovery.

MUSQUEAM WORKSHOPS

Musqueam IR#2 is one of the larger residential areas within the study area, and Musqueam works closely with the City of Vancouver through various protocol and service agreements. Musqueam engagement was supported by a Letter of Understanding (LoU) between Musqueam and the City of Vancouver to help ensure ongoing collaboration and coordination around flood management in the Fraser River Foreshore area. The LoU helped provide guidance for the City of Vancouver in engaging Musqueam in the CAP project through a separate but integrated part of the larger project. Both Musqueam workshops were carried out under the terms of the LoU, which also provided an opportunity for continued relationship building and joint planning for the City and Musqueam around coastal adaptation.

The first workshop was held on May 15th, 2018, for Musqueam staff members. This was followed by a second workshop on June 7th, 2018, for Musqueam community members. Approximately 20 staff members attended the first workshop, while about 15 community members attended the second event. Both workshops were held at Musqueam facilities.

The objectives of the two engagement events were to:

- Introduce the project and summarize the hazards of coastal flooding and sea level rise for Musqueam IR#2, Musqueam's main reserve and village centre;
- Learn about Musqueam's concerns and values in the context of community flood hazards;
- Discuss high-level flood management approaches for Musqueam; and
- Discuss potential design principles and attributes (at the staff workshop).

Both workshops began with an educational component during which participants were given an overview of the challenges at hand (i.e., how sea level rise will affect the area) and an introduction to the three



Musqueam community workshop

common adaptation approaches (resist, accommodate, move). Key findings from the workshops include:

- Coastal flooding impacts to roads, infrastructure, community facilities and gathering spaces, traditional use and ceremonial areas, recreation areas, and Musqueam's cemetery were the principal concerns raised.
- As a community that has lived beside the Fraser for millennia, there is considerable awareness around the ongoing risks of flooding from the river and some participants shared stories of how their families used to respond to flooding when they were children.
- While awareness of river flooding was considerable, the increased risk posed by coastal flooding from sea level rise is not as well understood in the community. Consequently, the need to increase community awareness and develop a shared understanding of the challenge was shared by all participants.
- There was a strong desire to see further planning and action follow these workshops. The desire for action was based both on participants' concerns regarding the emerging coastal flooding challenges, and on concerns from some participants that these types of conversations had been had before and did not lead to any actual changes.



Musqueam staff workshop

- Musqueam staff are concerned that the City of Vancouver’s timeline for planning and implementing flood management options does not align with Musqueam Capital Corporation’s (MCC) intent to develop a large parcel of land on IR#2 on the existing Musqueam golf course. MCC’s development timeline is relatively short and staff were concerned that the development will be impacted depending on the City of Vancouver’s future flood management approach for adjacent lands in Southlands.

Collectively, these common themes highlight the need for the City of Vancouver to continue building relationships with Musqueam staff and community members as future phases of the project progress.

For Musqueam, it should also be noted that many participants pointed out that Musqueam sites of interest and concern are spread throughout the Lower Mainland and not limited only to IR#2. Some of these sites include the Marpole Midden (a portion of which is now owned by Musqueam as fee simple property) and cultural sites along Jericho, Locarno and Spanish Banks beaches. Some participants also felt that additional efforts should be made to engage Musqueam Elders around coastal traditional use sites, cultural resources and areas that may be threatened by sea level rise and/or disturbed by potential flood management approaches. This is an important consideration for future CAP planning work.

COMMUNITY WORKSHOPS

Three community workshops were organized with residents, business owners, and community stakeholders to elicit community values around coastal flooding in the Fraser River foreshore area. The three two-hour workshops were held in different areas of the general study area and at different times to facilitate participation of business owners and residents from different neighbourhoods in the Fraser River Foreshore area. With a focus on values elicitation, the objectives of these workshops were to:

- Introduce the project and the City of Vancouver's work leading up to it;
- Summarize the risks and hazards of coastal flooding and sea level rise;
- Collect feedback on general adaptation approaches (resist, accommodate, move); and
- Learn about what matters most to those affected (their values).

Community engagement events were held for businesses and residents from 7:30 to 9:30am on May 25th at the Scottish Community Centre, and for community residents on May 29th at the Marpole Community Centre (11:30am to 1:30pm) and June 5th at the Dunbar Community Centre (5:30 to 7:30pm). Over 140 people attended the three events.

Through structured, interactive activities, community workshop participants identified important community assets and spaces and provided input on future adaptation approaches (move, accommodate, retreat). While much concern was expressed about the loss of homes, impacts to property values, and access to recreation and green spaces, there was also a strong understanding of the need for this type of planning and most participants expressed a desire to stay involved and see action result from these workshops. Key findings from the community workshop sessions are summarized in the following bullets:

- Many participants had limited awareness of the present-day risks associated with living in active and largely unprotected (i.e., non-diked) coastal floodplain.

- Generally, the same broad values and concerns were heard at each session. The most widely stated concerns included future and potential impacts to homes and housing, potential impacts on (and loss of) property values, public health and safety concerns (injuries, contamination from flood events), impacts to infrastructure and transportation routes, loss of pedestrian access to the Fraser, impacts to parks, greenspaces and recreational facilities (golf courses, equestrian facilities), environmental impacts (damage to and loss of habitat, impacts to fish and wildlife).
- Existing concerns, including nuisance flooding, poor street drainage, and shoreline erosion were also identified, along with concerns about how these existing issues will be impacted by, and likely exacerbated by, sea level rise.
- Questions were also raised over the roles and responsibilities of individuals, businesses, and government around funding future flood management approaches and supporting ongoing operations and maintenance.
- There was a general understanding of the challenge at hand and the need for adaptation planning, but less agreement over which approaches could be feasible and why. While some residents were quick to dismiss the "move" approach, others became more supportive of it throughout the session as their understanding of the complexity of the challenges at hand deepened.



Community workshop at Dunbar Community Centre

COMMUNITY OPEN HOUSES

Two drop-in style community open houses were organized with residents, business owners, and community stakeholders. The objectives of the two open houses were to:

- Introduce the project and the City of Vancouver’s work leading up to it for those participants who may not have attended any of the previous community workshops;
- Summarize the risks and hazards of coastal flooding and sea level rise;
- Present back, confirm and validate community values and coastal flooding issue areas from community workshops and other engagement;
- Continue to collect feedback on general adaptation approaches (resist, accommodate, move);
- Present and collect feedback on preliminary draft coastal flood management principles; and
- Provide information on future project phases and opportunities for continued engagement and involvement.

Community open houses were held on July 24th at the Scottish Community Centre (7:30 to 9:30am), and for on July 26th at the Dunbar Community Centre (5:30 to 7:30pm). Over 110 people attended the two events.

The community impacts that CAP partners and stakeholders reported being most concerned about at earlier workshops were presented at the open house. This feedback was collected at three community sessions, a workshop with Musqueam staff, an open house for Musqueam members, and a workshop with key project stakeholders who own and operate utilities and infrastructure in the area (e.g., Metro Vancouver, Fortis, BC Hydro, TransLink). The impacts were organized into seven thematic categories, or value categories, with specific sub-concerns captured under each theme. The seven value categories were:

- Communities and People
- Environment
- Recreation
- Infrastructure and Transportation
- Local and Regional Economy
- Culture and Heritage
- Health and Safety

Participants were first asked to first prioritize the sub-concerns identified under each of the seven value categories to get a sense of which ones mattered most to them. They were then asked to prioritize the value categories themselves to get a sense of which general categories matter most to participants. Participants were also invited to provide additional feedback on the three general adaptation approaches – resist, accommodate, move – and to provide feedback on the preliminary design principles. Key findings from these sessions included the following:

- Many participants who had not attended the earlier community workshops had limited awareness of the present-day risks associated with living in an active and largely unprotected (i.e., non-diked) coastal floodplain.
- While there was some consistency between top-ranking value categories – Communities and People, Environment, Health and Safety, Infrastructure and Transportation – there were pronounced differences between the more business-focused first open house, and the more resident-focused second open house. For example, the first open house identified Local and Regional Economy as the second most important value category, while the second open house identified this as the least important value category.

VALUE CATEGORY	PRIORITY – OPEN HOUSE 1	PRIORITY – OPEN HOUSE 2
Communities and People	1 st	2 nd
Environment	3 rd	4 th
Recreation	7 th	5 th
Infrastructure and Transportation	5 th	3 rd
Local and Regional Economy	2 nd	7 th
Culture and Heritage	6 th	6 th
Health and Safety	4 th	1 st



Community open house at Dunbar Community Centre

- Potential property value losses emerged as an important issue in both open houses. This was the most important sub-concern in the Communities and People value category.
- Potential Environment sub-concerns were the same between both open houses with contaminants released into the environment from flooding; damage to and loss of intertidal habitats (mud flats, salt water marsh, intertidal areas); and damage to and loss of habitat on land, including shoreline habitats and wetlands emerging as the top three.
- Potential Infrastructure and Transportation sub-concerns were the same between both open houses with damage to and disruption of infrastructure services (water, sewer); damage to and disruption of power infrastructure (electrical, natural gas); and emergency access disruptions (due to road closures, damage) emerging as the top three.
- The top two Health and Safety sub-concerns were the same between both open houses with contaminants released into the environment from flooding and disruptions to lifeline infrastructure and services (power, water, roads, communications).
- As expected at this early stage of conversation, there was a strong protection bias, with participants at both workshops showing a strong interest in the resist approach. However, from comments and discussions at both open houses, there was also awareness of the challenges, costs, and increased risks posed by this approach.
- There were some differences between the two open houses in terms of prioritizing the draft principles, but considerable discussion around the importance of designing for co-benefits and addressing multiple community values in the development and implementation of future adaptation options.

