Policy Brief #2: Coastal sustainability and climate change adaptation for future flood management in BC's lower mainland

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Issue	Opportunity	Action
Current coastal flood infrastructure and planning does not consider ecological impacts and negative influences on valuable aquatic species	Municipalities from across the region are currently developing a Lower Fraser Flood Management Strategy, now is the time to consider ecological impacts of flood protection	Embracing, where possible, flood protection strategies that enhance estuarine and coastal habitat while maintaining freshwater sustainability.

The Lower Fraser and Estuary

Flood management is a pressing issue in the Lower Fraser region, predicted to cost 9.5 billion to mitigate future risk associated with climate change. Sea level rise, coastal storm surges, and king tides can result in significant damage to infrastructure and coastal flooding. This puts pressure on freshwater ecosystems due to saltwater intrusion of streams and flood protection structures. The dominant use of "hard" flood protection works on BC's coasts have resulted in multiple negative ecological impacts and lost recreational opportunities. Sea dams on coastal rivers negatively impact local restoration efforts and affect socially and economically important species like herring and smelt. Alternatives to “hard” flood protections exist and should be embraced in appropriate locations.

Overview: Local Government

Federal, provincial, municipal and regional authorities, all play a role in defining laws and bylaws that influence the management of flood infrastructure; however, ownership and cost typically fall to local governments. Flood protection structures such as seawalls, dikes, sea-dams, floodgates and pumping stations are all highly expensive methods for protecting communities and farmland, placing considerable financial burden on municipalities. These structures also significantly impact local fish communities including reducing access to important rearing areas for salmon in the Lower Fraser River. Municipalities across the region are currently partnered in the development of the Lower Mainland Flood Management Strategy and have the opportunity to create regional priorities around enhancing the environment. Raincoast Conservation and West Coast Environmental Law are contributing to this process as members of the environmental advisory committee. Phase 2 of the strategy is now underway, to develop a regional flood strategy report and recommendations for action, including cost-sharing options and alternative technologies. Current flood control standards do not consider ecological sustainability or healthy fish habitats, and therefore we are advocating for incorporating environmental considerations into the strategy.

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Recommendations

- Prioritize alternatives to the installation of traditional dikes, sea dams and other hard structures by employing green infrastructure such as such as “Living Dikes” and Green Shores™ that would provide multiple benefits
- Work with local stewardship groups to identify opportunities to reduce impacts of current infrastructure, reduce barriers and identify benefits for green infrastructure
- Create integrated watershed management plans that include funding streams for implementation
- Implement storm water user fees to raise funds for green infrastructure projects
- Remove flood control structures where they are not required and implement solutions to improve riparian habitats
- Allow less productive agricultural areas to be inundated and provide monetary related incentives to landowners for the service

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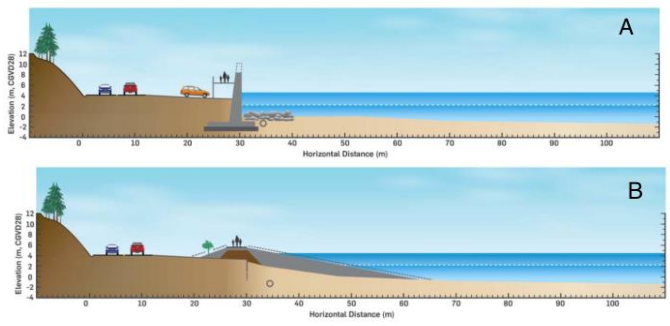
Benefits to Local Government

- Salt marshes in front of coastal sea dikes can reduce near shore wave heights by as much as 40%
- “Soft” shoreline protection can cost less and be equally effective
- Provides access to waterfront for recreation opportunities
- Natural assets managed as part of city infrastructure providing ecosystem services
- Increased access to various funding sources when looking to “green” the infrastructure
- Creative ways to improve efficiency reduce energy use and improve habitats.
- Support to build trails and low intensity uses that can withstand flooding

Background

The Lower Fraser River delta in British Columbia is a highly settled delta in which flood control structures have become abundant in a historically productive ecological system. The Lower Fraser River is tidal for 115 km upstream of the mouth historically connecting an intricate floodplain of tidal freshwater creeks [1]. The Lower Fraser also historically supports one of the world's largest salmon (*Oncorhynchus* spp.) populations, which have enormous local economic, social and cultural significance [1,2]. To facilitate conversion for agricultural uses, and later for urban developments, much of the delta has been diked and drained to protect from inundation during high tides and coastal storm surges. Along with dikes, pumping stations and tide gates prevent normal fish passage and further alters the movement of freshwater into the estuary. In coastal river systems such as the Serpentine and Nikomekl, sea-dams on the river main stem prevent the upstream movement of high tides, creating barriers to fish passage and creating opportunities for predators. In the main stem of the Fraser, the combination of river dredging and sea-level rise are pushing the salt wedge further upstream, altering previously freshwater habitats and reducing access for farmers to freshwater for irrigation.



Examples of “hard” (A) and “soft” (B) shore line protection strategies. Adapted from Lamont et al. (2014)

Recent Research

As the climate continues to change and the associated impacts become increasingly understood, the need to invest in the upgrading of existing flood infrastructure is becoming apparent [3]. Conventional systems for sea level protection on the BC coast have typically employed the use of armoured revetments or armoured dikes along the shoreline, referred to as “hard” shore armouring approaches [3]. These techniques often heavily alter the shoreline habitat by changing flow patterns and corresponding erosion [4].

