

# Beyond the Dykes

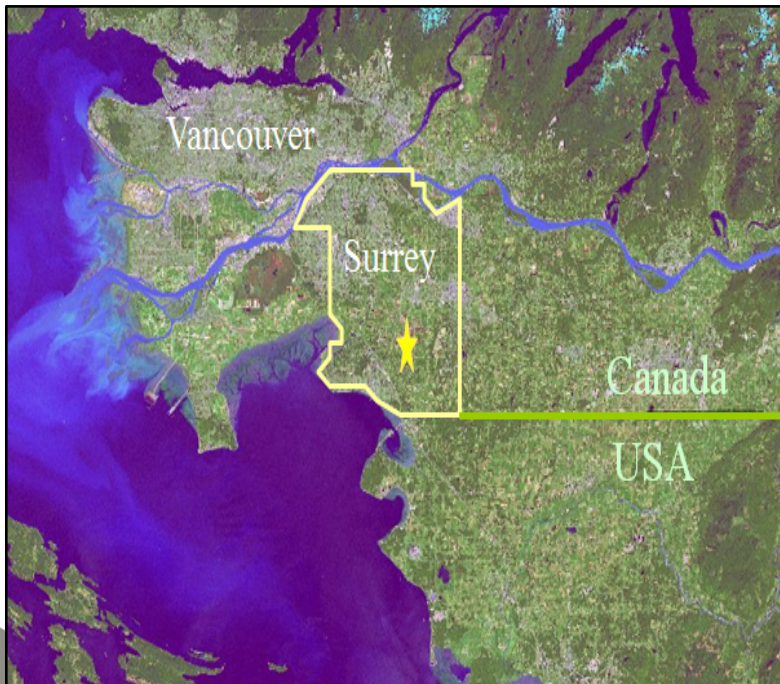
## Preparing Surrey for the Potential Impacts of Sea Level Rise



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# City of Surrey



- Population of over 500,000 with growth of approx. 1000 people per month
- Land area of over 317 sq.km (122 sq.mi.) of which 85 sq. km is within floodplains
- 54 km of shorelines - Boundary Bay (32km) and Fraser River (22km)
- approximately 100 km (63 miles) of dykes, 30 drainage pump stations, 2 sea dam structures, over 170 flood boxes and 10 spillways



