



SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)


March 9th, 2018 Mud Bay Options Selection



Mud Bay

PROJECT BACKGROUND

Climate Change & Coastal Floods

An aerial photograph showing a coastal area. On the left, there's a body of water with a sandy beach. A river or canal flows from the top right towards the center. To the right of the river, there are green agricultural fields. In the lower right, there's a residential or farm area with several buildings, including a large barn, and some trees. The overall scene illustrates the proximity of land and infrastructure to the ocean.

- Coastal cities around the world are facing same challenges of sea level rise
- Province directed municipalities to plan for at least 1 m sea level rise by 2100
- In Surrey and Metro Vancouver most drainage systems not designed for projected changes

Study area @ a glance



What is at Risk?

COMMUNITIES AND PEOPLE



Many residential areas and neighbourhoods
Semiahmoo First Nation
2,500+ residents
Approximately 20% of Surrey's land area

PARKS AND ENVIRONMENT



Destination regional and City parks
Beaches and recreation areas
Critical foreshore, coastal, and riparian areas

LOCAL AND REGIONAL ECONOMY



3,500+ jobs
Over \$100M in annual farm gate revenue
Over \$1B in assessed property value
Almost \$25B annual truck and rail freight traffic

INFRASTRUCTURE



Over 10km of Provincial Highways
Over 200,000 vehicle trips a day
Over 30km of railway (freight, passenger)

FOOD SECURITY



~ 60 km² agricultural land
~10% of Metro Vancouver's farmland

COASTAL AND RIVER FLOODING

1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100 2100

Major Coastal and River Flood Events



A Changing Shoreline

In 1890, dyking of Mud Bay begins. Shortly afterwards, dyking and damming of the Serpentine and Nicomekl Rivers begins. By 1953, a timber sea wall at Crescent Beach is constructed.

Since then, residents of Surrey's Coastal Floodplain have relied on a system of dykes and sea dams to protect themselves from ocean and river flooding.



Sea Level Rise

TODAY

An Evolving Future

As our climate continues to change and sea levels continue to rise over the coming years, it is anticipated that the frequency and intensity of major coastal and river floods will also increase.

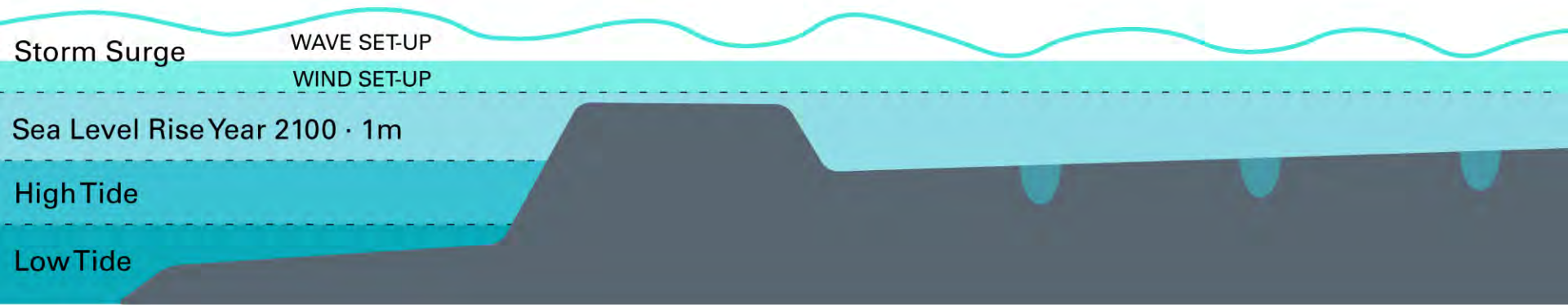
The Province has directed municipalities to plan for at least 1m sea level rise by 2100. In Surrey, and elsewhere in the Lower Mainland, most drainage systems are not designed for projected changes.



Approximate sea level rise since 1972



Sea level rise 1 metre by 2100



Extreme Floods

- Climate change is affecting intensity and frequency of storms and flood events
- Extreme floods of today become more frequent in the future



Extreme Flood Events

- Flood of 1948
 - +1 metre depth
 - flowing water



Calgary 2013 - flood



Extreme flood

- Homes flooded
- Electricity failed
- Vehicles carried off roadways
- Residents evacuated



England 2016 - flooding



Extreme flood

- Homes flooded
- Electricity failed
- Vehicles carried off roadways
- Residents evacuated

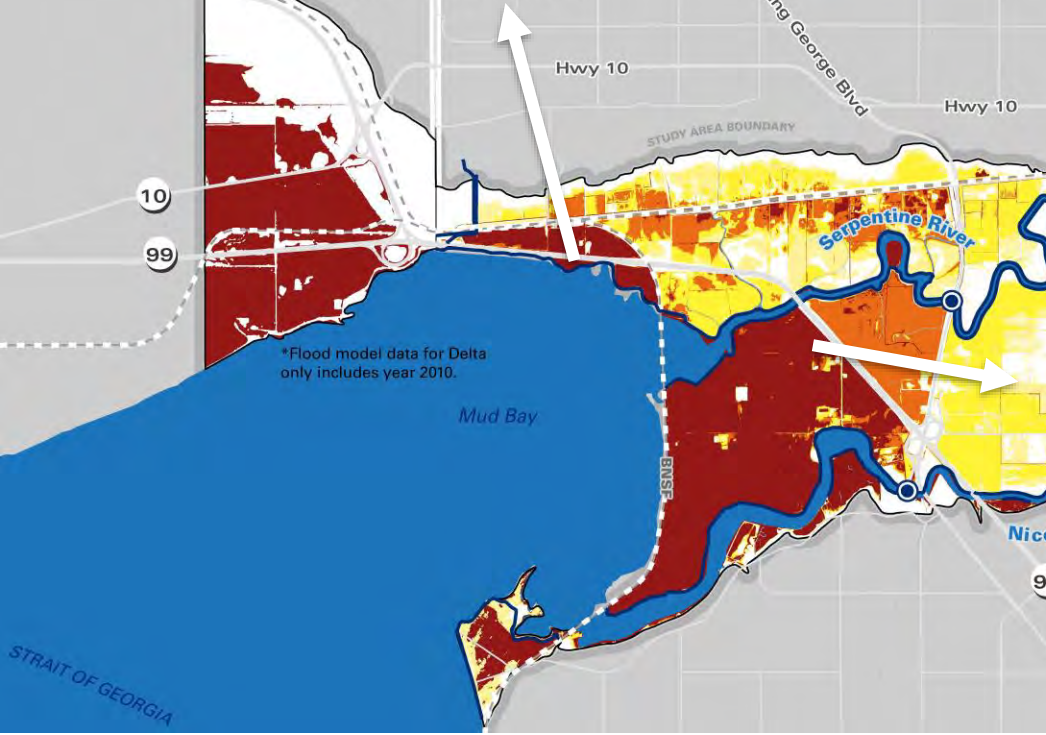
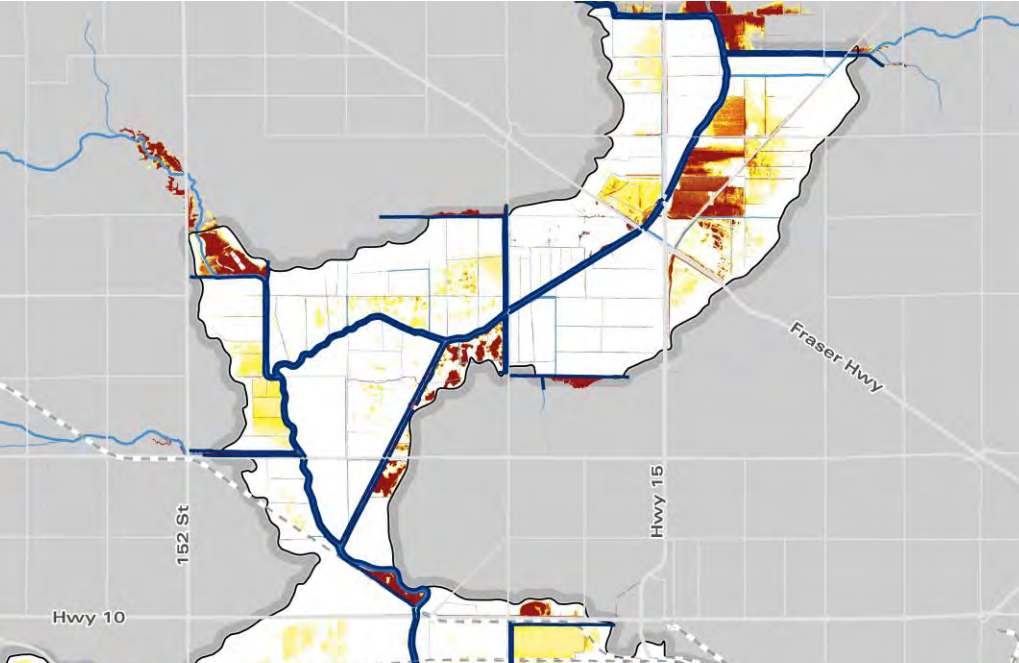


Houston 2017 - flooding



Extreme flood

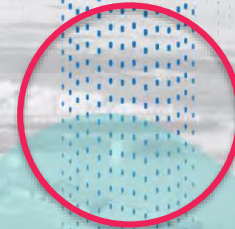
- Homes flooded
- Electricity failed
- Vehicles carried off roadways
- Residents evacuated