PRINCIPLES	PRIORITY – OPEN HOUSE 1	PRIORITY – OPEN HOUSE 2
Design for adaptability	1 st	1 st (tie)
Design for public health and safety	6 th	1 st (tie)
Design for “safe-to-fail” infrastructure systems	4 th	2 nd
Design for nature	3 rd	3 rd (tie)
Design for access	5 th	4 th
Design for co-benefits	2 nd	3 rd (tie)

COMMUNITY SURVEYS

Two TalkVancouver surveys were administered, one short one targeting residents of the Fraser River floodplain area that closed on June 18th, 2018 and received 118 responses, and longer survey, open to all Vancouver residents, that closed on August 23, 2018 and received 907 responses. The focus of the longer survey was to gauge overall the level of concern of participants had about flooding, as well as to inquire about community values impacted by sea level rise. The key findings from the surveys included the following:

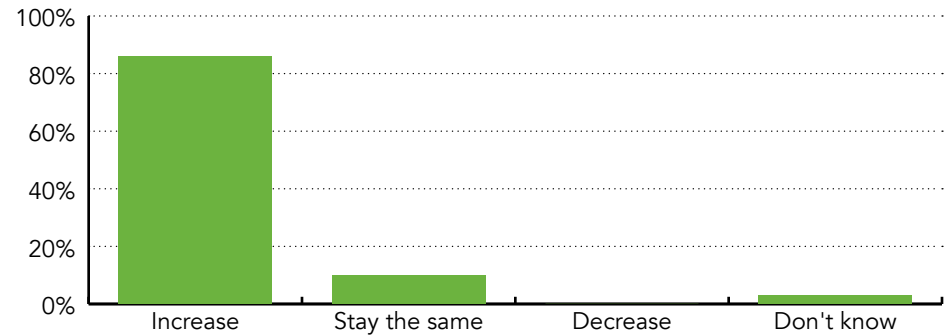
- The majority of respondents believe that the risk of flooding in Vancouver will increase over the next 30 years.
- The majority of respondents think that the issue of sea level rise is equally important to other issues that the City is facing.
- Regarding who should pay for the cost of adapting to sea level rise, we surprisingly found that there was somewhat of an agreement between the subgroups of owners and non-owners of land in the floodplain.
- The top four values respondents are concerned about are:
 1. communities and people
 2. infrastructure and transportation
 3. health and safety
 4. environment

Round 1 Survey

The first survey closed on June 18th, 2018 and received 118 responses. This survey targeted residents who lived or operated businesses in the Fraser River floodplain. It was sent to Talk Vancouver panel members with a postal code that identified that they lived in the study area. The results are the following.

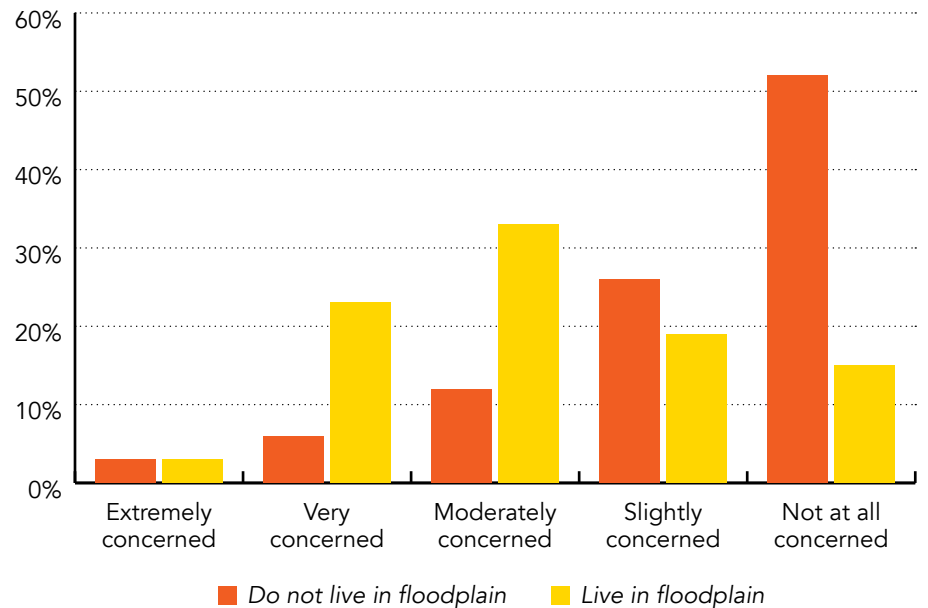
The majority of respondents (86%) believe that the risk of flooding in Vancouver will increase over the next 30 years.

FIGURE. Do you believe that the risk of flooding in Vancouver will change over the next 30 years? 1st Survey.



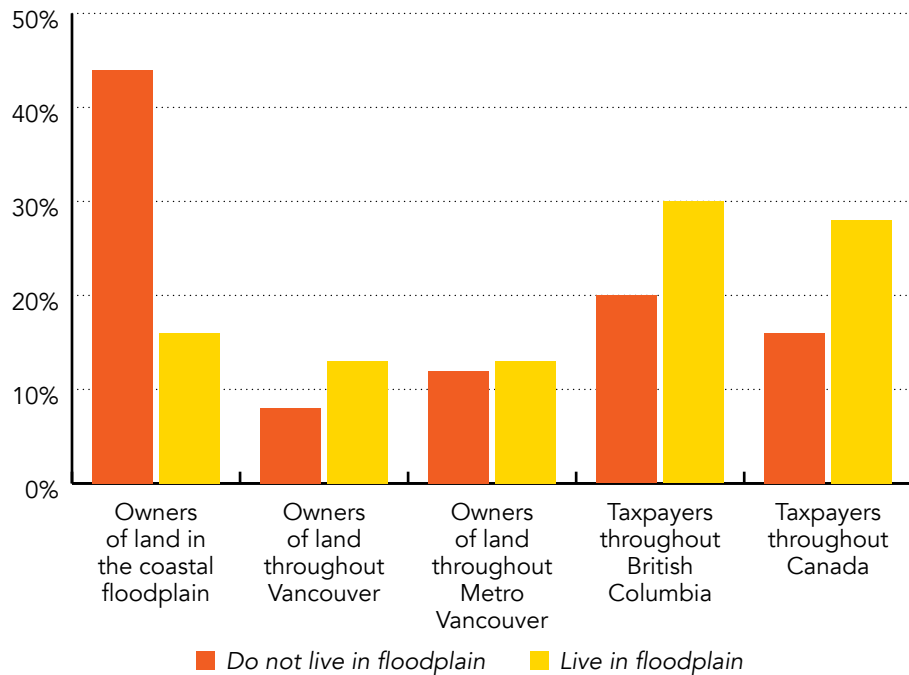
In regard to respondents' concern about coastal flooding risks to their properties, we can see in the next figure that those who live in the floodplain (yellow bars) are more concerned than those who do not live in the floodplain (orange bars).

FIGURE. How concerned are you about coastal flooding risks to your property? Yellow bars indicate those who live in the floodplain and orange bars indicate those who live outside the floodplain.



The next figure shows the difference in beliefs between respondents who live in the floodplain and those who do not regarding the question of who should bear the financial responsibility of adapting to sea level rise. It is clear that those who do not live in the floodplain believe that a large portion (44%) of the cost of adaptation should be borne by owners of land in the floodplain, whereas those who live in the floodplain believe that owners of land in the floodplain should bear a small percentage (16%) of the cost of adaptation to sea level rise. The orange bars represent those who do not own property in the particular area, while the yellow bars represent those who do own property in the area.

FIGURE. Who should bear the cost of adaptation? 1st Survey

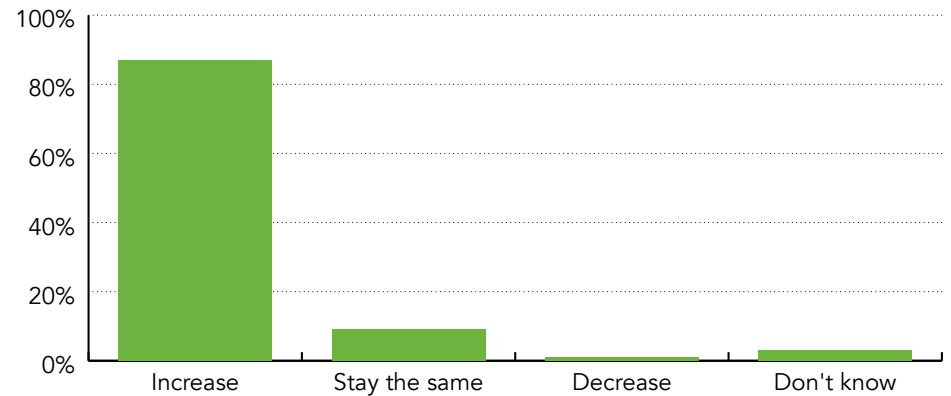


Round 2 Survey

The second survey closed on August 23, 2018 and received 907 responses. This survey was sent through Talk Vancouver to all those registered on that listserv. As such, the survey went out to a diverse audience of residents living on and outside of the Fraser River floodplain.

The majority of respondents (87%) believe that the risk of flooding in Vancouver will increase over the next 30 years. The results were almost identical to the first survey.

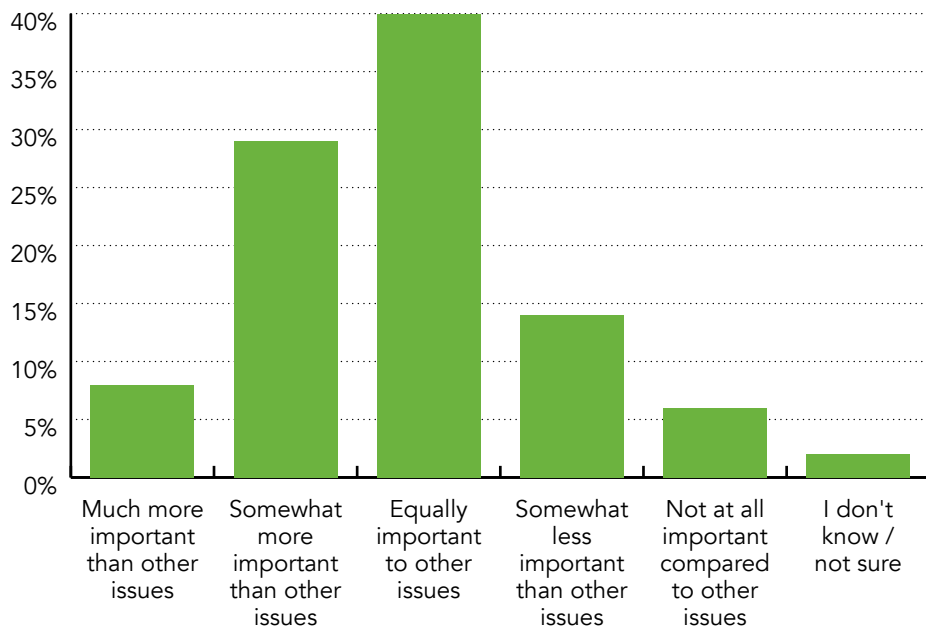
FIGURE. Do you believe that the risk of flooding in Vancouver will change over the next 30 years? 2nd Survey