# Distinct Floodplain Areas

Fraser River dyke protected area –  
Fraser freshet and  
behind dyke floods

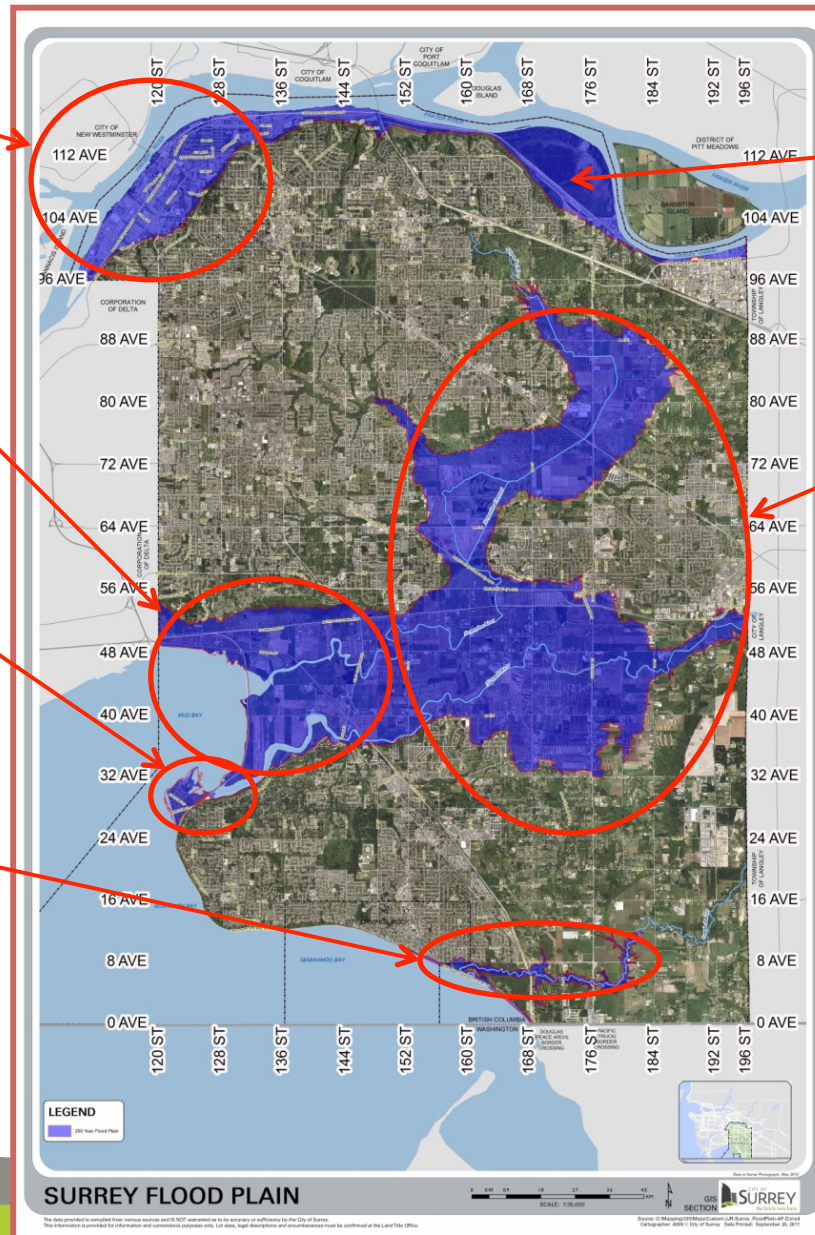
Coastal dyke area –  
storm surge events

Crescent Beach  
dyke area – storm  
surge events &  
groundwater

Campbell River  
undyked – storm  
surge & rainfall  
events

Fraser River  
unprotected area –  
Fraser freshet

Serpentine &  
Nicomekl River  
lowlands – lower  
sections surge  
events or longer  
duration high  
tides, upper  
reaches rainfall  
events, middle  
reaches  
influenced by  
both factors



# Climate Change Impacts

Adapting to sea level rise and climate change encompasses looking beyond science to become part of the fabric of City management activities.