Flood Frequency

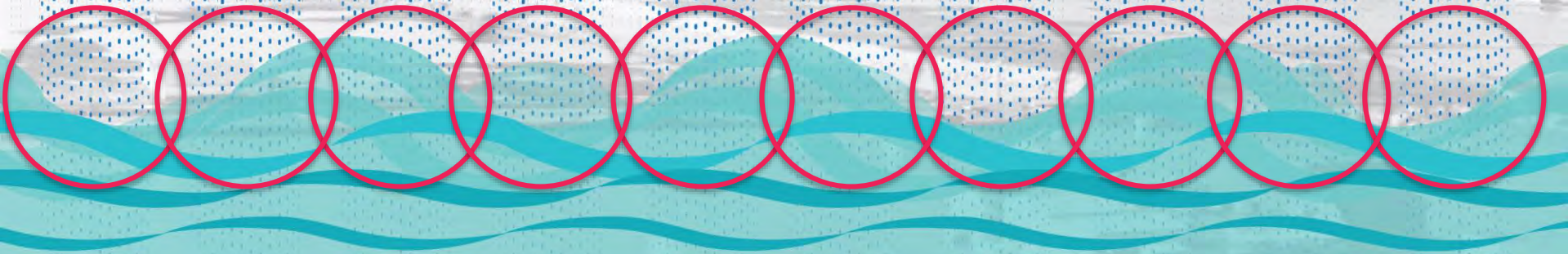
0.5%

chance of an
extreme
flood today

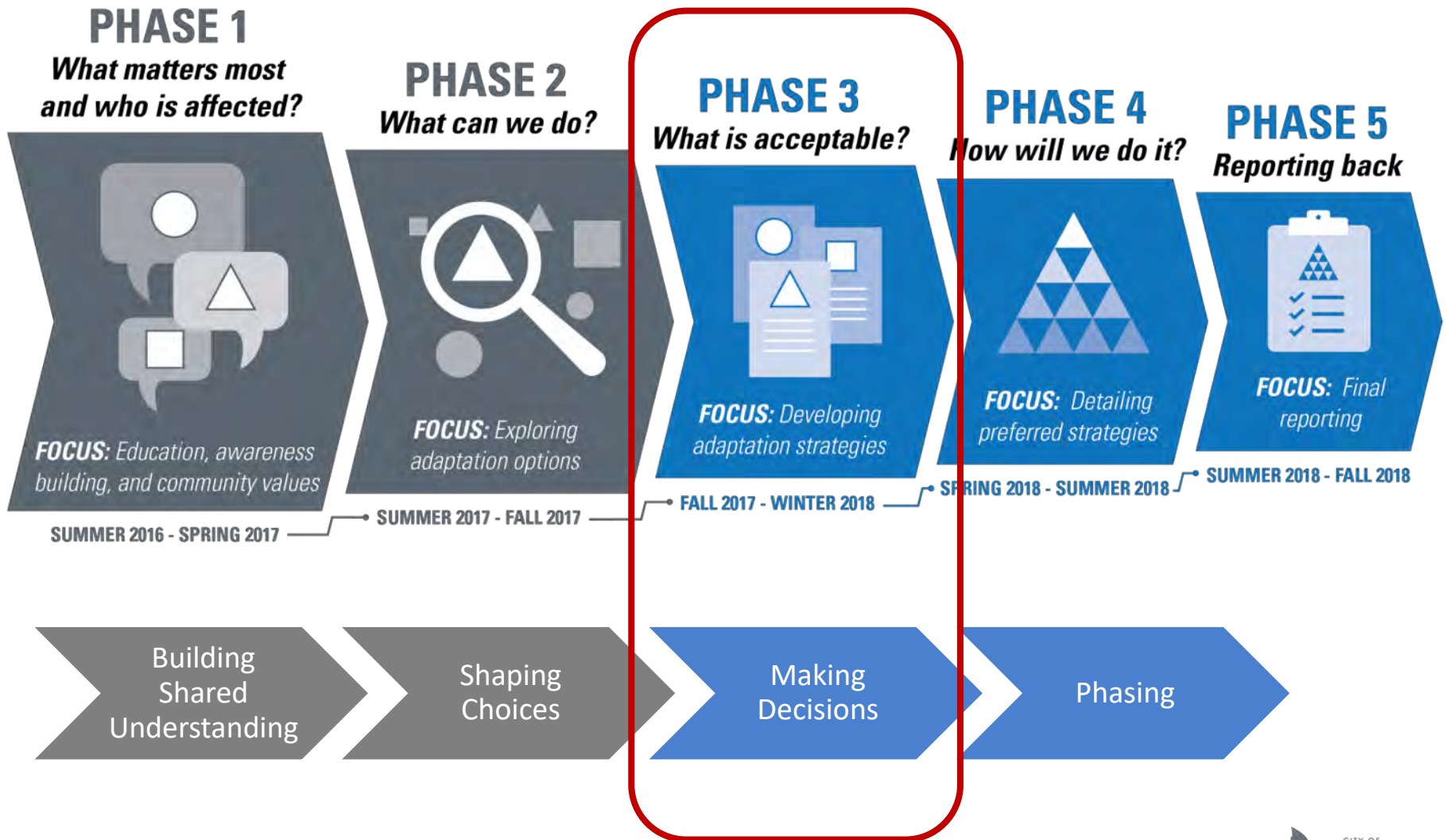


Flood Frequency

50%
chance of an
extreme
flood in
2100



Surrey CFAS Process



CFAS Phase 1 Video

What Matters Most?



Mud Bay

Engagement and Outcomes

Engagement

THREE CRESCENT BEACH COMMUNITY MEETINGS

- May to September, 2016
- 60+ Participants

THREE FOCUS GROUPS

- February to March, 2017
- 60+ participants
- Agriculture & Farming
- Community & Residential
- Environment & Recreation

OPEN HOUSE PHASE 1

- April 26, 2017
- Participants: 30+

SEMIAHMOO FIRST NATION

- Field visit and 4 meetings

TECHNICAL WORKSHOPS

- Nov 2016 to Dec, 2017
- 150+ participants
- 2 Green Shores™ Shoreline Design
- 2 PIEVC™ Infrastructure
- Coastal Design with Dutch & UBC
- Coastal Regulators
- Coastal Stewards
- Agriculture Land Commission

OPTIONS ASSESSMENT

- July to December, 2017
- 100+ participants
- Advisory Group Workshop
- Crescent Beach Workshop
- Semiahmoo Bay Workshop

Surveys

- Three public surveys

Communications & Outreach

COMMUNICATIONS

- Website
- Surveys
- Interactive “Story Maps”
- E-newsletters
- Social Media #SurreyCoastal
- Print materials
- Media

OUTREACH

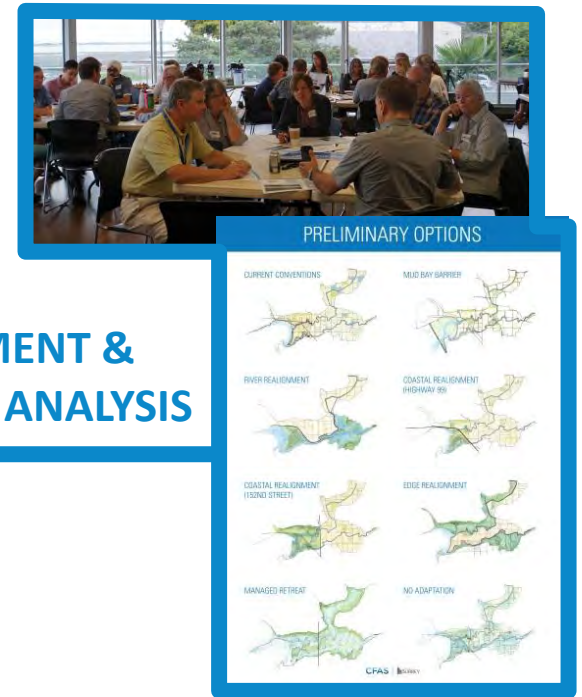
- Presentations to Council Committees
- Community events
- City and civic spaces
- School outreach
- Conference presentations
- Study tours
- Pop up events

Options Development – What can we do?

Preliminary Options Development with Community and Professionals



Community Review of Preliminary Options



HIGH-LEVEL FEASIBILITY ANALYSIS

REFINEMENT & TECHNICAL ANALYSIS

Shortlisted Options





Mud Bay

Purpose of Workshop

Today's Tasks

- Mud Bay Focus
 - Review and discuss shortlisted options
 - Review and discuss risks
 - Ranking and discuss priority options



Mud Bay Ground Rules

- Group discussion is important; and everyone should get a chance to speak
- Provide honest, open opinions
- Agree to disagree; consensus may not always be achieved

Activity #1

- In tables, please share the main reason for wanting to be part of today's workshop

Mud Bay

Shortlisted Options

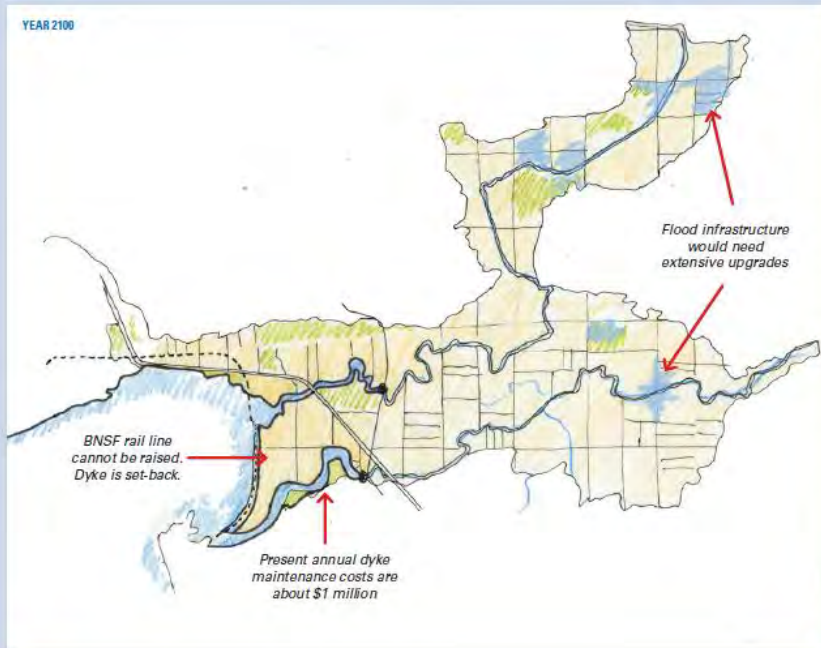
Shortlisted Options for Mud Bay

1. Current Conventions
2. Mud Bay Barrier
3. Highway 99 Realignment
4. Managed Retreat

Option Overview

CHAPTER 1: MUD BAY

OPTION 1: CURRENT CONVENTIONS



OPTION DESCRIPTION

As sea levels rise, Surrey continues to maintain existing flood control works to meet protection requirements. Present day annual dyke maintenance costs of about \$1 million increase substantially over time. Significant investments in upgrading existing flood control measures are required. The BNSF railway embankment along Mud Bay is not a dyke and cannot be raised, so a separate parallel dyke is built. Coastal dykes are raised over time by up to 3 metres and river dykes are raised by up to 1 metre. For every metre dykes are raised, an additional 8 metres of land is required for the base of the dykes, which requires purchasing private property on the landward side or building out into the foreshore on the ocean side. Going forward, the time the two sea dams remain open continues to decrease as a result of sea level rise, resulting in higher river levels and increased flooding of agricultural lands. Additional pumping capacity is unlikely to offset the increased flooding. The raising of dykes and other upgrades are implemented in phases over time. Ongoing costs are significant. This option is most familiar to stakeholders and no new land owners are impacted.