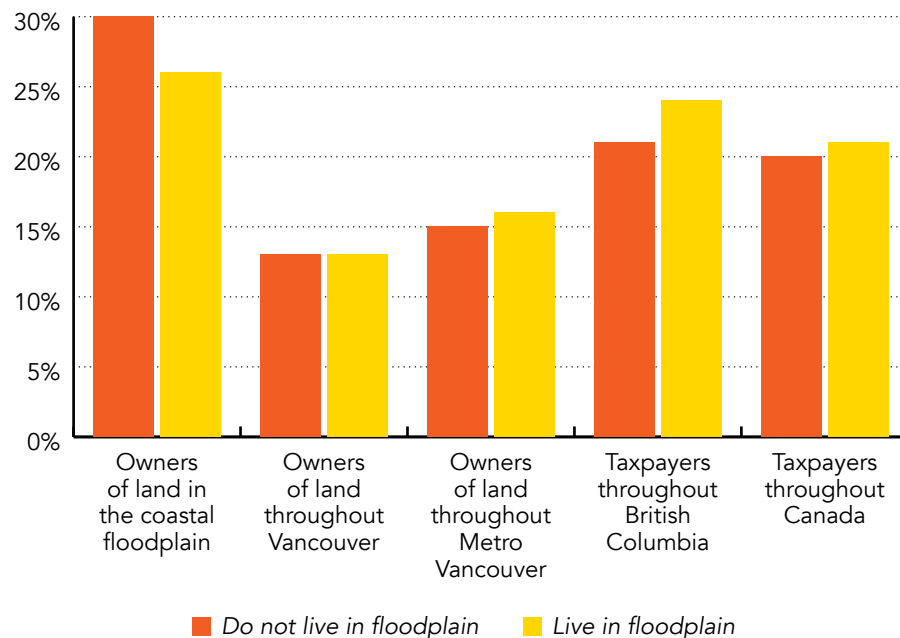
In regard to how important the issue of sea level rise is compared to other issues the City is facing, the majority (40%) said it was equally important with a trend towards it being more important (37%) than less important (20%).

FIGURE. Compared to other issues the City is facing, how important is the issue of sea level rise and coastal flooding?



The next figure shows the difference in beliefs between respondents who live in the floodplain and those who do not regarding the question of who should bear the financial responsibility of adapting to sea level rise. With the larger sample size of the second survey what we find is that there tends to be more agreement between the sub-groups of owners and non-owners of land in the floodplain.

FIGURE. Who should bear the cost of adaptation? 2nd Survey. Yellow "Yes" bars indicate those who own property in a particular area, while orange "No" bars indicate that they do not own property in the area.

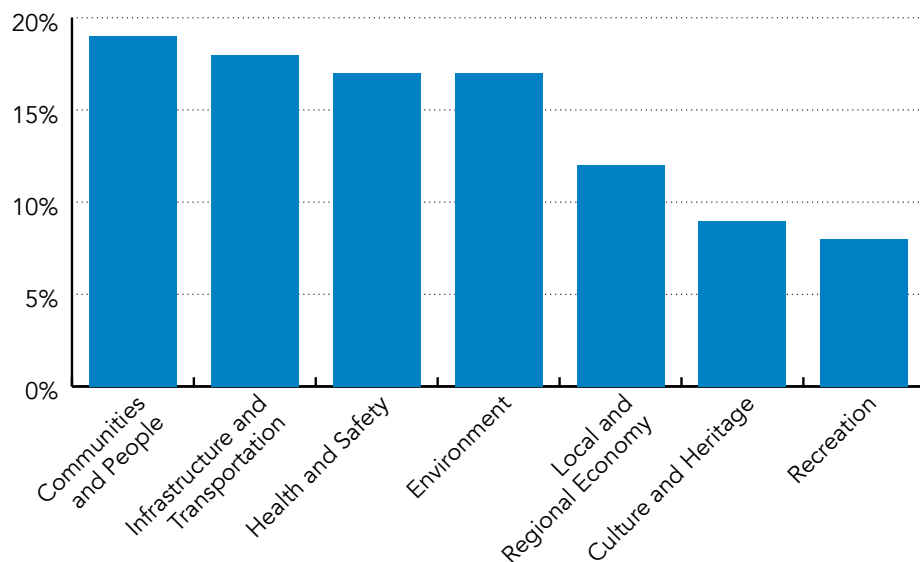




Fraser River looking west from East Fraser Lands area

The next figure shows the relative importance of the seven impacted values identified through the public engagement process. What we can observe is that the top four values - communities and people; infrastructure and transportation; health and safety; environment - are of relatively equal importance and ranked highly.

FIGURE. Concern of values impacted.

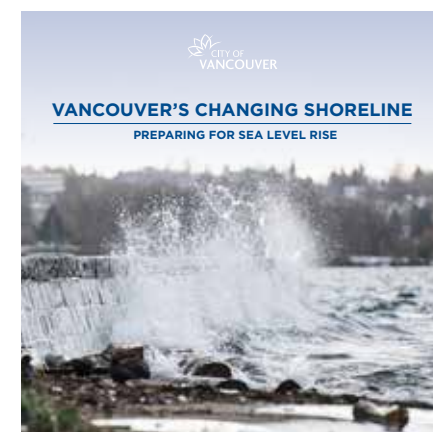


OTHER OUTREACH AND COMMUNICATIONS

The City of Vancouver supported community outreach and engagement with two key communications pieces, an introductory sea level primer, *Vancouver's Changing Shoreline: Preparing for sea level rise*, and a development of a CAP project website to host project materials, including reports, presentations, and workshop materials (e.g., maps, posters).

Vancouver's Changing Shoreline: Preparing for sea level rise is a 21-page document that provides an overview of the sea level rise challenge Vancouver is facing and outlines some of the steps Vancouver is already taking today to address the challenge. The primer was distributed to participants who attended community workshops and open houses and is available on line to download.

Several earned media events also took place, including CBC radio morning and afternoon shows. The City of Vancouver's "Greenest City" social media channels were also used to promote project events.



Outcomes

The following sections outline the outcomes of CAP Fraser River engagement and planning, including general community feedback on adaptation approaches, community values, adaptation design principles and supporting design attributes.

ADAPTATION APPROACHES

Coastal flood adaptation options can be organized into three general approaches – resist, accommodate, and move. Through two rounds of engagement and engagement with Musqueam, participants were asked to review the general options and to provide feedback on them, including what they liked about them, what they did not like about them, and how they could improve the different options.



Resist

Build structures to keep floodwater out and protect areas and community assets. Common approaches here include shoreline and inland dikes or offshore features to help reduce wind and wave action (which can help push more water ashore during storm surges).

Pros:

- Helps better protect communities and people
- Helps better protect infrastructure and transportation
- Opportunities for co-benefits (e.g., recreational trails)

Cons:

- Depending on alignment, some loss of land or building and homes will occur
- With sea level rise, the risks from a dike breach become more consequential (i.e., risks go up for people, communities and infrastructure behind dikes)
- Requires significant and expensive drainage infrastructure to move water from behind dikes into the river such as pump stations
- May not be technically feasible due to soils and seismic concerns
- Potential negative impacts on the environment and fish habitat, depending on location and type of dike
- Requires on-going maintenance and must be raised and upgraded over time as sea level rise continues



Accommodate

Rather than keeping floodwater out, these flood management options aim to keep community assets dry when flooding occurs. Examples include raising buildings and infrastructure (i.e., Flood Construction Levels) or designing them so that they can accommodate temporary flooding and stay dry when flooding occurs (e.g., “wet-proofing,” “dry-proofing”).

Pros:

- Promotes and supports recovery after a flood event (i.e., promotes resiliency)
- Helps better protect infrastructure and transportation
- Opportunities for co-benefits (e.g., recreational trails)

Cons:

- Implementation challenges (cost, phasing)
- Expensive to raise infrastructure and buildings to flood construction levels
- Relatively expensive, but the cost could be part of regular building replacement
- Requires on-going maintenance and may require retrofitting over time as sea level rise continues over the long term
- Long implementation horizon if accommodation relies on re-development (i.e., existing buildings remain at risk until redevelopment)



Move

Plan for the eventual relocation of people and/or facilities and buildings in high exposure, high risk areas of the city. This approach often includes returning portions of land to pre-development conditions (i.e., “naturalizing”).

Pros:

- Potential habitat gains
- Potential recreational gains
- Would reduce flood risk during an earthquake
- Long-term strategy would work regardless of rate of sea level rise

Cons:

- Implementation challenges (cost, phasing)
- Would likely take decades to be implemented

Across all engagement (community workshops, community open houses, Musqueam engagement) various concerns and comments were heard. One of the most prominent concerns was over the loss of homes, and, in the case of moving, where people would relocate to. This was particularly the case with the move and accommodate approaches. At the same time, people questioned the long-term efficacy of diking as part of the resist approach and raised concerns over how diking would hold up over the long term or during events like earthquakes or tsunamis.

Many participants had questions about the logistics of raising roads and homes and building up to new Flood Construction Levels (FCLs) in the accommodate approach. They were also concerned about the impacts or issues that raised roads or buildings would have on existing homes and facilities. Many participants also had questions around the City continuing to allow new development in the floodplain (e.g., East Fraser Lands), even being built with existing FCLs, given the long-term challenges.

The cost of each approach was also brought up, in terms of what the costs would be and who would cover them. While it is too early to discuss potential costs, the costs of implementing various approaches will likely be an ongoing concern and interest.

As expected at this early stage of conversation, there was a strong protection bias, with participants at workshops showing a strong interest in the resist approach. However, from comments and discussions at engagement events, there was also awareness of the challenges, costs, and increased risks posed by the approach. There was also wide understanding the path forward will likely involve a combination of approaches. The table summarizes consistent and common feedback on the three adaptation approaches.