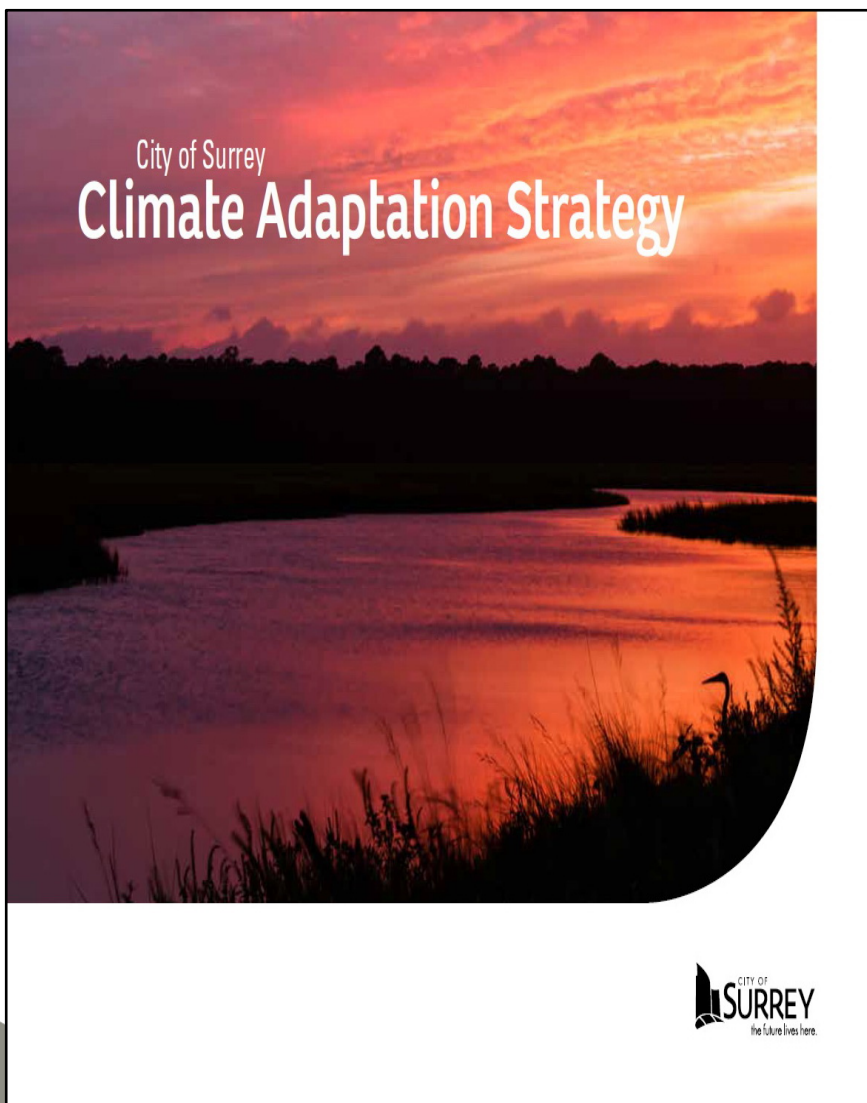
Adaptation strategies and projects will affect the social, economic and environmental aspects of life in Surrey.

Incorporating the strategies into Surrey policies and daily business units will help to make the changes more seamless.