WHAT THIS COULD LOOK LIKE



Maintain flood infrastructure: raised dykes



Maintain flood infrastructure: sea dams



Maintain flood infrastructure: pump stations

INFRASTRUCTURE, EARTHQUAKE & LANDUSE CHANGES & DESIGN

Reduction in dyking: None.

New dykes: 2.5 km long, 5 metre high, 35 metre wide dyke parallel to and set back from BNSF railway embankment. Raise all other existing dykes to design level and protect against erosion as required. This includes the south Nicomekl River dyke downstream of the sea dam which will need to be moved inland some distance and extended along Crescent Road.

Changes to sea dams: Over time, replace in same locations. Raise and design to meet current earthquake standards. Add pumping capacity.

Earthquake design: Present dykes would fail in an earthquake. New dyke parallel to BNSF would be more earthquake resistant, but not earthquake proof.

Re-purposed land: None. Some reduction in farmland due to footprint of dyke parallel to BNSF and other dyke improvements.

Relocated roads/rail lines: None. Extensive improvements required to accommodate future flood levels.

Runoff management: Improved with additional pumping capacity added at sea dams.

Values Criteria



RESIDENTS:

Are people permanently displaced?



AGRICULTURE:

Is there permanent loss of agriculture land?



ENVIRONMENT:

Are there impacts (positive & negative) to wetland habitats, freshwater fish habitat & riparian areas?



INFRASTRUCTURE:

Is service/transportation infrastructure made vulnerable?



ECONOMY:

Is there a permanent loss of business?



RECREATION:

Is there a diversity of recreational activities (positive & negative)?



CULTURE:

Are there Semiahmoo First Nation cultural impacts that could be expected?


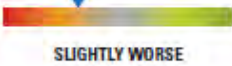



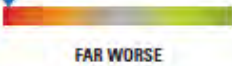



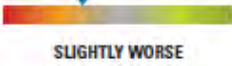




Values Ranking:



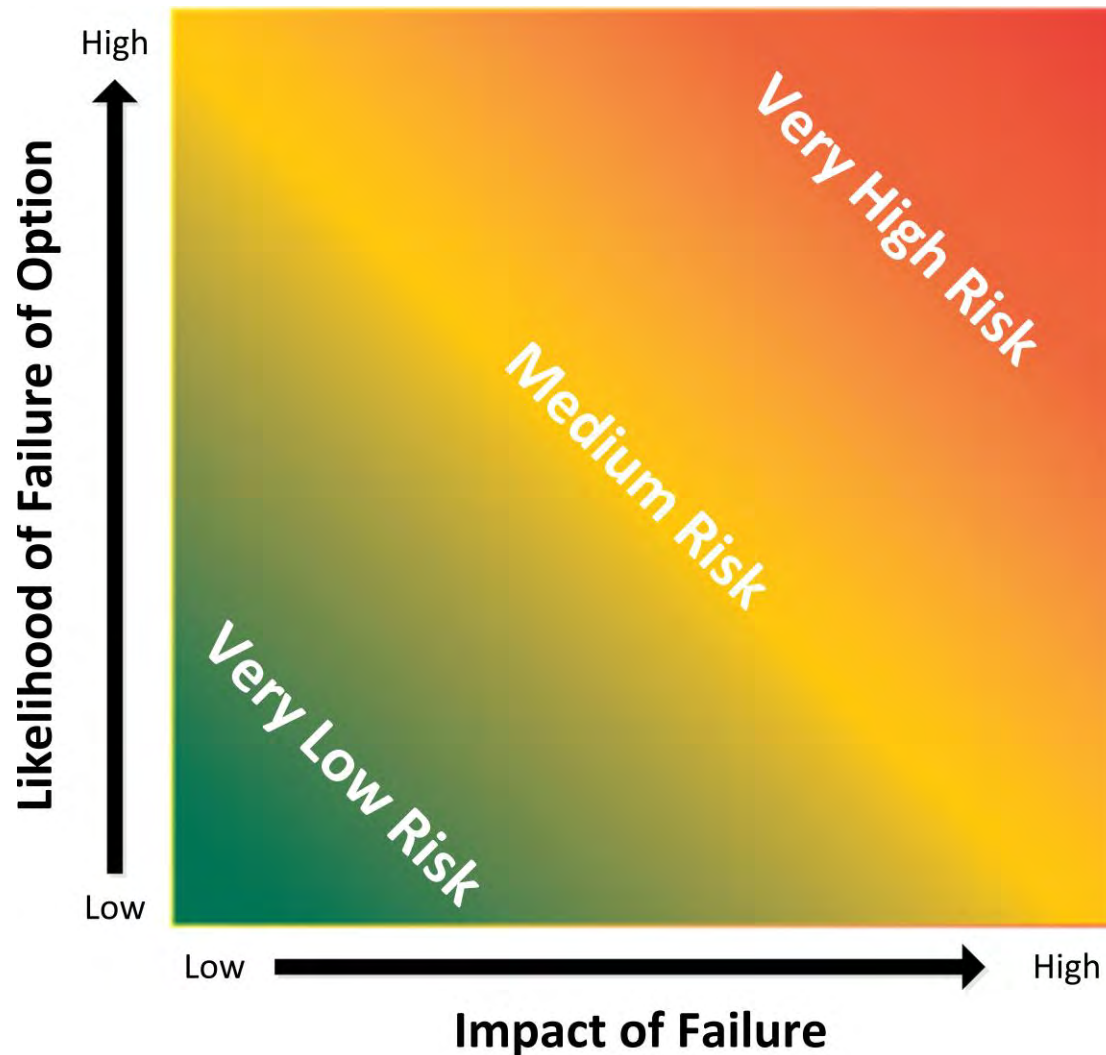
WORSE ← NO CHANGE → BETTER

Values Criteria





























VALUES CRITERIA

		FAR WORSE ← NO CHANGE → FAR BETTER
 <p>RESIDENTS</p>	<p>Some residents (approximately 25 homes) are displaced because over time dykes will need to be pushed back, widened, and raised, displacing homes near the current dykes. Also, quality of life will be negatively impacted as there will be a loss of views with higher dykes. Potentially, insurance rates could go up significantly and property values could decrease.</p>	<p><i>Indicator: People permanently displaced</i></p>  <p>SLIGHTLY WORSE</p>
 <p>AGRICULTURE</p>	<p>Some agricultural land is lost due to raising and widening of dykes. Land productivity is negatively impacted given that salinization, subsidence, and localized flooding become more of an issue. Waterfowl begin to impact crops, as they start utilizing crops for feed as they lose natural habitat.</p>	<p><i>Indicator: Permanent loss of agriculture land</i></p>  <p>SLIGHTLY WORSE</p>
 <p>ENVIRONMENT</p>	<p>Over time all the tidal flats in Mud Bay would be negatively impacted by coastal squeeze. Even though sea dams would be replaced with ones that have fish ladders allowing salmon migration, the loss of eelgrass beds would likely be detrimental to salmon. Migration from land to water could be difficult for some species due to larger dykes.</p>	<p><i>Indicator: Impacts to wetland habitats, freshwater fish habitat & riparian areas</i></p>  <p>FAR WORSE</p>
 <p>INFRASTRUCTURE</p>	<p>All transportation corridors and utilities adapt alongside the option and citizens do not experience any change in infrastructure services.</p>	<p><i>Indicator: Percent of service/transportation infrastructure made vulnerable</i></p>  <p>NO CHANGE</p>
 <p>ECONOMY</p>	<p>River dyke setback may displace some businesses. As well, farms will be affected by increased soil salination and increased spillway or riverine flooding. Farms will likely need to change crop types and practices, and likely experience higher maintenance costs due to regular flooding and salination.</p>	<p><i>Indicator: Revenue</i></p>  <p>SLIGHTLY WORSE</p>
 <p>RECREATION</p>	<p>Walking trails and wildlife areas could potentially be more difficult to access. At the same time, with wider and better dyke design, trails could be better integrated into future options. However, there is no significant change from today. The present natural shoreline will disappear. Waves will wash over the now abandoned BNSF railway embankment.</p>	<p><i>Indicator: Diversity of recreational opportunities</i></p>  <p>NO CHANGE</p>
 <p>CULTURE</p>	<p>New dykes would not disturb subsurface soils and therefore have limited archeological impacts.</p>	<p><i>Indicator: Opportunities for traditional practices</i></p>  <p>NO CHANGE</p>

Risk: Likelihood & Impact of Failure



Risk Evaluation

IMPACT & RISK OF FAILURE		Impact of Failure on Value	x	Likelihood of Failure of Option	=	Risk
 RESIDENTS	All housing within floodplain could be affected. Some loss of life possible from sudden dyke breaching irrespective of failure mode. Restrict future development and limit the population of the area.					
 AGRICULTURE	Some agricultural land within floodplain potentially affected but land partly recoverable over time.					
 ENVIRONMENT	Contamination from septic fields, sewage backflow, manure, and chemical storage.					
 INFRASTRUCTURE	A failure of a dyke would likely disrupt multiple transportation corridors and utilities.					
 ECONOMY	Extensive direct and indirect losses.					
 RECREATION	Temporary disruptions but trails/parks likely recoverable.					
 CULTURE	A dyke breach and flood event would have limited archeological impacts.					



Overall Risk:



Cost Criteria










An aerial photograph of a mud bay, showing intricate patterns of mudflats and channels. The image is overlaid with a semi-transparent blue filter. The text 'Mud Bay' is positioned in the lower-left area of the image.