ADAPTATION APPROACH	COMMON FEEDBACK AND CONCERNS
Resist	<ul style="list-style-type: none"> · Would help protect property values and communities over the short-term · Questions around long-term efficacy of diking with ongoing sea level rise · Questions and concerns on ability of dikes to hold up during earthquakes and tsunamis · Concerns over environmental impacts to creeks and intertidal zones · Concerns over long-term risks (i.e., bathtub effect) posed by diking · While approach could protect homes and facilities, some participants also aware of impacts over loss of views, encroachment, property loss, etc. that development of dikes could generate
Accommodate	<ul style="list-style-type: none"> · Questions around feasibility of raising roads and homes and building up to new Flood Construction Levels (FCLs), and the impacts this would have to existing buildings and infrastructure · Questions over long-term viability of current FCLs in face of continuing sea level rise · Concern over loss of homes that could be a part of any accommodate strategy · Support for habitat creation benefits of approach
Move	<ul style="list-style-type: none"> · Many participants see the approach as a “last resort” · Loss of property values a considerable concern with this approach · Concern over loss of homes, facilities and Musqueam cultural sites · Likely the leading contender for a long term (100+ year) strategy · Difficult to compensate and move whole communities, particularly in a city like Vancouver with a limited land base and high property values

Values, Principles and Attributes

Like all large, complex projects, the Coastal Adaptation Plan for the Fraser River Foreshore will likely require trade-offs. The development of guiding principles and attributes, and the use of community values to help evaluate future flood management approaches, will provide a clear and transparent framework in which to consider these trade-offs, and help select an optimal strategy for managing coastal flooding and sea level rise along the Fraser River.

Preliminary community values, design and planning principles, and supporting design and planning attributes developed through the first phase of the Fraser River Foreshore project are presented in the following sub-sections.

VALUES

Collectively, community engagement helped identify many consistent and broadly-shared values. Values are the community concerns and desires that represent what residents and other stakeholders care about most in the Fraser River Foreshore area. Values were first identified during community workshops and then organized into seven thematic categories with related sub-concerns that were confirmed, validated and prioritized through community open houses and surveys.

In future project phases, measures will be developed for the community values so that the values can be used along with more technical engineering criteria in future project phases to help evaluate potential adaptation options. Similar measures can also be developed for sub-values and used as evaluation criteria of future adaptation options. The use of community values in the evaluation of adaptation options will help ensure that the potential flood options incorporate community concerns. They will also help support future conversations around potential trade-offs within and between community values. They are presented in general order of priority and importance based on community feedback.



Community open house at Dunbar Community Centre

1. Communities and People
2. Environment
3. Health and Safety
4. Infrastructure and Transportation
5. Local and Regional Economy
6. Culture and Heritage
7. Recreation



New development along the Fraser River

Communities and People

The Fraser River Foreshore area is home to multi-family housing units in the eastern part of the floodplain, mostly detached homes in the Southlands neighbourhood towards the west, and a mix of dwellings within Musqueam's principal reserve, which is also home to large number of leaseholder homes.

Beginning as an agricultural and farming community, Southlands is one of Vancouver's most unique neighbourhoods and is the only area in the city that is in the provincial Agricultural Land Reserve. The Southlands area is where Musqueam's principal reserve is located. It is home to hundreds of members and a range of community facilities, including Musqueam's Administrative Office, a Cultural Centre, Musqueam Community Centre and Musqueam Golf Course

Future flood management approaches must consider impacts on communities and people, and, where practical and feasible (technically, in terms of risk tolerance, etc.), minimize permanent displacement of residents.

Prioritized sub-concerns identified through community engagement include:

- Property value losses
- People permanently displaced due to flooding
- Damage to homes from flooding
- Vulnerable people adversely impacted (e.g., seniors)
- Adverse impacts to Musqueam housing and facilities
- People temporarily displaced due to flooding
- Loss of residential land in an area currently facing both housing shortages and limited developable land



Great Blue Heron on Fraser River

Environment

The Fraser River Foreshore includes marine, inter-tidal and terrestrial habitat areas of various sizes, condition and connectivity. Individually and collectively, they provide critical habitat for juvenile salmon and migratory birds, as well as function as wildlife corridors along Vancouver's southern border.

Future flood management approaches should, where practical, minimize negative impacts to wetland, freshwater and riparian habitats, while seeking opportunities to enhance and expand them.

Prioritized sub-concerns identified through community engagement include:

- Contaminants released into the environment from flooding
- Damage to, and loss of, intertidal habitats (mud flats, salt water marsh, intertidal areas)
- Damage to and loss of habitat on land, including shoreline habitats and wetlands
- Coastal squeeze⁵ and loss of intertidal ecosystems
- Temporary and permanent loss of access and flood damage to parks and open spaces

⁵ See page 21. Coastal squeeze refers to the reduction and permanent loss of intertidal ecosystems over time as they are "squeezed" out between permanent inundation due to rising sea levels and increased development pressure on land that does not permit intertidal habitats to migrate inland over time.

Health and Safety

Public safety and wellbeing are critical community concerns that only become heightened during an emergency (i.e., flooding). While flood events pose life safety concerns, recovery from flood events can also pose significant health and safety challenges.

Future flood management approaches should minimize health and safety impacts and integrate with existing emergency response planning.

Prioritized sub-concerns identified through community engagement include:

- Disruptions to lifeline infrastructure and services (power, water, roads, communications)
- Contaminants released into the environment from flooding
- Loss of life
- Emergency access disruptions (due to road closures and damage)
- At-risk people adversely impacted (e.g., seniors)
- Injuries



Coast Mountain Bus Company Vancouver Transit Centre

Infrastructure and Transportation

From lifeline services supporting both the local area and larger city (e.g., natural gas, hydro, cellular, water, sewer) to important transportation corridors (Kent Street) and the Vancouver Transit Centre, the Fraser River Foreshore area is home to a range of critical infrastructure and services.

Future flood management approaches should minimize service disruptions where possible.

Prioritized sub-concerns identified through community engagement include:

- Damage to and disruption of infrastructure services (water, sewer)
- Damage to disruption of power infrastructure (electrical, natural gas)
- Emergency access disruptions (due to road closures, damage)
- Damage to disruption of transportation infrastructure (roads, transit)
- Damage to and disruption of telecommunication services (phone, internet)
- Cascading impacts to other parts of Vancouver and region (i.e., cumulative impacts and inter-connected impacts)

Local and Regional Economy

The Fraser River Foreshore area is home to about 280 industrial, warehouse and commercial buildings, concentrated within the floodplain area south of Marine Drive. This area is home to approximately 700 businesses. There are also a number of businesses located there that rely on access to the Fraser River for their operations.

Future flood management approaches should, where practical and feasible (technically, in terms of risk tolerance, etc.), minimize permanent displacement of businesses and/or loss of employment lands.

Prioritized sub-concerns identified through community engagement include:

- Business interruptions and damage to assets from flooding (buildings, inventory, etc.)
- Disruption to regional services, supply chains and goods movement
- Loss of employment lands
- Employment interruptions and job losses



The Mali lands near Musqueam is a culturally and environmentally sensitive and important foreshore area

Culture and Heritage

From sites of spiritual, historic and archeological significance to the Musqueam People, such as middens and ceremonial sites, to the unique agricultural character of the Southlands, culture and heritage are deeply rooted along the Fraser River Foreshore. Additionally, Musqueam members use some foreshore areas near their reserve for traditional use activities (e.g., fishing, gathering).

Future flood management approaches should recognize the importance of cultural and traditional use sites and strive to retain these sites as much as possible.

Prioritized sub-concerns identified through community engagement include:

- Damage to and loss of traditional use areas
- Damage to archeological sites
- Damage to and loss of cultural sites, including ceremony sites
- Damage to heritage landscapes in Southlands
- Damage to heritage homes in Southlands

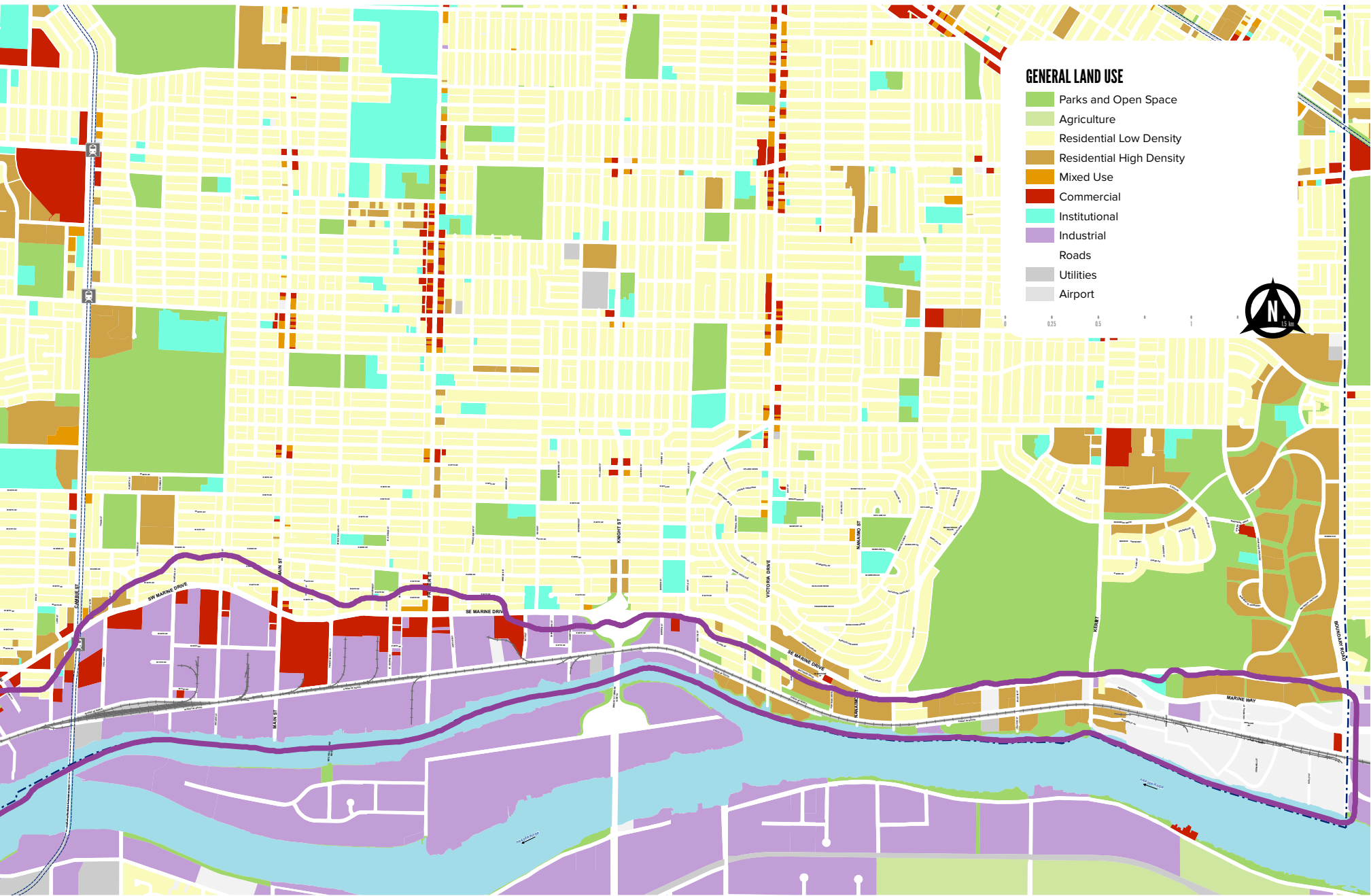
Recreation

From trails to and along the Fraser River for walking, cycling, horseback riding, bird watching and the like, to three golf courses and many horse stables, the Foreshore area is also home to multiple recreational opportunities.