Just to south in Puget Sound, the impacts of coastal armouring have been widely studied and have shown to alter coastal ecology and reduce the resilience of the coast to rising sea levels [5]. Altered wave action from seawalls facilitate the elimination of narrow high tide beaches which can reduce the area available for recreation, and change sediment transport patterns [6]. With changes in erosion rates and sediments along the coast comes change in ecological communities that inhabit the area. Researchers found that surf smelt (*Hypomesus pretiosus*) eggs laid in heavily altered beaches of Puget Sound were half as successful as those laid in natural beaches [7]. On top of the changes in coastal aquatic habitat, armoring modifies the transition zone into terrestrial ecosystems. The connectivity between these systems affects the movement of materials and organisms, reducing the capacity of riparian ecosystem functions [6]. This break in connectivity also influences the movement of abiotic components of ecosystems, altering drainage patterns and natural additions of sediments to the coast [6].

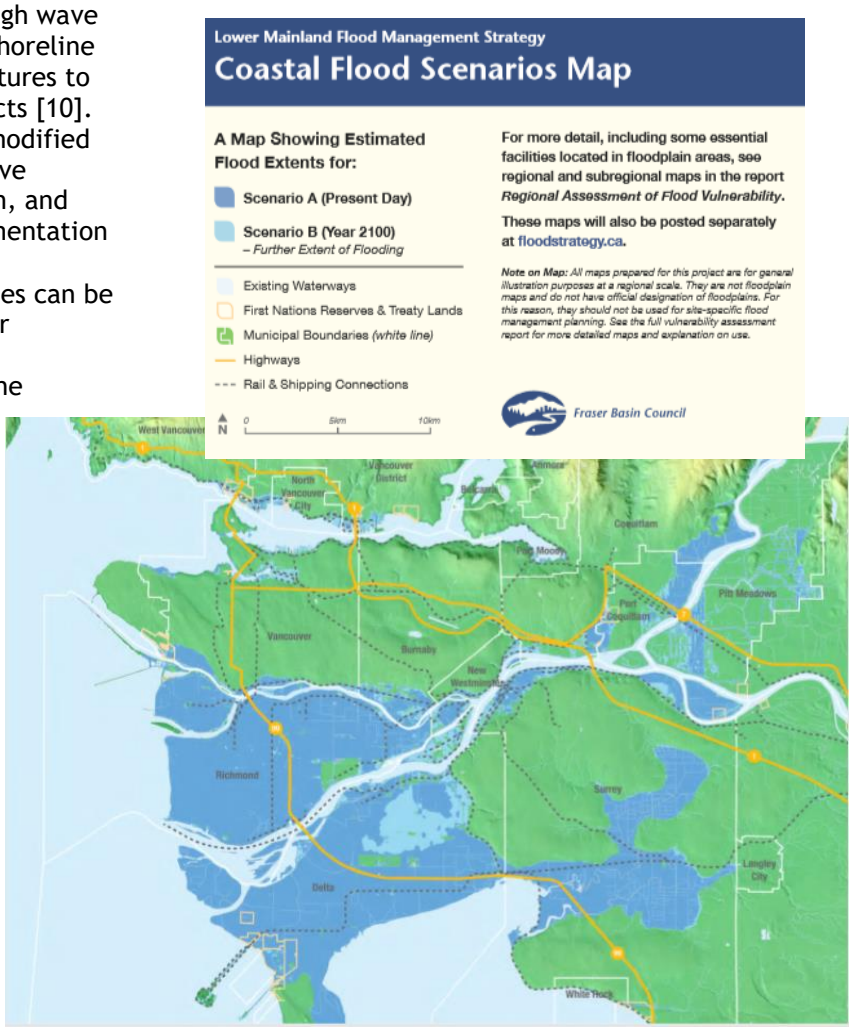
The current development of a Lower Fraser Flood Management Strategy represents an opportunity to improve upon the conventional practices of flood management and combat sea level rise in a way that can restore coastal habitat function and conserve freshwater ecosystems.

Living Shorelines

The living shoreline approach characterizes an effort to incorporate living ecosystems into shoreline protection works [8]. These strategies often include the transplanting of native plants, wetland restoration, large wood placement, and beach nourishment [9]. On the mid-Atlantic coastline and estuarine systems the living shoreline approach has been combined with hardened structures to create a 'hybrid' approach utilizing the transplanting of native plants combined with rock sills [8]. North Carolina, Delaware, and Maryland have all implemented regulations that encourage the use of living elements when designing shoreline protection [8].

Coastal vegetation and saltmarshes have been demonstrated to provide context dependant protection from erosion, storm surges, reduced wave heights, and can even provided lasting adaption to accelerated sea level rise [10]. However, this sea level rise is simultaneously increasing the need for shoreline protection while changing the way wetlands and saltmarshes work to provide it [10]. In many cases hardened structures are necessary for the protection shoreline, particularly in exposed areas with high wave action [10]. It is in these locations that living shoreline features can be combined with hardened structures to mitigate some of the negative ecological impacts [10]. The balance of hard and soft features can be modified depending on the locations characteristics. Wave energy, tidal currents and amplitude, elevation, and underlying geomorphology all make the implementation of living shorelines a site-specific strategy [8]. Understanding where and how hybrid approaches can be implemented in the coastal region of the Lower Mainland is an important step in improving the ecological resiliency of our coastal and estuarine ecosystems.

> "Living shoreline features can be combined with hardened structures to mitigate negative ecological impacts "



Lower Mainland Flood Management Strategy Phase 1 Flood Scenarios map. Blue areas demonstrate estimated flood extents in the present and future (2100). Map created for phase one of the Lower Fraser Flood Management Strategy [11] assessing regional flood vulnerabilities.

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