Mud Bay

Current Conventions

Video






VALUES CRITERIA

	RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE
	AGRICULTURE <i>Permanent loss of agriculture land</i>	FAR WORSE	SLIGHTLY WORSE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	MODERATELY WORSE	FAR WORSE
	INFRASTRUCTURE <i>Percent of service/ transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE
	ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY WORSE
	RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	NO CHANGE
	CULTURE <i>Opportunities for traditional practices</i>	SLIGHTLY WORSE	NO CHANGE

IMPACT & RISK OF FAILURE

	OVERALL RISK	VERY HIGH	VERY HIGH
--	---------------------	------------------	------------------

COST CRITERIA

	 CAPITAL COST	—	\$100M - \$1B
	OPERATION & MAINTENANCE COST	MORE THAN \$10M	MORE THAN \$10M
	INFRASTRUCTURE MARGINAL COST	MORE THAN \$100M	\$10M - \$100M
	COST TO FUTURE GENERATIONS	\$1B - \$4B	\$1B - \$4B

An aerial photograph of a coastal wetland area, likely a mud bay, with a prominent barrier. The terrain is characterized by intricate, winding channels and a complex network of ridges and depressions, typical of a tidal flat or marsh. The water bodies are interspersed among the landforms, creating a highly textured and irregular landscape. The overall color palette is dominated by various shades of blue and green, suggesting water and vegetation respectively. The barrier is a distinct, curved line that separates a larger body of water from the inner wetland area.

Mud Bay

Mud Bay Barrier








Video

**BASELINE -
NO ADAPTATION**

**CURRENT
CONVENTIONS**

**MUD BAY
BARRIER**

VALUES CRITERIA

	RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE
	AGRICULTURE <i>Permanent loss of agriculture land</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	MODERATELY WORSE	FAR WORSE	FAR WORSE
	INFRASTRUCTURE <i>Percent of service/ transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE	NO CHANGE
	ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE
	RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	NO CHANGE	SLIGHTLY WORSE
	CULTURE <i>Opportunities for traditional practices</i>	SLIGHTLY WORSE	NO CHANGE	MODERATELY WORSE

IMPACT & RISK OF FAILURE

	OVERALL RISK	VERY HIGH	VERY HIGH	VERY HIGH
--	---------------------	------------------	------------------	------------------

COST CRITERIA

	 CAPITAL COST	—	\$100M - \$1B	MORE THAN \$4B
	OPERATION & MAINTENANCE COST	MORE THAN \$10M	MORE THAN \$10M	\$1M - \$10M
	INFRASTRUCTURE MARGINAL COST	MORE THAN \$100M	\$10M - \$100M	LESS THAN \$10M
	COST TO FUTURE GENERATIONS	\$1B - \$4B	\$1B - \$4B	\$1B - \$4B

An aerial photograph of a wetland or mudflat area, showing intricate patterns of water channels and mud. The entire image is overlaid with a semi-transparent blue filter. In the lower-left quadrant, there is white text. A dark blue curved shape is positioned behind the main title text.

Mud Bay

Highway 99 Realignment

Video








BASELINE -
NO ADAPTATION

CURRENT
CONVENTIONS

MUD BAY
BARRIER

HIGHWAY 99
REALIGNMENT

VALUES CRITERIA

	RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE
	AGRICULTURE <i>Permanent loss of agriculture land</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	MODERATELY WORSE	FAR WORSE	FAR WORSE	SLIGHTLY BETTER
	INFRASTRUCTURE <i>Percent of service/ transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE	NO CHANGE	NO CHANGE
	ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE
	RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	NO CHANGE	SLIGHTLY WORSE	SLIGHTLY BETTER
	CULTURE <i>Opportunities for traditional practices</i>	SLIGHTLY WORSE	NO CHANGE	MODERATELY WORSE	NO CHANGE

IMPACT & RISK OF FAILURE

	OVERALL RISK	VERY HIGH	VERY HIGH	VERY HIGH	MEDIUM
--	---------------------	-----------	-----------	-----------	--------

COST CRITERIA

	 CAPITAL COST	—	\$100M - \$1B	MORE THAN \$4B	\$1B - \$4B
	OPERATION & MAINTENANCE COST	MORE THAN \$10M	MORE THAN \$10M	\$1M - \$10M	\$1M - \$10M
	INFRASTRUCTURE MARGINAL COST	MORE THAN \$100M	\$10M - \$100M	LESS THAN \$10M	\$10M - \$100M
	COST TO FUTURE GENERATIONS	\$1B - \$4B	\$1B - \$4B	\$1B - \$4B	\$1B - \$4B

An aerial photograph of a coastal wetland area, likely a mud bay, with a blue overlay. The terrain is characterized by intricate patterns of water channels and mudflats. The text "Mud Bay" is positioned in the lower-left quadrant of the image.

Mud Bay

Managed Retreat

Video

		BASELINE - NO ADAPTATION	CURRENT CONVENTIONS	MUD BAY BARRIER	HIGHWAY 99 REALIGNMENT	MANAGED RETREAT
--	--	--------------------------	---------------------	-----------------	------------------------	-----------------

VALUES CRITERIA

	RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE	FAR WORSE
	AGRICULTURE <i>Permanent loss of agriculture land</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE	FAR WORSE
	ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	MODERATELY WORSE	FAR WORSE	FAR WORSE	SLIGHTLY BETTER	FAR BETTER
	INFRASTRUCTURE <i>Percent of service/transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE	NO CHANGE	NO CHANGE	SLIGHTLY WORSE
	ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE	MODERATELY WORSE
	RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	NO CHANGE	SLIGHTLY WORSE	SLIGHTLY BETTER	MODERATELY BETTER
	CULTURE <i>Opportunities for traditional practices</i>	SLIGHTLY WORSE	NO CHANGE	MODERATELY WORSE	NO CHANGE	NO CHANGE

IMPACT & RISK OF FAILURE

	OVERALL RISK	VERY HIGH	VERY HIGH	VERY HIGH	MEDIUM	VERY LOW
--	---------------------	-----------	-----------	-----------	--------	----------

COST CRITERIA

	 CAPITAL COST	—	\$100M - \$1B	MORE THAN \$4B	\$1B - \$4B	\$1B - \$4B
	OPERATION & MAINTENANCE COST	MORE THAN \$10M	MORE THAN \$10M	\$1M - \$10M	\$1M - \$10M	LESS THAN \$1M
	INFRASTRUCTURE MARGINAL COST	MORE THAN \$100M	\$10M - \$100M	LESS THAN \$10M	\$10M - \$100M	MORE THAN \$100M
	COST TO FUTURE GENERATIONS	\$1B - \$4B	\$1B - \$4B	\$1B - \$4B	\$1B - \$4B	LESS THAN \$100M

Activity #2

- In tables, please review each option and discuss:
 - Do you understand the options and the evaluation for each?
 - Are there any concerns you have that have not been captured in the evaluation?
 - Are there any options that you think are missing?










Mud Bay

Risk

Mud Bay Risk Heat Map

		IMPACT				
		Very Low	Low	Medium	High	Very High
LIKELIHOOD	Very High				CURRENT CONVENTIONS	
	High					MUD BAY BARRIER
	Medium			HIGHWAY 99 REALIGNMENT		
	Low					
	Very Low		MANAGED RETREAT			

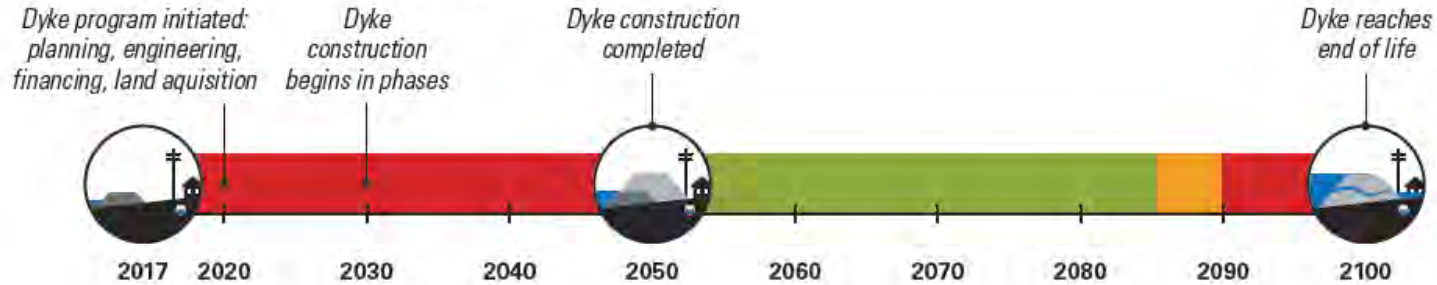
Mud Bay Risk Heat Map

<u>VALUES</u>	<u>Very Low Risk</u>	<u>Medium Risk</u>	<u>Very High Risk</u>
	<ul style="list-style-type: none"> No housing in floodplain impacted No loss of life expected 	<ul style="list-style-type: none"> Housing within floodplain could be affected Loss of life possible 	<ul style="list-style-type: none"> All housing within floodplain could be affected Loss of life likely
	<ul style="list-style-type: none"> Remaining agricultural land within floodplain potentially affected 	<ul style="list-style-type: none"> Agricultural land potentially affected but most of the land recoverable over time 	<ul style="list-style-type: none"> Agricultural land within floodplain affected but land partly recoverable over time
	<ul style="list-style-type: none"> Primary sources of pollution removed 	<ul style="list-style-type: none"> Potential contamination from septic fields, sewage backflow, manure, and chemical storage 	<ul style="list-style-type: none"> Contamination from septic fields, sewage backflow, manure, and chemical storage
	<ul style="list-style-type: none"> The adapted transportation corridors and utilities could fail, but catastrophic and/or multiple failures at the same time would be uncommon 	<ul style="list-style-type: none"> Some disruptions to transportation corridors and utilities 	<ul style="list-style-type: none"> Disrupt multiple transportation corridors and utilities
	<ul style="list-style-type: none"> no negative economic impacts are expected from flooding 	<ul style="list-style-type: none"> Extensive direct and indirect losses 	<ul style="list-style-type: none"> Extensive direct and indirect losses
	<ul style="list-style-type: none"> Recreation options adapted to retreat 	<ul style="list-style-type: none"> Temporary disruption to recreation, but recoverable 	<ul style="list-style-type: none"> Permanent disruption to recreation areas
	<ul style="list-style-type: none"> Limited archeological impacts 	<ul style="list-style-type: none"> Limited archeological impacts 	<ul style="list-style-type: none"> Limited archeological impacts