Future flood management approaches should, where practical and feasible (technically, in terms of risk tolerance, etc.), maintain and where possible increase the diversity of recreation opportunities in the area.

Prioritized sub-concerns identified through community engagement include:

- Loss of access to Fraser River
- Loss of access to trail network
- Impacts to equestrian areas and stables
- Environmental impacts to recreation areas (i.e., open space, greenspace)
- Damage to recreational facilities (golf courses)



VALUES AND FUTURE OPTION EVALUATION

In future project phases, measures will be developed so that the community values can be used along with more technical engineering criteria to help evaluate potential adaptation options. The use of community values in the evaluation of adaptation options will help ensure that the potential flood options incorporate community concerns but will also help support future conversations around potential trade-offs within and between community values.

Any future values assessment would be supported by a technical and risk assessments, which will likely include a summary of how well the option would perform during an earthquake, a large flooding event (i.e. 1-500 year storm) and the option's ability to manage stormwater runoff and drainage.

Recognizing that all flood protection options would carry some risk of failure, future work would include an analysis of the anticipated impacts to community from a failure of an option. For each option, a detailed description of the anticipated impacts to community values would be provided, likely using a scale from Very Low to Very High. As illustrated, the impact of a failure on a community value would be assessed against the likelihood of failure of an option to provide a risk assessment (i.e., against each value and overall for the option).

FIGURE. Sample option assessments using community values (for illustrative purposes only)

	NO ADAPTATION	OPTION A	OPTION B	OPTION C
IMPACT & RISK OF FAILURE				
Overall risk	Very High	Very Low	High	Medium
VALUES CRITERIA				
Communities and People	Far Worse	Far Worse	No Change	Slightly Worse
Environment	Moderately Worse	Far Better	Slightly Worse	Slightly Worse
Recreation	Far Worse	Far Better	No Change	Slightly Better
Infrastructure and Transportation	Far Worse	Far Better	No Change	Slightly Worse
Local and Regional Economy	Far Worse	Far Worse	Slightly Better	Slightly Worse
Culture and Heritage	Far Worse	Slightly Worse	No Change	Slightly Worse
Health and Safety	Far Worse	Far Better	Slightly Better	Slightly Better
COST CRITERIA				
Adaptability Over Time	High	High	Low	Medium
Operation & Maintenance Cost	Medium	Low	Very High	High
Capital Cost	Very Low	Low	Very High	High

PRINCIPLES

Based on feedback from community members and stakeholders, the project consultant team developed a list of high-level design principles. The foundational guidelines also reflect the accumulated knowledge and experience of the City and consultant team with coastal flood management. The draft principles were presented to the community at the two open house events and through the second community survey for feedback and refinement.

The principles will provide direction for future phases of CAP work, including the development of flood management options, infrastructure design and policy.

They are presented in order of priority based on community feedback.



Design for adaptability: Develop flexible options that can adjust to a wide range of future conditions, including the pace of sea level rise, the height of sea level rise, and future land uses.



Design for co-benefits: Ensure that new approaches support multiple community values (e.g., recreation, health and wellbeing, communities and people).



Design for nature: While the study area is heavily urbanized, the Fraser River is the most significant salmon river in BC. It is also home to other threatened species (e.g., sturgeon) and regionally critical and rare estuary habitats.



Design for safe-to-fail infrastructure systems: Ensure risks to lifeline infrastructure and services are minimized, and that redundant systems are in place in case of failure.



Design for safety and public health: Ensure public safety risks are minimized, and that public health and wellbeing are protected.



Design for access: Improve access to and around the Fraser River and include recreational and interpretive opportunities where feasible.

In addition to the design principles, the following planning principles were also developed to support internal City planning and future project work. They were reviewed by City project staff, but not presented to the public. They are not presented in any hierarchy.

- **Plan for integration:** Integrate flood management strategy with relevant City-wide plans (e.g., *Citywide Integrated Rainwater Management Plan*) and local level, neighbourhood plans (e.g., Marpole Neighbourhood Plan), and where required, provide direction on necessary amendments (e.g., zoning changes). Coordinate with other relevant municipalities.
- **Plan for reconciliation:** Specifically address Musqueam, cultural values (hunting, gathering, ceremony sites), and cultural/ archeological sites (e.g., Marpole Midden). Incorporate City of Reconciliation policy and related emerging City of Vancouver protocols, procedures and plans.
- **Plan for transparency (education):** Flood management approaches should include educational and awareness building components that openly communicate flood risks facing the area, as well as the City's decision-making and management processes.
- **Plan for cost-sharing:** work with all levels of government, asset holders and other stakeholders to implement short-, medium-, and long-term flood control infrastructure measures and maintenance efforts.

ATTRIBUTES

Attributes are a subset of design principles that provide more detail about design considerations and elements intended to operationalize and support the principle(s) under which they are organized. The attributes were developed by project consultants and presented to community members, stakeholders and City staff for feedback and refinement. Multiple attributes can be employed across adaption approaches to help ensure that co-benefits across both principles and community values area achieved.



Design for adaptability

- Prioritize options that can be phased with increasing levels of sea level rise
- Prioritize options that continue to be feasible with more than 2 meters of sea level rise
- Areas where flooding would have higher consequences should be protected to higher standards than areas with lower consequences (e.g., golf courses and associated community amenities may not be protected to the same standards)
- Resist features (e.g., dikes, flood walls) phased over time with increasing sea level rise
- Tiered development with flood tolerant uses, such as pathways, at lower elevations
- Flood Construction Levels (FCLs) raised over time
- Sponge parks or flood parks
- Raise roads
- Relocate over time
- Flood tolerant building techniques (e.g., stilts, floats, wet-proof, dry-proof)



Design for nature

- Restore, rehabilitate or create new foreshore habitat areas where practical
- Address overland flooding hazards by prioritizing green infrastructure solutions for storm water retention, detention, and infiltration.

- Where feasible allow for river channel migration or expansion to accommodate additional flows (riverine, freshet flooding hazard)
- Work with the natural water dynamics
- Utilize Green Shores⁶ techniques for resist approaches
- Flood wall with habitat features
- River channel migration
- Expanded riparian areas
- Remove sea walls and barriers and restore foreshore habitat



Design for safe-to-fail infrastructure systems

- Relocation of lifeline infrastructure and services out of the floodplain should be the first consideration
- Where relocation is not possible, lifeline infrastructure should be protected to higher standards (e.g., 1-in-10,000) than non-lifeline infrastructure
- Where relocation is not possible, robust strategies to reduce the consequence of failed lifeline infrastructure should be developed and implemented to ensure continuity of critical services
- Wet proof/ dry proof strategies



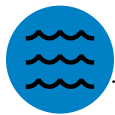
Design for safety and public health

- Adaptation strategies should first focus on seeking opportunities for relocation
- Where risk to public health and safety is high (e.g., higher density, community amenities, brownfield sites) and relocation is not feasible, build in redundancy through the incorporation of multiple

⁶ Green Shores is a program of the Stewardship Centre for BC. It provides science-based tools and best practices to help communities and people minimize the impacts of new developments, and to restore shoreline ecosystem function of previously developed sites. Projects can also receive certification through our credits and rating system.

structural and non-structural flood management approaches (e.g., protective dike, building wetproofing, emergency warning system, public education and communications), as well as build to higher flood protection standards

- Ensure floodplain can be preventively evacuated within 24-hours. If this is not feasible, ensure safe havens (areas inside the threatened zone that will not be affected) are built to high safety standards
- Flood management approaches developed on brownfields should minimize risk of water contamination during construction and flood inundation
- Seek strategies that lower the vulnerability of at-risk and vulnerable populations and coordinate with emergency response planning
- Built in redundancy, such as wet proof buildings
- Flood tolerant land uses, such as parking or other non-habitable uses below the FCL
- Elevate or raise critical access roads
- Remove contaminants from flood zones
- Relocate homes from flood zone where possible



Design for access

- Integrate shoreline access and trails into flood management approach
- Ensure accessibility of shoreline access and trails
- Seek opportunities to improve trail connections and shoreline access
- Maintain opportunities for fishing and hunting along foreshore and intertidal lands
- Trails on flood management features (e.g., trails on dikes)
- Improve shoreline access
- Improved access to recreation (e.g., nature watching, fishing, paddling)

In addition to design attributes, project consultants also developed a series of attributes for the planning principles. These were reviewed by City staff for feedback and refinement, but not presented to the public.