# Surrey's Climate Adaptation Strategy

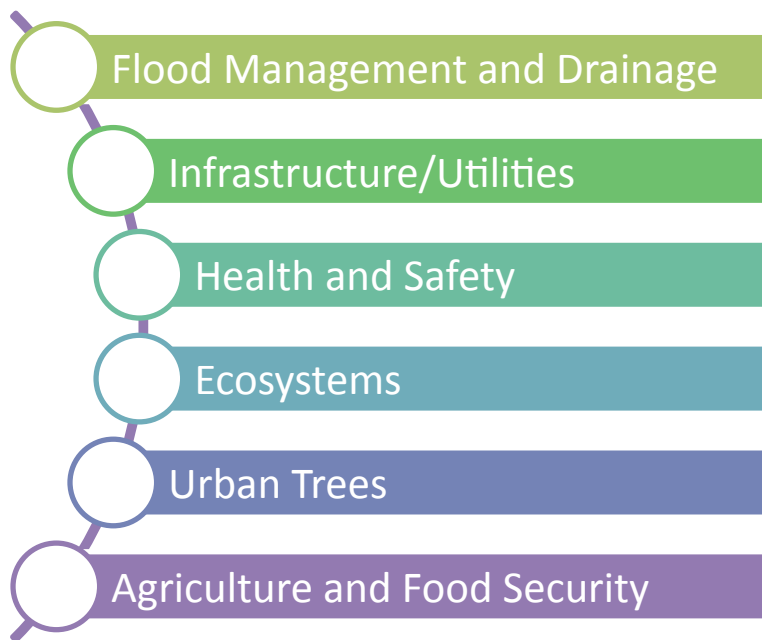


## City Departments Involved with Strategy Development

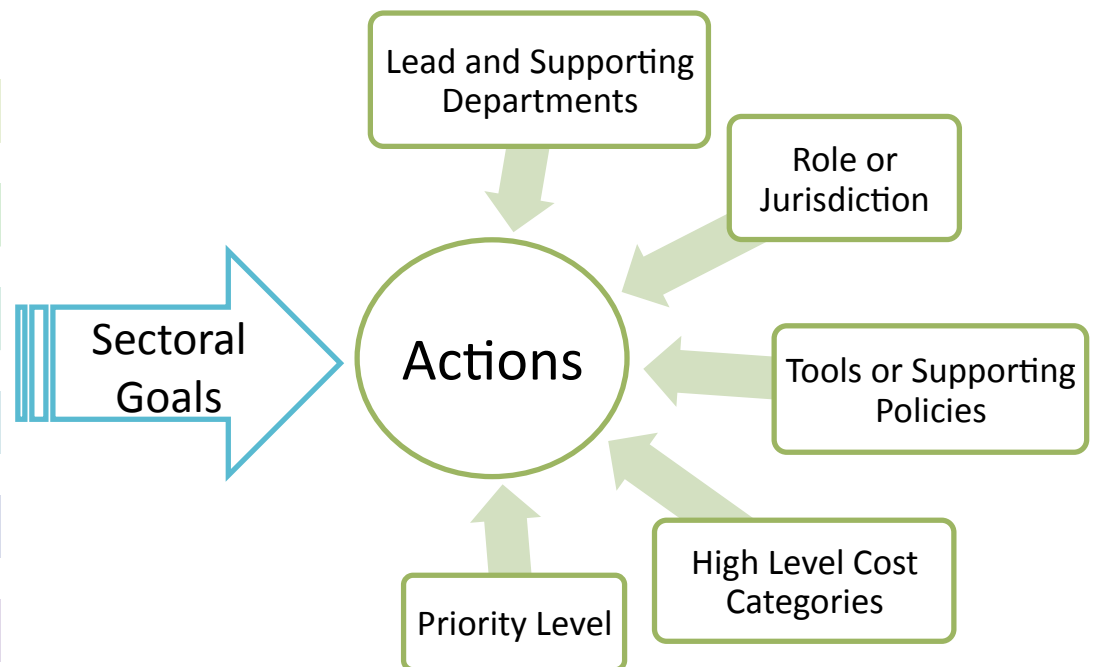
- Planning & Development – Community Planning, Area Planning, Trees & Buildings
- Engineering – Utilities & Land Development
- Finance – Risk
- Surrey Fire
- Parks, Recreation and Culture - Parks
- Economic Development
- Crime Reduction
- Sustainability

# Adaptation Strategy Overview

## Six sectors:



## Implementation:





# Action Items

The Strategy outlines 91 actions to increase resiliency in the six sectors. Some of the prioritized actions include:

- Integrate climate change education & awareness into existing programs.
- Conduct detailed assessment of impacts from SLR on flood construction levels and floodplain designations.
- Implement the Biodiversity Conservation Strategy.
- Enhance field data collection and monitoring for climate impacts.
- Continue to build community capacity to respond effectively in an emergency.
- Select tree species from provenances that will be well adapted to future climate.
- Work with other levels of government to evaluate long-term flood management options with consideration to agricultural viability.
- Review policies and bylaws to identify practices that support resilience and reinforce their implementation and enforcement.