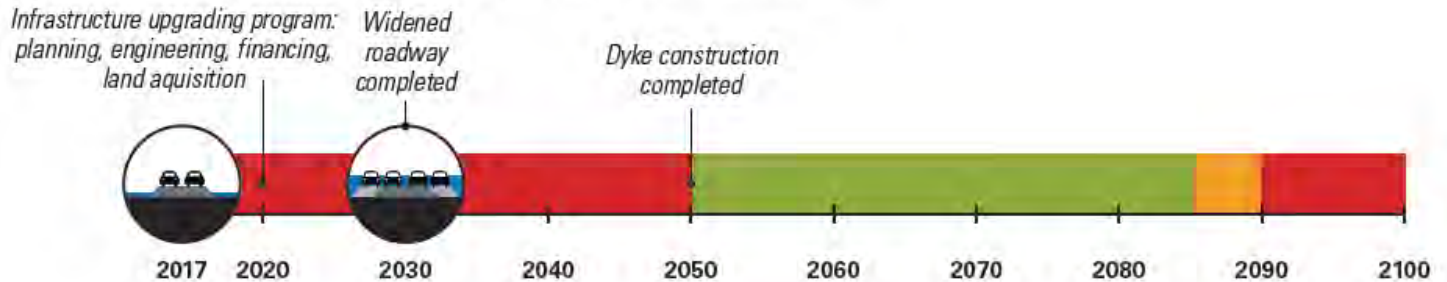
Infrastructure Renewal Planning

■ LOW RISK ■ MEDIUM RISK ■ HIGH RISK

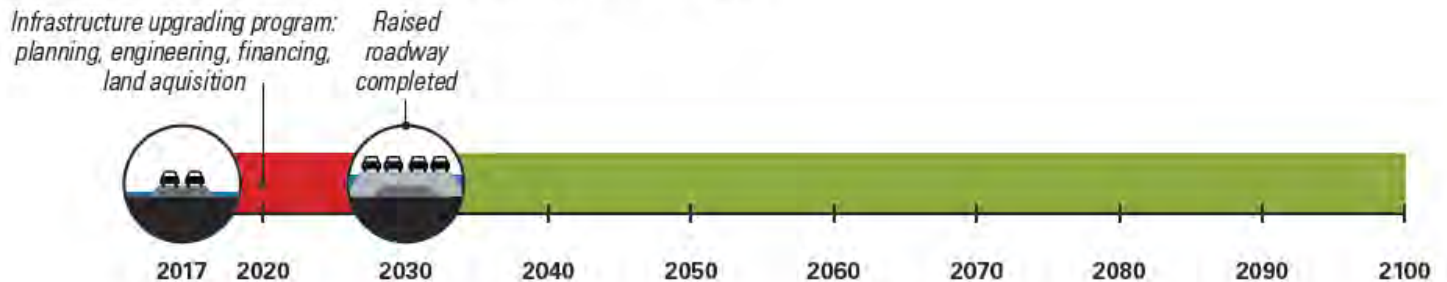
Risk of Flooding from Dyke Failure



Risk to Adjacent Infrastructure *WITHOUT* Adaptation

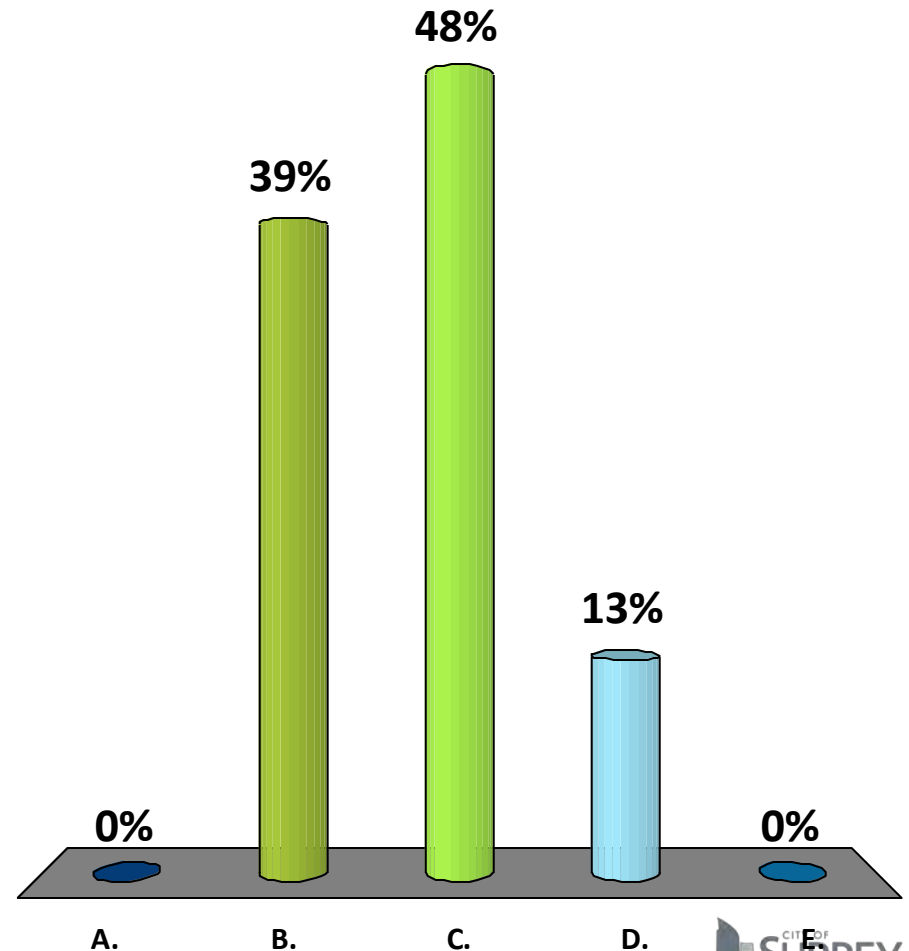


Risk to Adjacent Infrastructure *WITH* Adaptation



How old are you?

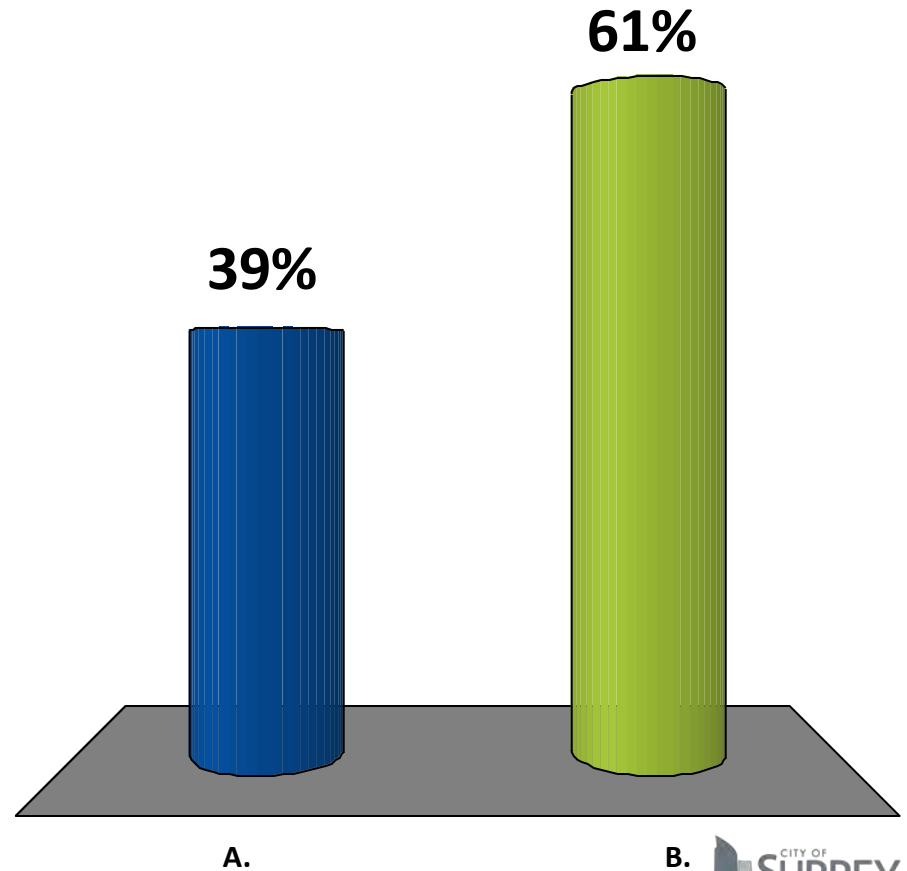
- A. Under 25
- B. 26-40
- C. 41-60
- D. 61-80
- E. 80+



Do you live in Surrey?

A. Yes

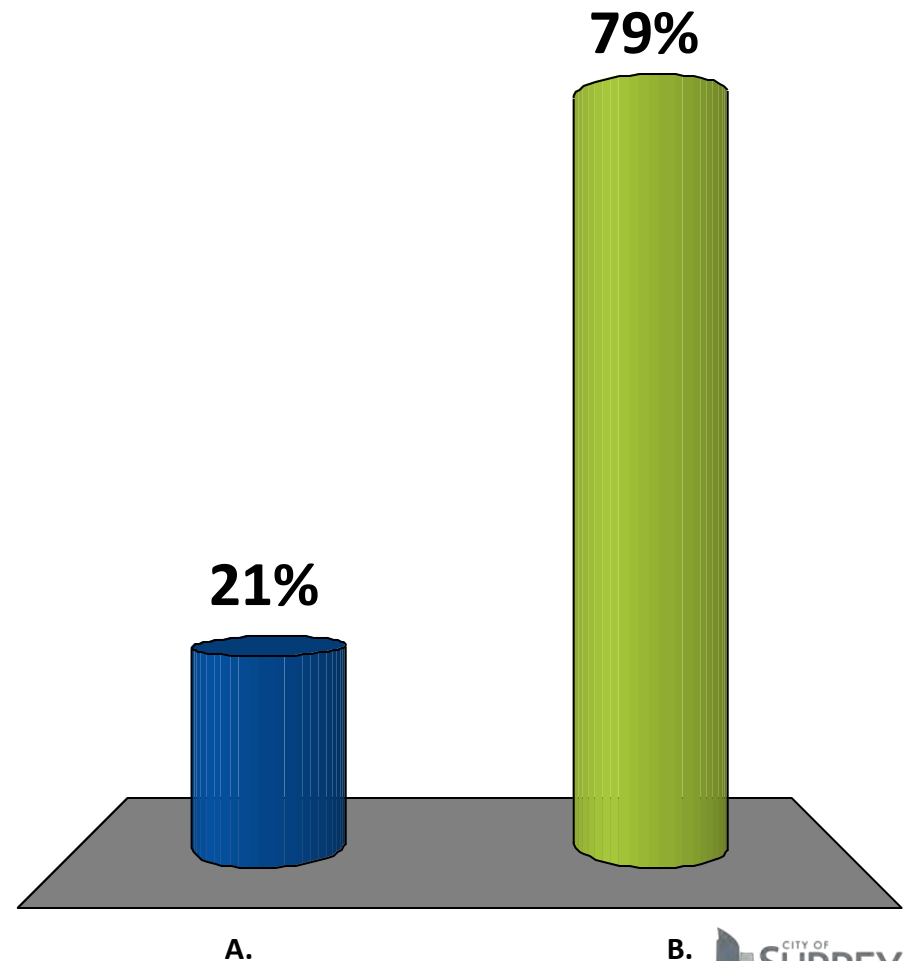
B. No



Do you live or work in Mud Bay?