Plan for integration

- Coordinate flood management approach with regional bodies and senior governments and agencies
- Coordinate flood management approach with neighbouring municipalities
- Coordinate flood management approach with other City of Vancouver planning initiatives (e.g., *Citywide Integrated Rainwater Management Plan*, *Marpole Neighbourhood Plan*, *Greenest City Action Plan*)

Plan for reconciliation

- Integrate and coordinate flood management planning and implementation with Musqueam
- Support cultural programming and interpretative signage along the Fraser River with Musqueam

Plan for transparency (education)

- Engage stakeholders throughout the design and decision-making process of developing flood management strategies
- Communicate that absolute protection is impossible and that we should plan for safe-to-fail flood management approaches
- Improve awareness of flood risk, sea level rise and climate change through educational signage and interpretive features
- Openly communicate flood risk to decision makers, asset owners and the public

Plan for cost-sharing

- Demonstrate public benefits beyond the protection of private land for publicly-funded flood management projects
- Prioritize and phase solutions to obtain the best value for money
- Take advantage of opportunities that arise through infrastructure lifecycle planning and land redevelopment

Resist

Applying principles and attributes to flood adaptation approaches



Design for adaptability



Design for safety and public health



Design for safe-to-fail infrastructure systems



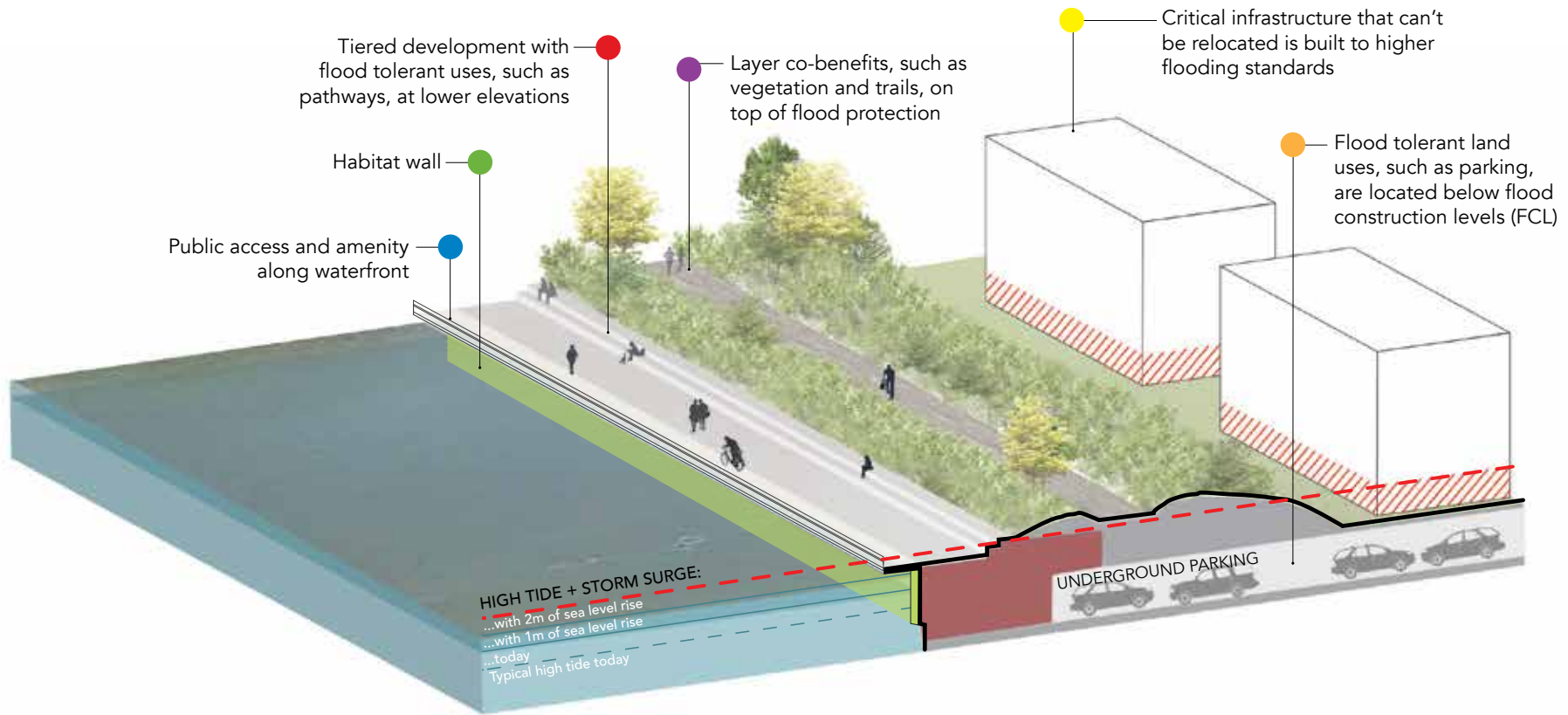
Design for nature



Design for access



Design for co-benefits



Resist

Applying principles and attributes to flood adaptation approaches



Design for adaptability



Design for safety and public health