# Official Community Plan Update

## Flood Hazard and Land Use Planning

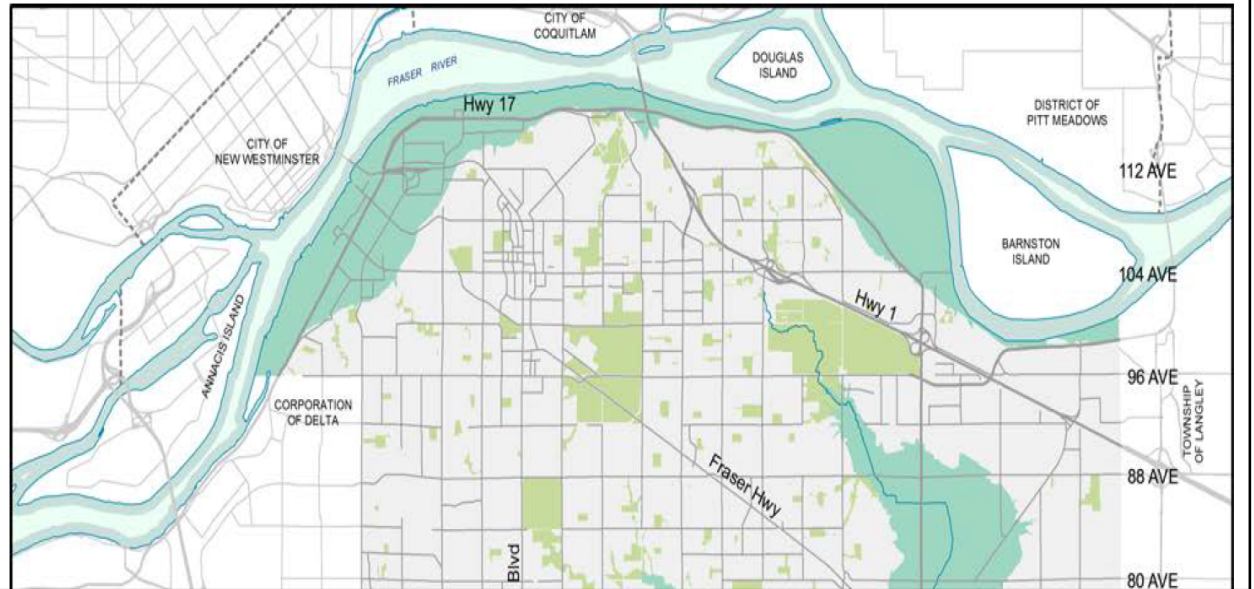
Draft OCP (PlanSurrey2014) has new Hazard Lands Development Permit Area (DPA) for flood prone areas and steep slopes

- Currently defers to Provincial flood construction levels (FCL)
- Will be one of the tools to regulate Surrey-specific flood construction elevations when engineering studies are complete

Key existing City Policy - 2008 Surrey Council Policy (O-55) restricts development in Serpentine-Nicomekl 200 year floodplain