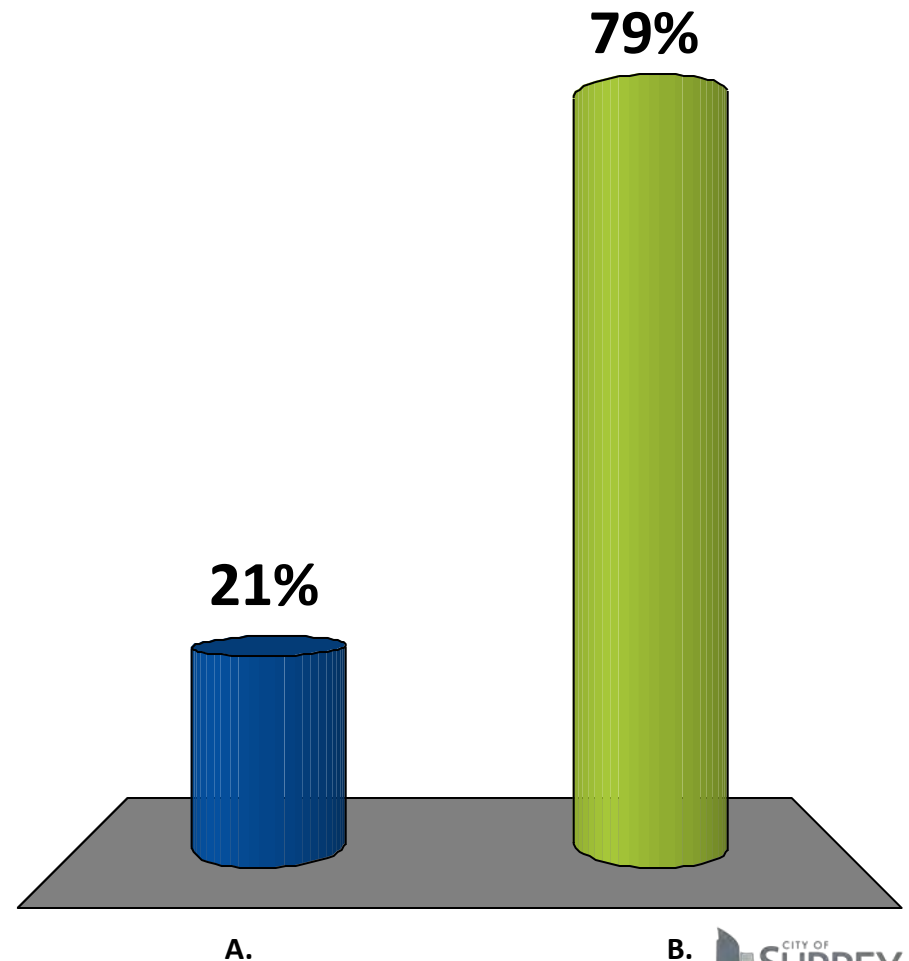
A. Yes

B. No



Do you own property in Mud Bay?

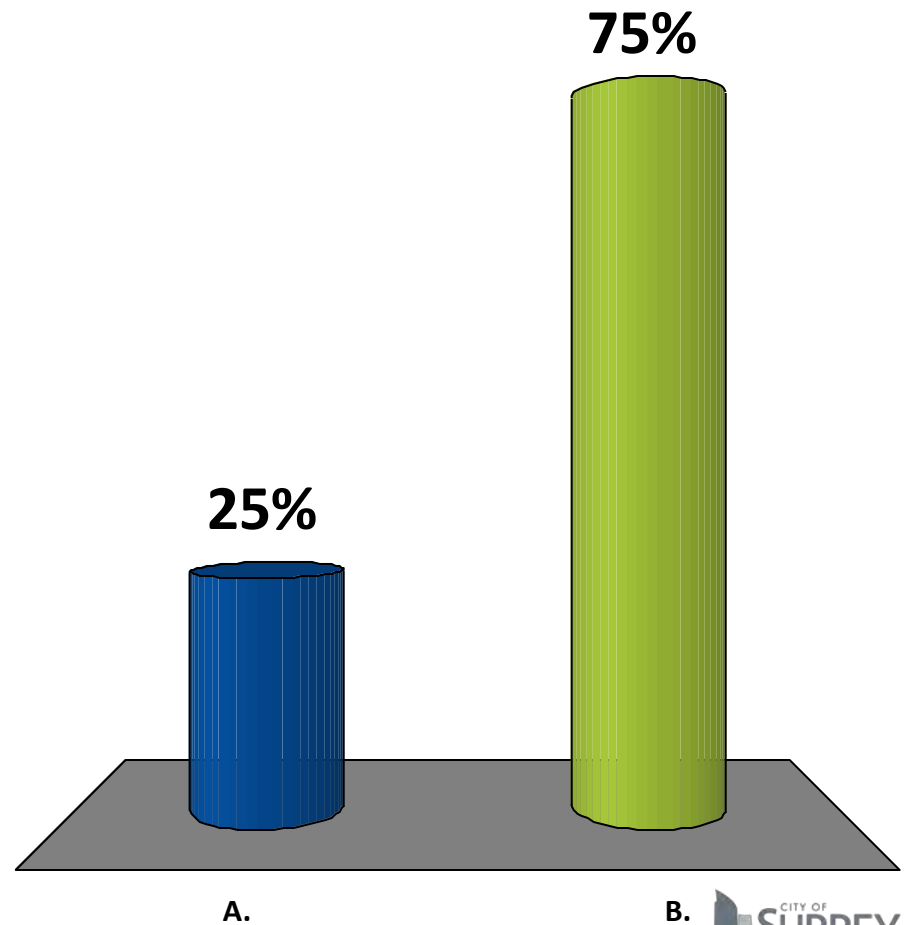
- A. Yes
- B. No



Are you a farmer?

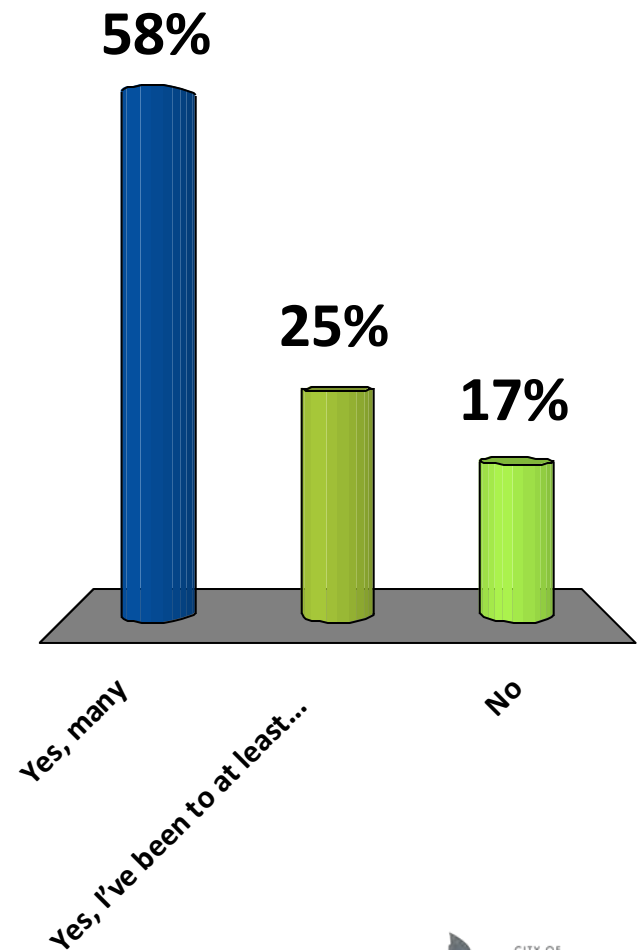
A. Yes

B. No



Have you participated in other CFAS events?

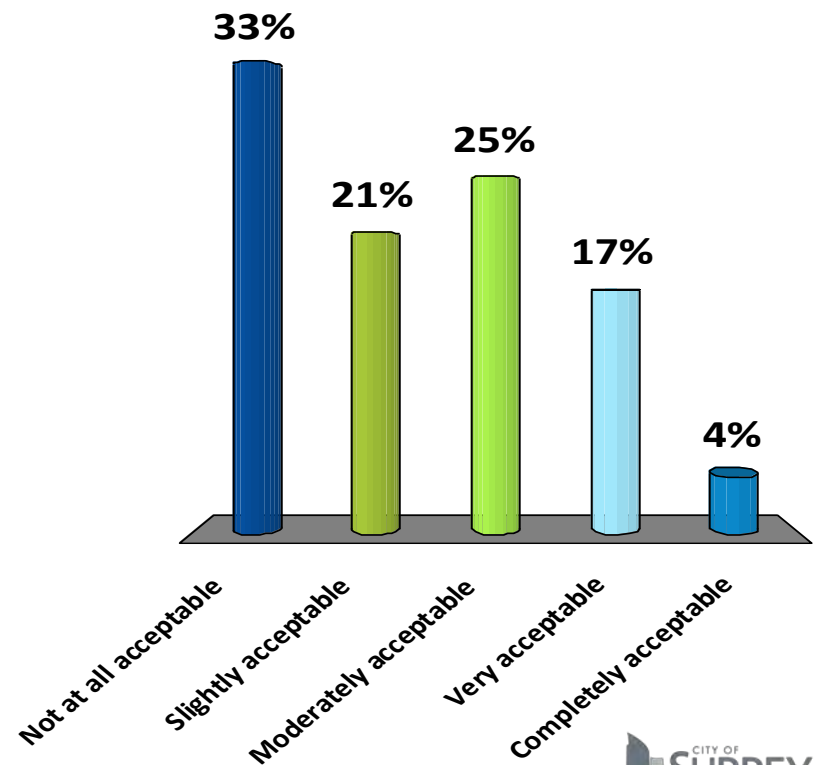
- A. Yes, many
- B. Yes, I've been to at least one event
- C. No



Risk Acceptance

Current Conventions and Mud Bay Barrier options are both associated with Very High Risk of extreme flooding, how acceptable is this to you?