Design for safe-to-fail infrastructure systems



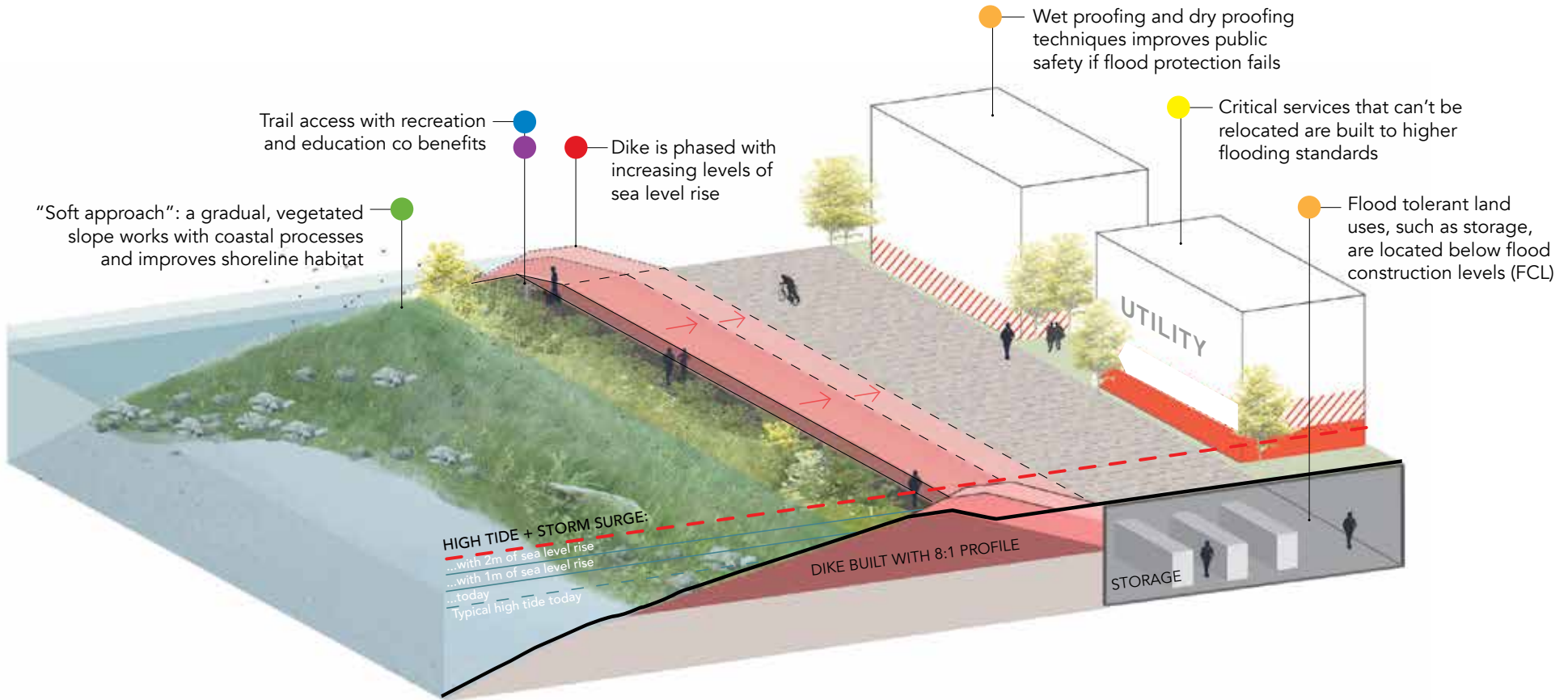
Design for nature



Design for access



Design for co-benefits



Accommodate

Applying principles and attributes to flood adaptation approaches



Design for adaptability



Design for safety and public health



Design for safe-to-fail infrastructure systems



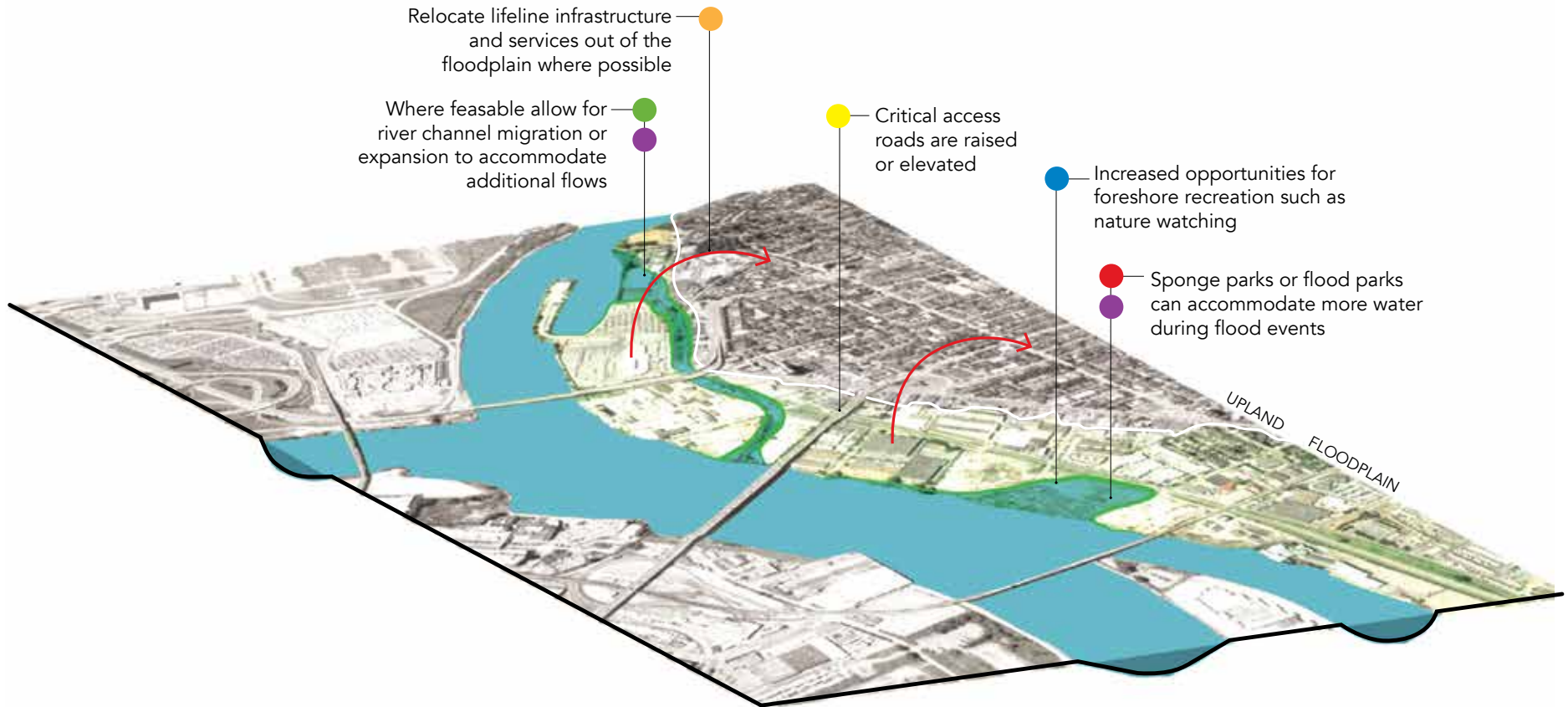
Design for nature



Design for access



Design for co-benefits



Accommodate

Applying principles and attributes to flood adaptation approaches



Design for adaptability



Design for safety and public health



Design for safe-to-fail infrastructure systems



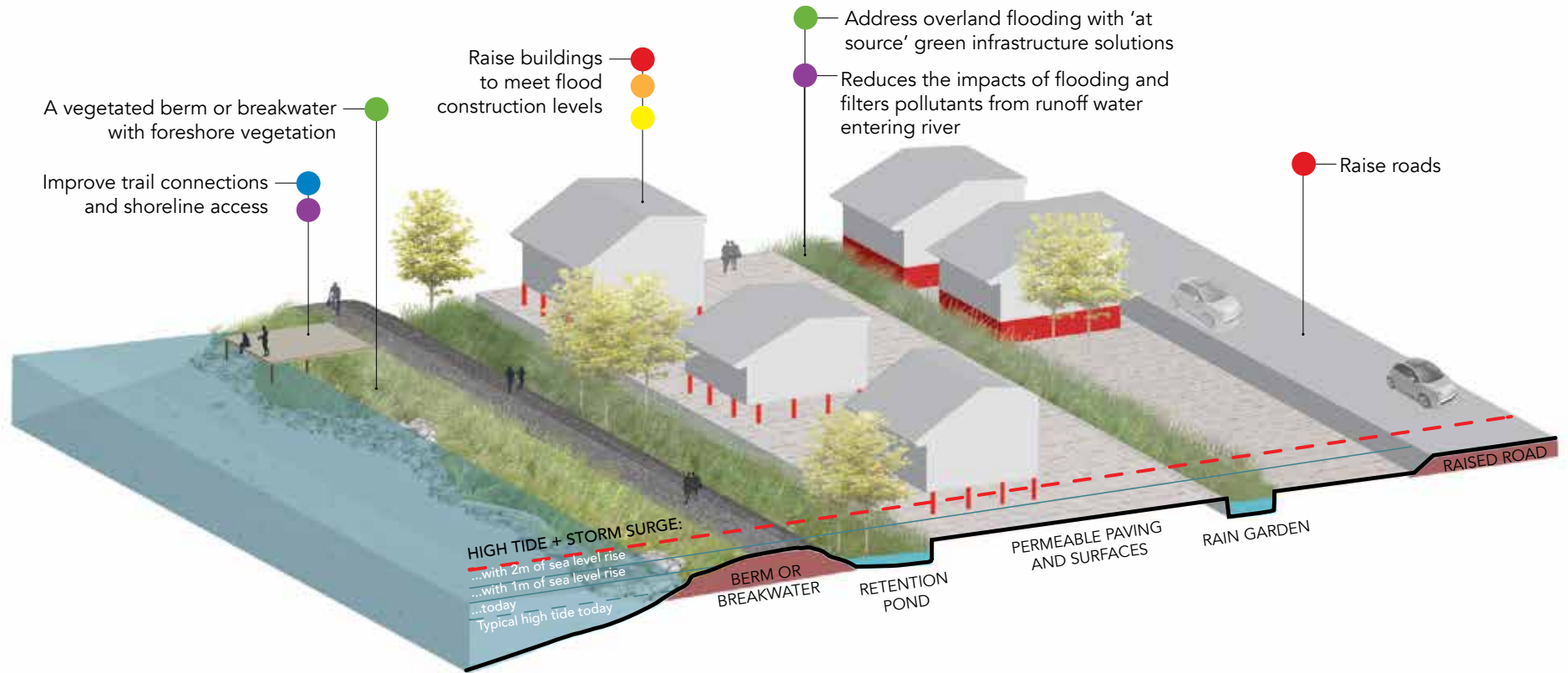
Design for nature



Design for access



Design for co-benefits



Move

Applying principles and attributes to flood adaptation approaches



Design for adaptability



Design for safety and public health



Design for safe-to-fail infrastructure systems



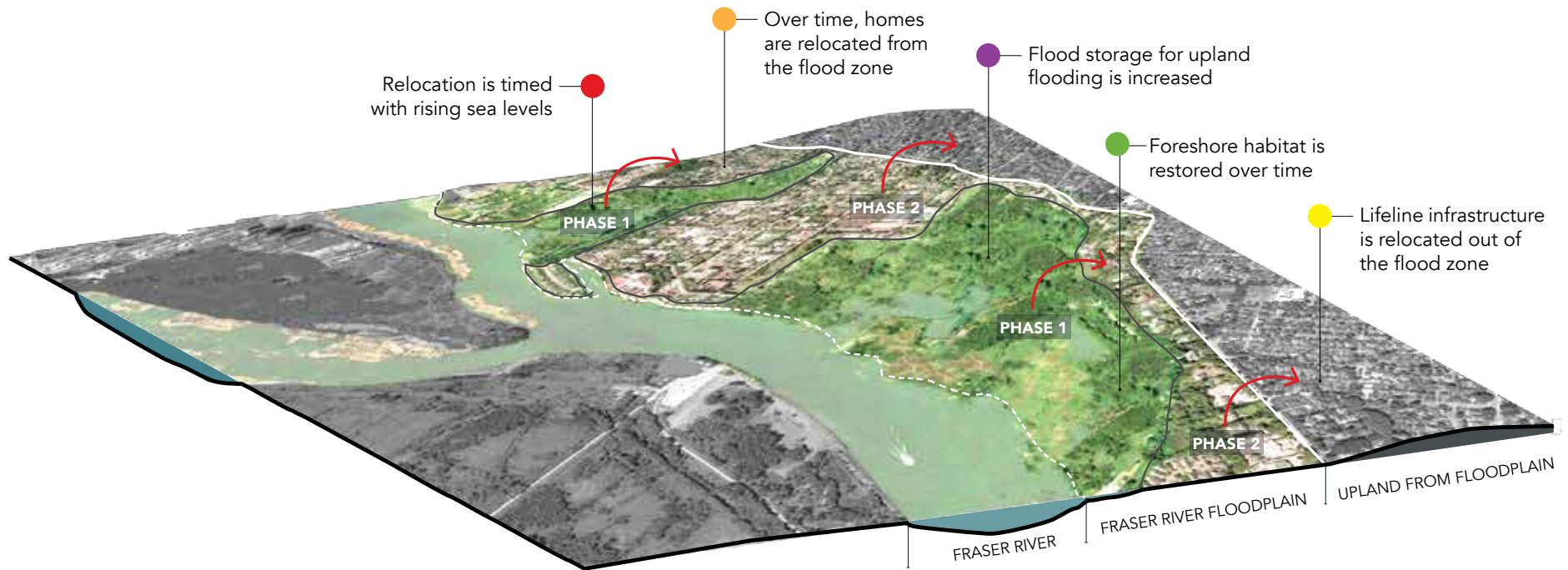
Design for nature



Design for access



Design for co-benefits



Move

Applying principles and attributes to flood adaptation approaches



Design for adaptability



Design for safety and public health



Design for safe-to-fail infrastructure systems



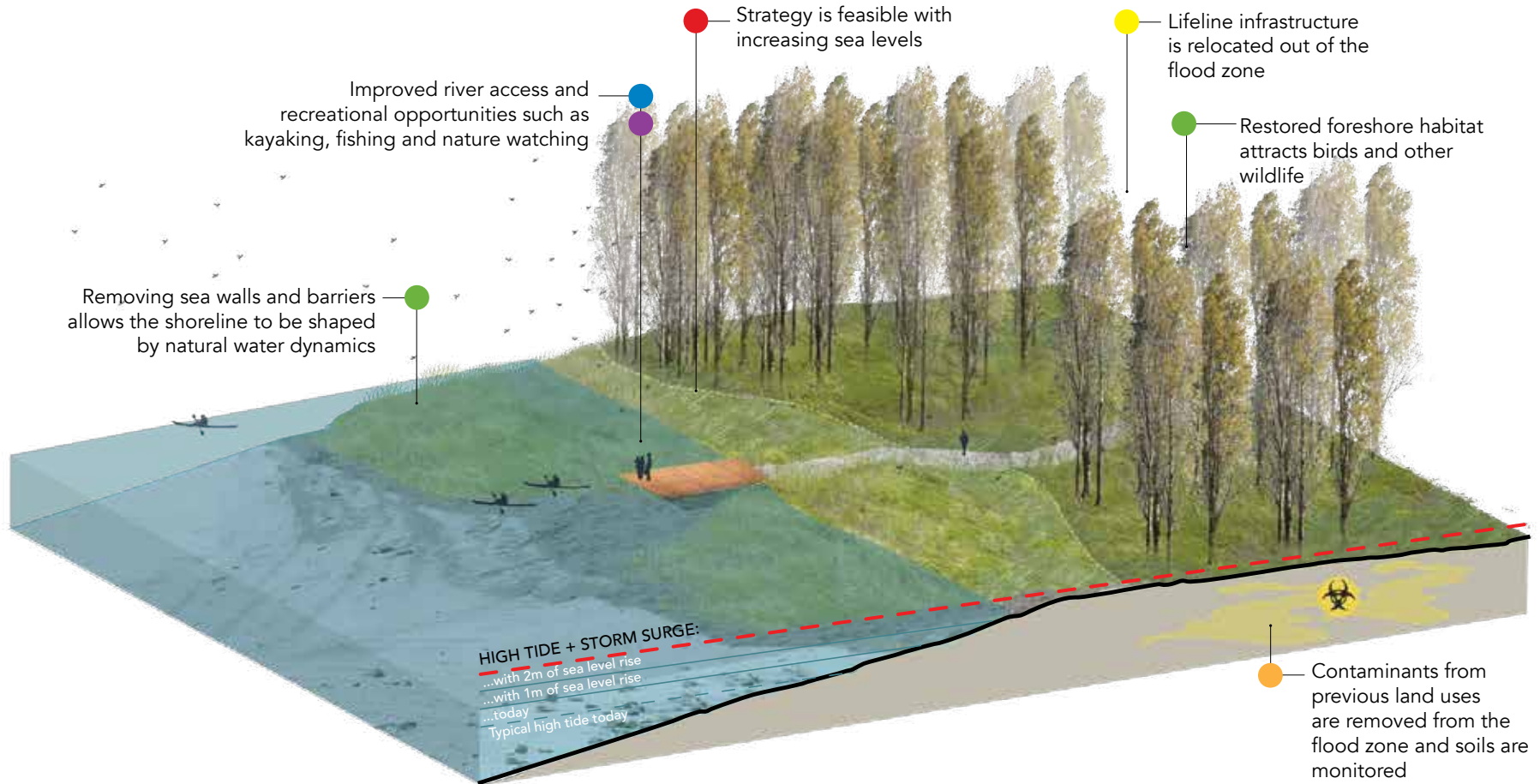
Design for nature



Design for access



Design for co-benefits



Recommendations

The following recommendations were developed by the project consultant team and City staff based on an analysis of project outputs and feedback from residents, Musqueam, business owners, asset owners and operators, and other project stakeholders. They are intended to help ensure that valuable lessons learned from first phase of the Fraser River Foreshore CAP are carried forward to help guide future project phases.