### Flood Prone Hazard Lands Development Permit Area





# Building Construction in Floodplains





# Engineering Projects recently completed or underway

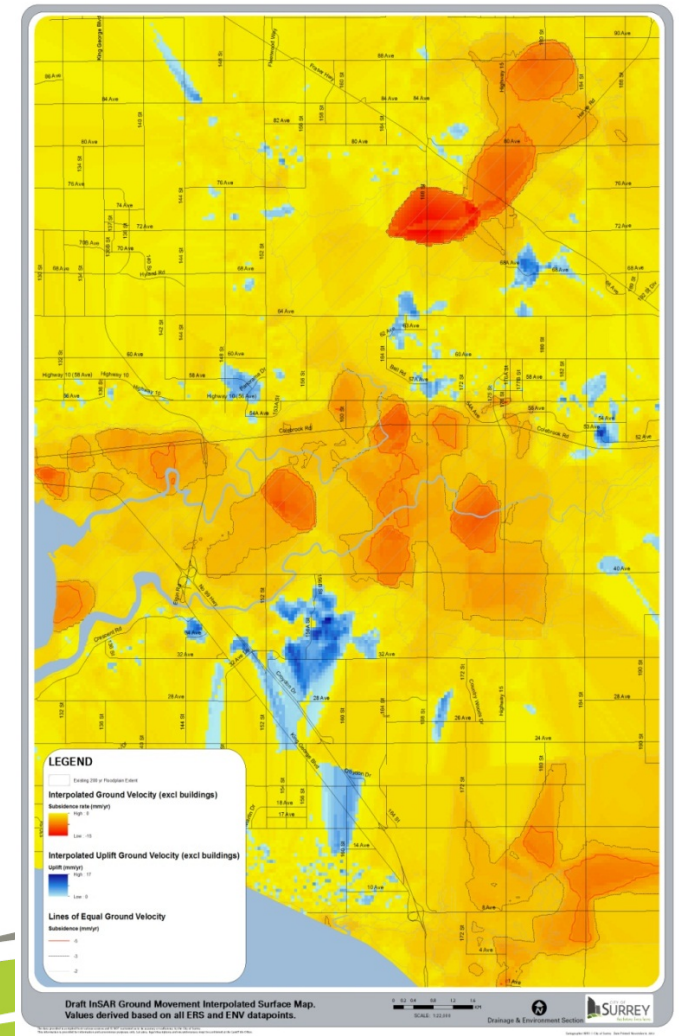


- Serpentine, Nicomekl & Little Campbell Rivers Climate Change Floodplain Review – Phase 1 complete, phase 2 underway
- Preliminary design for sea dam replacements
- Design concept for Nicowynd Dyke
- Maple Pump Station
- Crescent Beach servicing for climate change Phase 1



# Engineering Research Projects recently completed or underway

- Rainfall trending – showed statistically relevant increases in precipitation at the 3 Surrey gauges
- Update of IDF curves – new curves changed by up to 44% for some rainfall periods
- Investigating variability of subsidence using satellite data – ranges between 0-40mm/year
- Expansion of flow and rainfall monitoring to include areas outside of Surrey and automatic isohyetal plotting after each storm
- Water quality, expansion of Boundary Bay program
- Environmental changes – linked with Biodiversity conservation strategy
- Planned research into wave and coastal conditions



# Climate Change Review and the Serpentine, Nicomekl & Campbell Rivers





# Climate Change Floodplain Review

## *Rationale:*

- *Need more site-specific guidelines for Flood Construction Levels (FCLs) and Dyke Crest Elevations (DCEs)*
- *Need analysis for river systems – not just coastal*

### Phase 1, Complete:

Coastal focus  
Combined effects: SLR, precipitation, tidal, wave/wind, surge  
Land use changes and associated runoff  
“First cut” for site-specific FCLs and dyke heights