- A. Not at all acceptable
- B. Slightly acceptable
- C. Moderately acceptable
- D. Very acceptable
- E. Completely acceptable



Activity #3

- In tables, please discuss:
 - Current Conventions and Mud Bay Barrier are considered **Very High Risk options**, what are the gains that make it worth the risk?
 - Highway 99 Realignment is considered a **Medium Risk option**, what are the gains that make it worth the risk?

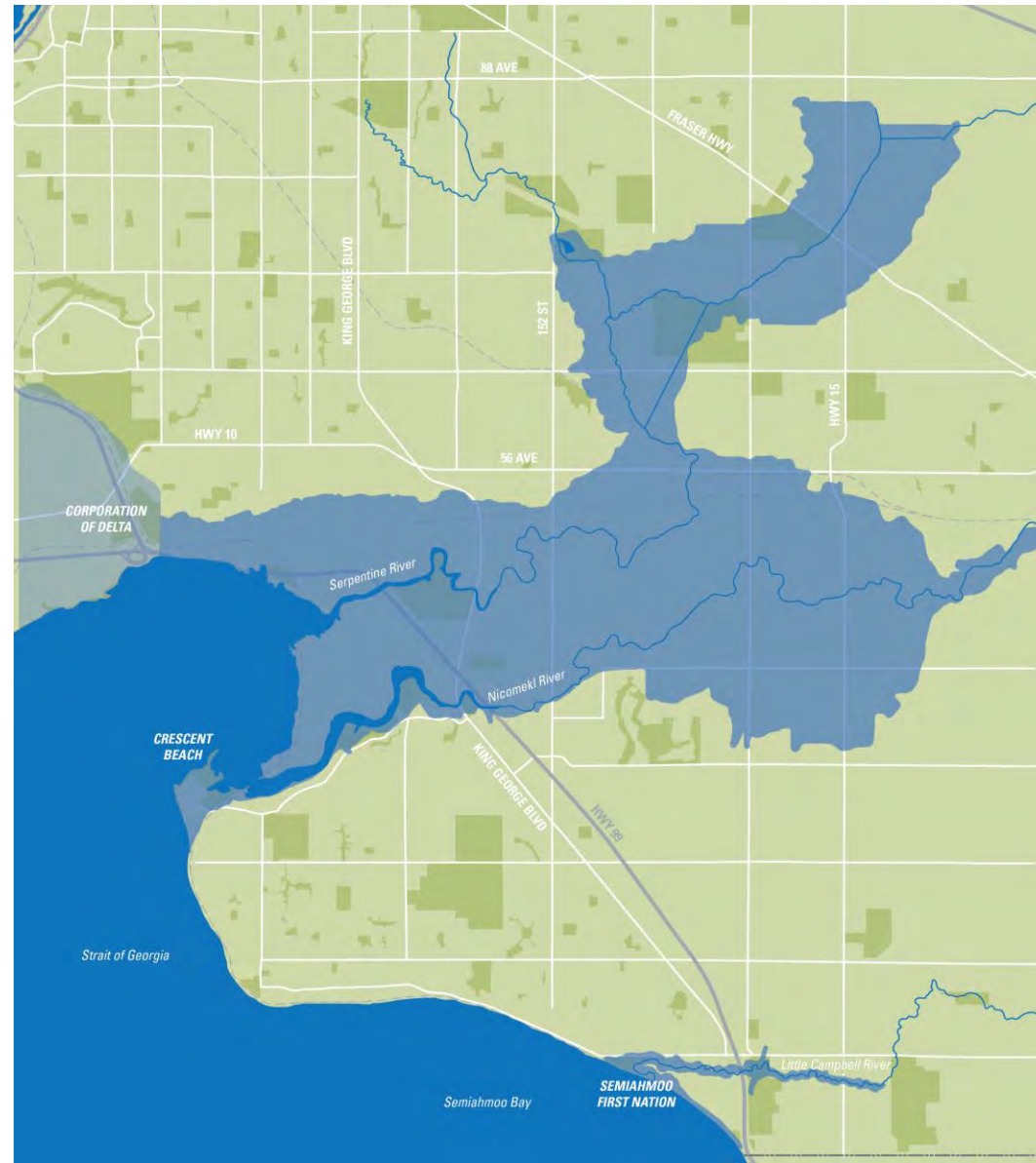


Mud Bay

Regional and financial considerations

Options Bundling

- Three study areas
- 10 shortlisted options
- Three budget bins
 - \$: less than \$100M
 - \$\$: \$100M to \$1B
 - \$\$\$: More than \$1B

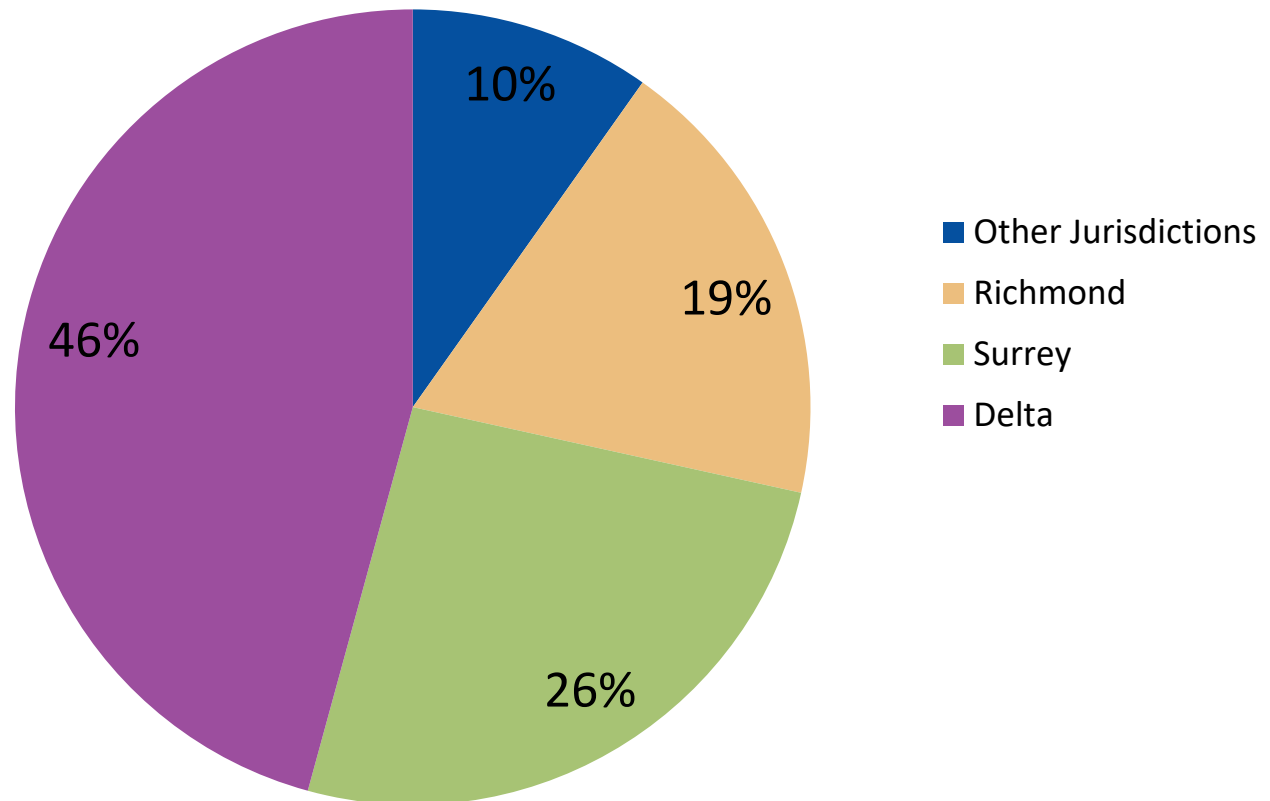


Regional Flood Planning

- The Joint Program Committee of the Fraser Basin Council is developing an approach to flood management through the Lower Mainland Regional Flood Management Strategy
 - **Phase 1** investigated the risk, vulnerabilities and consequences of a large flood event including effects of sea level rise.
 - **Phase 2** is underway to set regional priorities and advance funding discussions.
 - More information at www.floodstrategy.ca







Distribution of Agricultural Lands in Lower Mainland Vulnerable in an Extreme Coastal Flood in 2100



Funding

- 2016 Provincial budget allocated \$55 Million for flood safety one time investments
- City of Surrey's Capital Drainage budget allocates approximately \$4 million per year for lowland flood control
- City of Surrey's O+M budget allocates approximately \$1 million per year
- Canada created in 2017 a \$2 billion federal Disaster Mitigation and Adaptation Fund to support the infrastructure required to deal with the effects of a changing climate