- **Continue to refine and validate community values in future project phases.**

The community values identified during the first phase will be a critical component of future option development and option evaluation. Residents, business owners and other stakeholders who did not participate in the first phase of the project will become engaged in future phases, particularly as potential flood adaption options are developed and evaluated. To ensure there are as few gaps as possible, and to fully engage new participants, it is important to continue eliciting, refining and prioritizing community values in future project phases. Furthermore, over time, and with growing awareness of the challenges posed by climate change, sea level rise, and coastal flooding, community values and priorities may shift.

- **Maintain value-based, participatory process through future project phases.**

Participant feedback from the open houses, workshops and other outreach indicates that the City's commitment to participatory, values-based planning was strongly supported. Given that trade-offs and difficult conversations will be inevitable as the project moves forward into future phases, maintaining this commitment going forward will be a critical component of ongoing relationship building with residents and key project partners. A continued focus on a values-based, participatory process will help make some of the conversations less divisive.

- **Continue public education around the existing coastal flood risk.**

Even without climate change and sea level rise, the Fraser River floodplain is at risk from coastal flooding; however, most residents, asset operators and businesses who participated in the project did not know this. Continued public education and awareness building on the part of the City is required to address this issue and improve community resilience in the area.

- **Address existing emergency alert and response issues.**

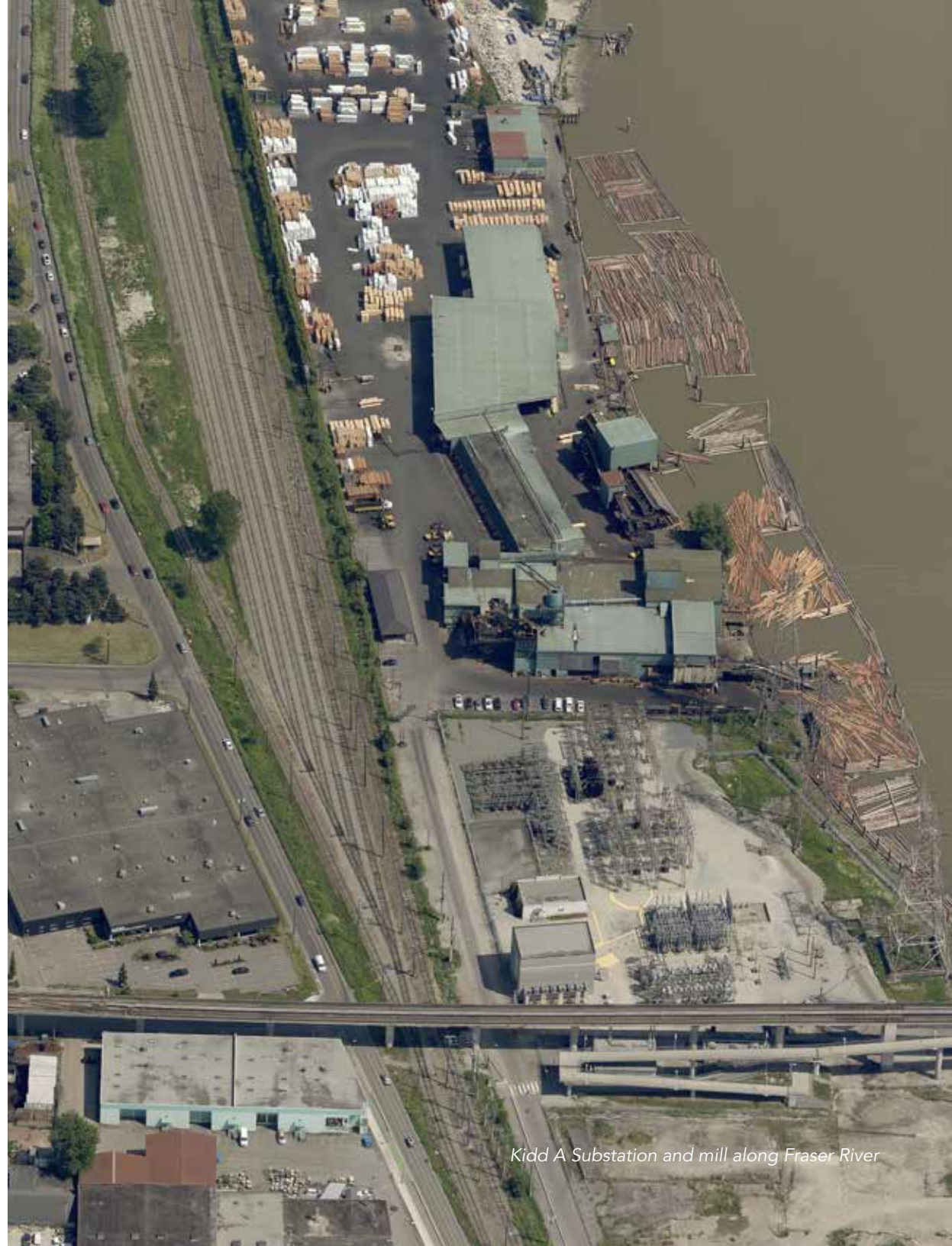
Engagement confirmed that many (if not most) participants had limited awareness of the existing flood risk posed by ocean-driven storm events. Engagement also confirmed limited awareness around the existing lack of protective infrastructure (dikes, pumps) in the Fraser River Foreshore area. The City of Vancouver should develop and implement an emergency alert system for ocean-driven storm events and a corresponding emergency response and management system.

- **Continue to work with and collaborate with Musqueam as a key partner.**

The City of Vancouver should continue building relationships with Musqueam staff and community members in future phases of the project. Engagement with Musqueam confirmed a strong desire to pursue further joint planning and action with the City. Of particular note, Musqueam staff were also concerned that the City of Vancouver's timeline for planning and implementing flood management options does not align with Musqueam Capital

Corporation's (MCC) intent to develop a large parcel of land on IR#2 on the existing Musqueam golf course. MCC's development timeline is relatively short and staff were concerned that the development may be impacted by the City of Vancouver's future flood management approach for adjacent lands in Southlands.

- **Continue to engage asset owners and operators.** The Fraser River Foreshore is home to major infrastructure, including critical lifeline infrastructure. Feedback from a workshop for asset owners with facilities and linear utilities located within the study area confirmed a strong desire to stay engaged in the Fraser River Foreshore process and to build on the preliminary vulnerability assessment carried out in the workshop. The event also underscored the need for the City to continue building relationships with the asset owners going forward into future phases of the project, particularly for those areas where highly sensitive facilities and critical lifeline infrastructure are clustered.



Kidd A Substation and mill along Fraser River

Considerations Going Forward

The following considerations were developed by the project consultant team and internal discussions with the City project team based on the understanding and recognition that the City is still working to detail the path forward on this complex and challenging issue. They are framed as questions and intended to support conversations around the scoping and phasing of future Fraser River Foreshore project phases.

- **How can the City best maintain project momentum and address expectations around future work with phase one participants?**

The Fraser River Foreshore CAP project represents significant ‘*engagement investment*’ for the City of Vancouver in the development of community awareness around existing and future coastal flood risks in the area. With participants now better understanding the present-day risks, engagement activities have also resulted in expectations from project participants (Musqueam, asset owners, residents, etc.) around future phases (i.e., there is a risk *today*, and a matching desire for action *today* to mitigate the risk). Related to these outcomes, the project has also created some momentum for future project phases which would need to be leveraged and harnessed in the shorter-term to be maintained. How can the City effectively maintain project awareness and momentum? How can the City best address project expectations, while not eroding the “good will” that has developed due to phase one activities? In the short term targeted external project communications with key partners and stakeholders will be key to maintain project momentum and address expectations around future work.

- **How can the City best address internal awareness gaps and bridge departmental silos?**

Climate change adaptation is a complex and crosscutting issue with relevance to many City departments and organizations. While City staff from some departments were engaged (Planning, Urban Design, and Sustainability; Engineering Services; Parks and Recreation) at different junctures throughout the project, their engagement was not consistent and also highlighted varying degrees of awareness around existing coastal flood risks and future coastal flood risks, both in the Fraser River Foreshore area and across the city. In future project phases, it may be advisable to more formally engage City staff and other relevant departments (Fire and Rescue and Emergency Management; Real Estate and Facilities Management; Finance, Risk, and Business Planning) as a project steering committee or advisory group to provide project input, improve issue awareness, and help ensure that every department with a role to play in addressing the challenges ahead are at the same planning table.

Appendices

APPENDIX A: ASSET OWNERS WORKSHOP – SUMMARY REPORT

APPENDIX B: MUSQUEAM ENGAGEMENT – SUMMARY REPORT

APPENDIX C: COMMUNITY WORKSHOPS, OPEN HOUSES AND SURVEYS – SUMMARY REPORT

APPENDIX D: REFERENCING SYSTEM – SUMMARY REPORT



Prepared with the assistance of:
EcoPlan, 208-131 Water Street, Vancouver BC, V6M4B3
info@ecoplan.ca • www.ecoplan.ca

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