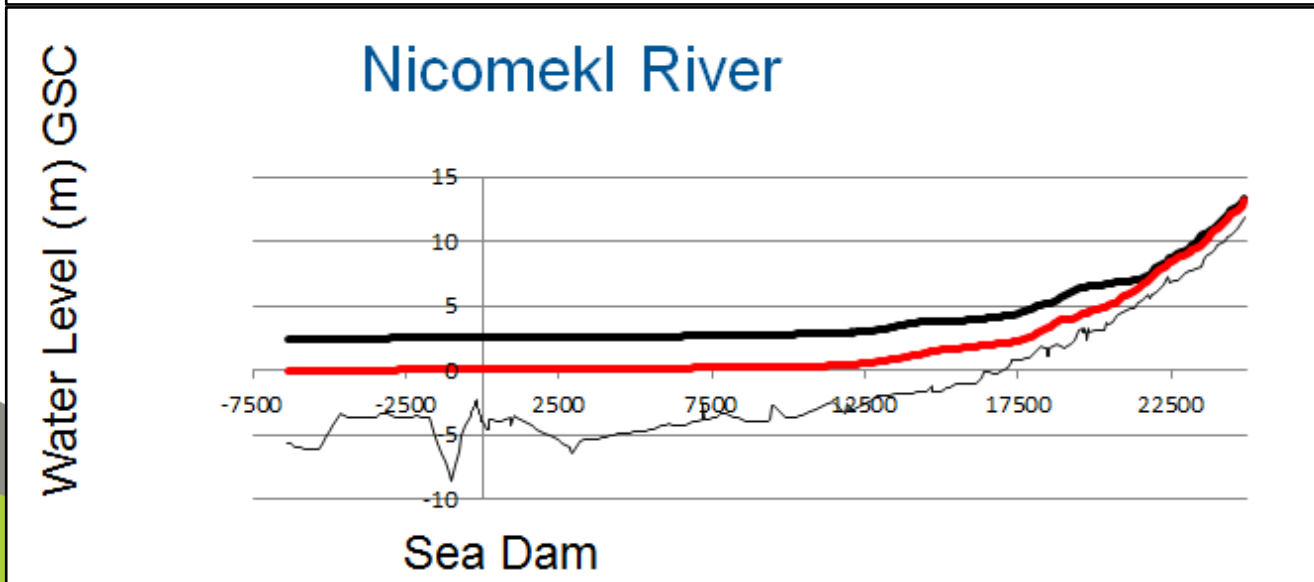
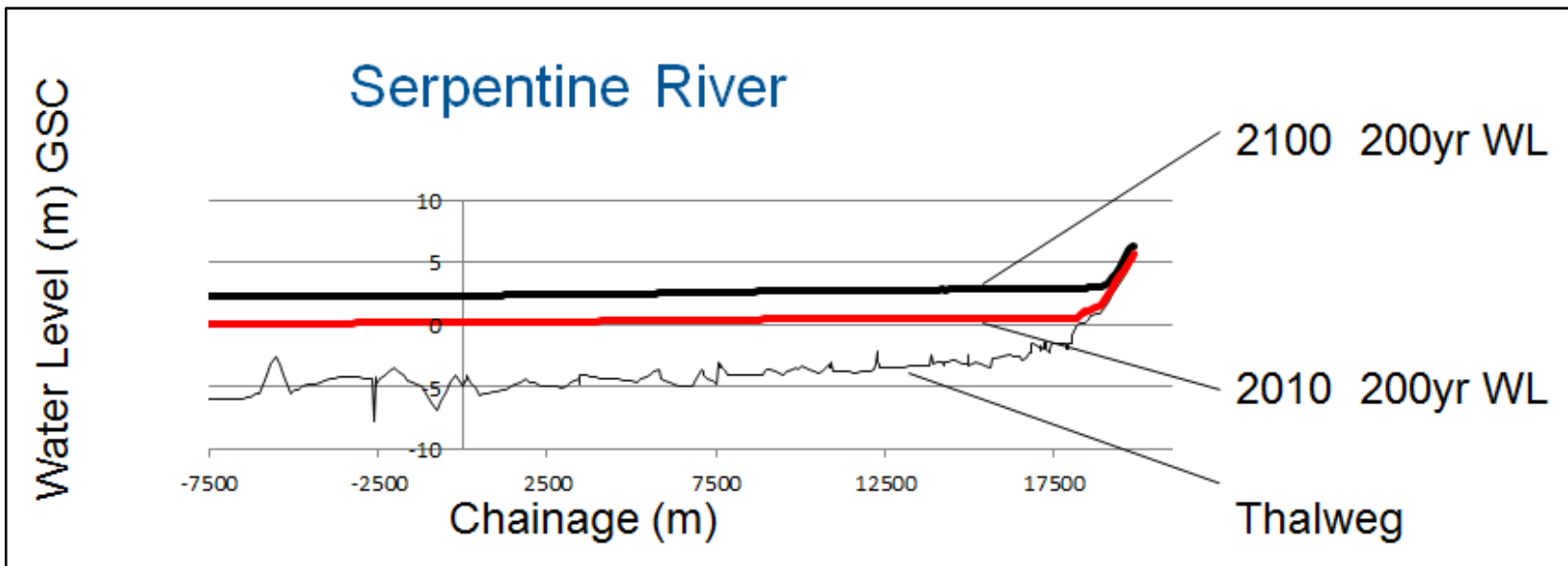
### Phase 2, Underway:

River system focus  
Sensitivity of rivers to precipitation change  
Timing of SLR  
Probability of dyke breaches

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Cost-benefit analysis of options for land use, engineering and design requirements

# Sea Level Rise Impacts





# Impacts to Flood Protection by 2100

- 200 year events become <2 year events (lower reaches)
- All coastal dykes are too low with some requiring a 3m+ extension
- River dykes will need to be reassessed for each flood cell and spillway design. Most will be too low.
- Of the 13 bridges on the rivers, 3 will be completely submerged and 7 will be partially submerged – none have been designed for these scenarios.



# Study Results – Coastal Impacts

## ***2010 to 2100 results – Elgin Village***

- Existing DCE = 3.3m
  - 2010 DCE = 3.51m
  - 2100 DCE = 4.74m
- (all heights relative the current mean sea level)

Sheltered area on Nicomekl River





# Study Results – Coastal Impacts

## ***2010 to 2100 results – Crescent Beach North***

- Existing DCE = 2.90m
- 2010 DCE = 3.95m
- 2100 DCE = 5.63m

Semi-exposed area to Bay

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## ***2010 to 2100 results – Colebrook West***

- Existing DCE = 3.15m
- 2010 DCE = 3.87m
- 2100 DCE = 6.76m

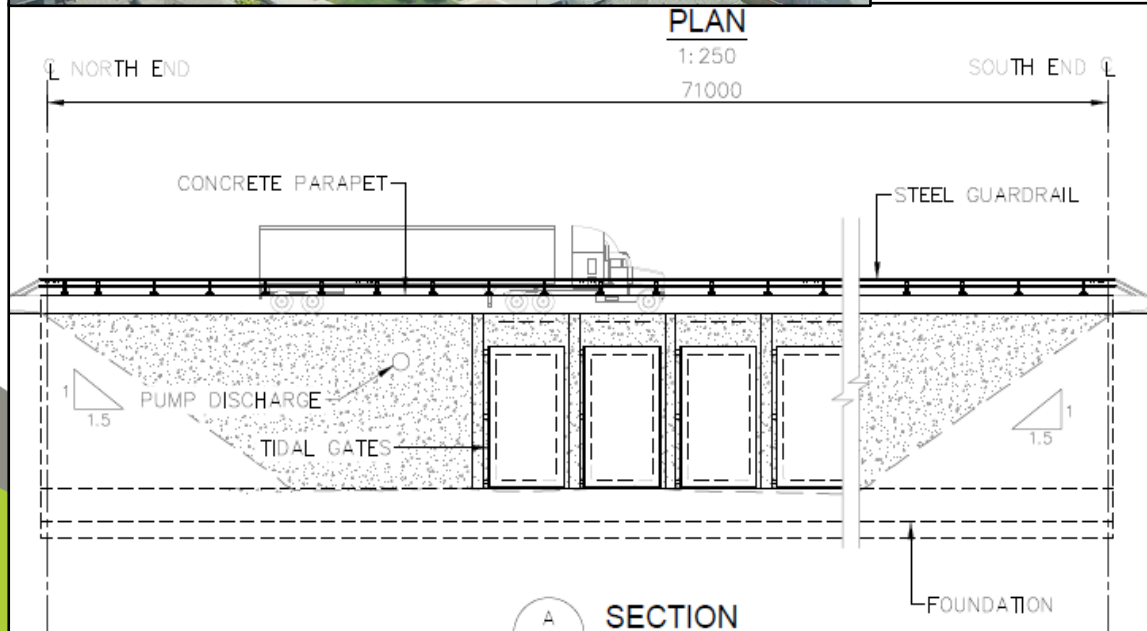
Exposed area of the  
Serpentine River



# Preliminary design work underway



- Sea dam replacement – original sea dams constructed in the early 1900s and nearing end of service life – looking at replacement considering seismic, flood control and sea level rise in the design
- Nicowynd dyke upgrades and enhancements for sea level rise





# Regional Context

Through the Joint Program Committee of the Fraser Basin Council, Surrey and numerous other local governments, Port Metro Vancouver, Vancouver Airport Authority, key industries, large utilities companies, railways, provincial and federal governments, are looking at developing a regional approach to flood management.

**Phase 1** has begun which investigates the risk, vulnerabilities and consequences of a large flood event including effects of sea level rise.

**Phase 2** will entail the development of a regional strategy and potential funding.



# Questions?