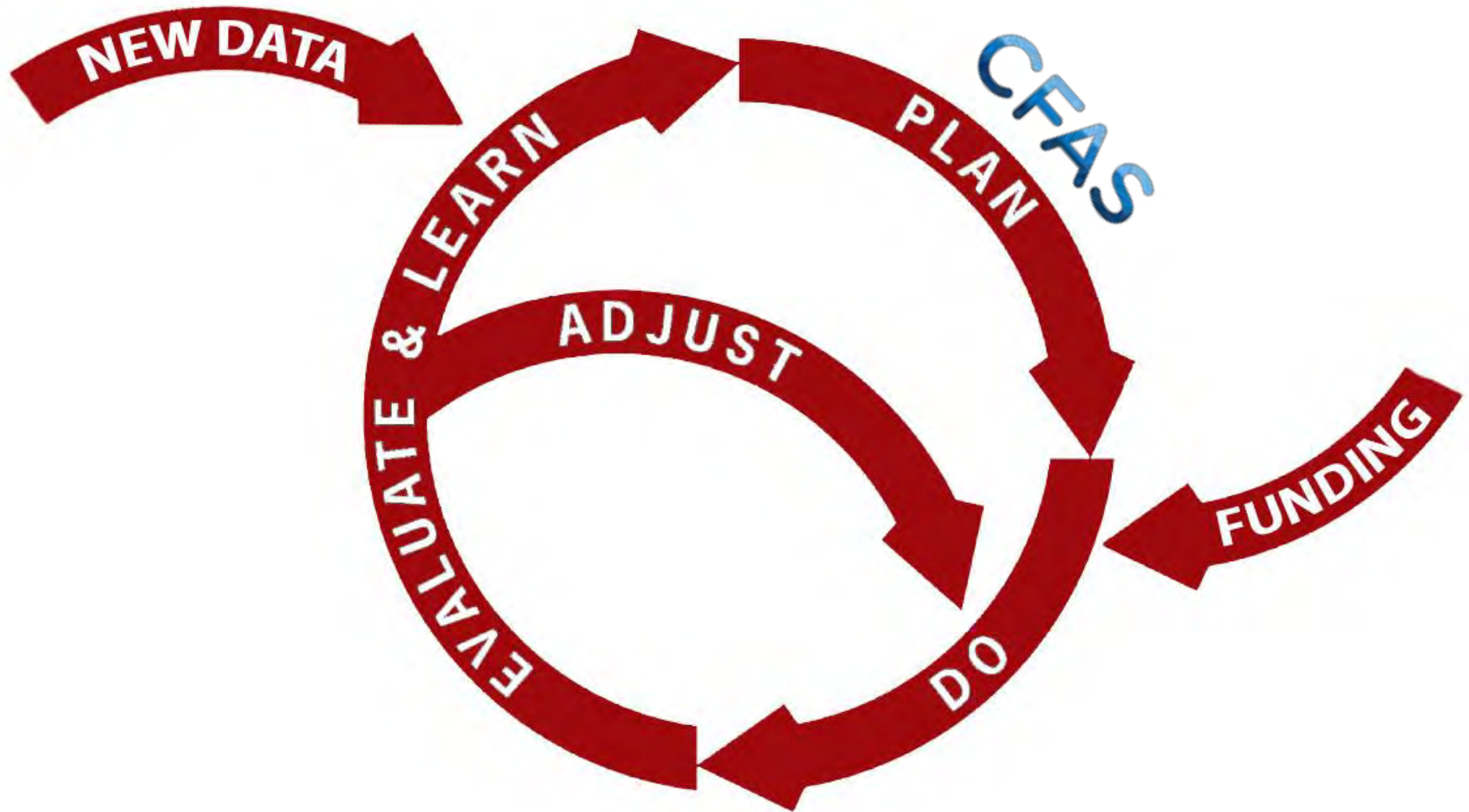
		BASELINE - NO ADAPTATION	CURRENT CONVENTIONS	MUD BAY BARRIER	HIGHWAY 99 REALIGNMENT	MANAGED RETREAT
 CAPITAL COST		—	\$100M - \$1B	MORE THAN \$4B	\$1B - \$4B	\$1B - \$4B
 OPERATION & MAINTENANCE COST		MORE THAN \$10M	MORE THAN \$10M	\$1M - \$10M	\$1M - \$10M	LESS THAN \$1M
 INFRASTRUCTURE MARGINAL COST		MORE THAN \$100M	\$10M - \$100M	LESS THAN \$10M	\$10M - \$100M	MORE THAN \$100M
 COST TO FUTURE GENERATIONS		\$1B - \$4B	\$1B - \$4B	\$1B - \$4B	\$1B - \$4B	LESS THAN \$100M

National Survey on Flood Risks

- 6% of Canadians know they live in a designated flood risk area
- 21% believe that the risk of flooding will increase over the next 25 years
- 83% of Canadians believe that homeowners are responsible for personal protection



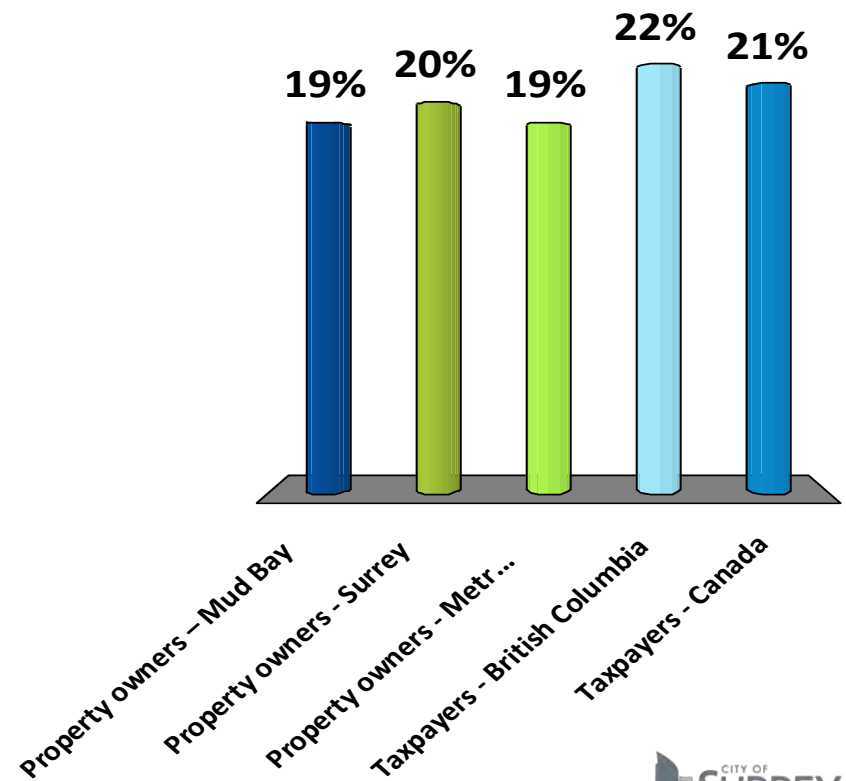
Post CFAS



Who should pay?

Who should pay the most to help Mud Bay adapt to sea level rise (rank)?

- A. Property owners – Mud Bay
- B. Property owners - Surrey
- C. Property owners - Metro Vancouver
- D. Taxpayers - British Columbia
- E. Taxpayers - Canada





Mud Bay

Priority Options

RANKING WORKSHEET



	A BASELINE - NO ADAPTATION	B CURRENT CONVENTIONS	C MUD BAY BARRIER	D HIGHWAY 99 REALIGNMENT	E MANAGED RETREAT	RANK CRITERIA
--	-----------------------------------	------------------------------	--------------------------	---------------------------------	--------------------------	----------------------

VALUES CRITERIA

RESIDENTS <i>People permanently displaced</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE	FAR WORSE	
AGRICULTURE <i>Permanent loss of agriculture land</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE	FAR WORSE	
ENVIRONMENT <i>Impacts to wetland habitats, freshwater fish habitat & riparian areas</i>	MODERATELY WORSE	FAR WORSE	FAR WORSE	SLIGHTLY BETTER	FAR BETTER	
INFRASTRUCTURE <i>Percent of service/transportation infrastructure made vulnerable</i>	FAR WORSE	NO CHANGE	NO CHANGE	NO CHANGE	SLIGHTLY WORSE	
ECONOMY <i>Revenue</i>	FAR WORSE	SLIGHTLY WORSE	NO CHANGE	SLIGHTLY WORSE	MODERATELY WORSE	
RECREATION <i>Diversity of recreational opportunities</i>	FAR WORSE	NO CHANGE	SLIGHTLY WORSE	SLIGHTLY BETTER	MODERATELY BETTER	
CULTURE <i>Opportunities for traditional practices</i>	SLIGHTLY WORSE	NO CHANGE	MODERATELY WORSE	NO CHANGE	NO CHANGE	
IMPACT & RISK OF FAILURE						
OVERALL RISK	VERY HIGH	VERY HIGH	VERY HIGH	MEDIUM	VERY LOW	
COST CRITERIA						
CAPITAL COST	—	\$100M - \$1B	MORE THAN \$4B	\$1B - \$4B	\$1B - \$4B	
OPERATION & MAINTENANCE COST	MORE THAN \$10M	MORE THAN \$10M	\$1M - \$10M	\$1M - \$10M	LESS THAN \$1M	
INFRASTRUCTURE MARGINAL COST	MORE THAN \$100M	\$10M - \$100M	LESS THAN \$10M	\$10M - \$100M	MORE THAN \$100M	
COST TO FUTURE GENERATIONS	\$1B - \$4B	\$1B - \$4B	\$1B - \$4B	\$1B - \$4B	LESS THAN \$100M	

RANK OPTIONS

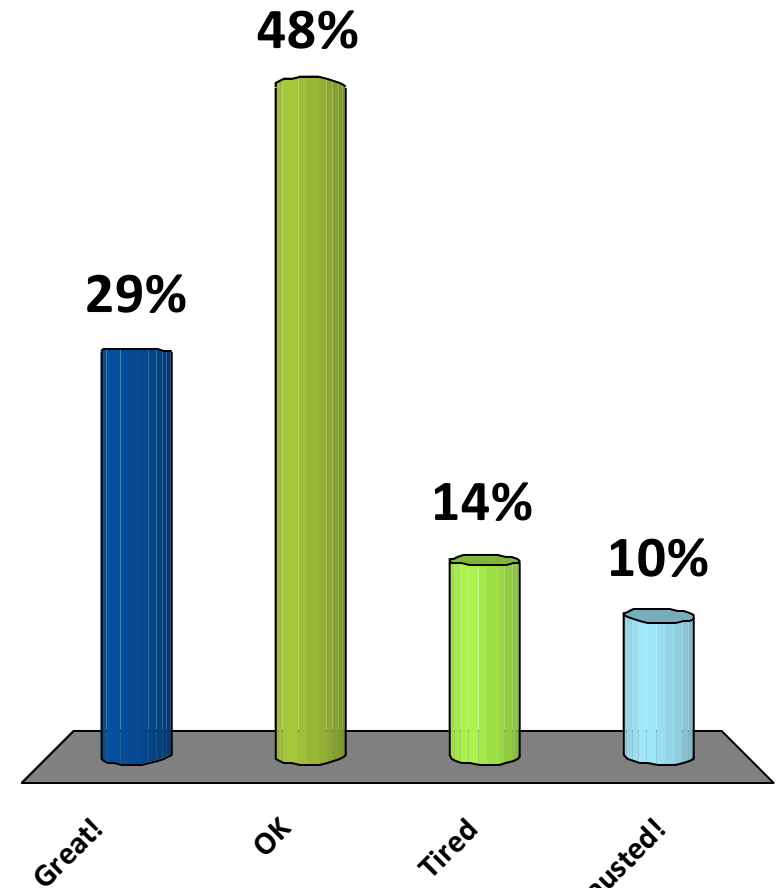
	OPTION A	OPTION B	OPTION C	OPTION D	OPTION E

Activity #4

- Individually:
 1. Rank top 5 criteria
 2. Rank all options
- In tables, discuss:
 - Does your top option perform well on the criteria you care most about?

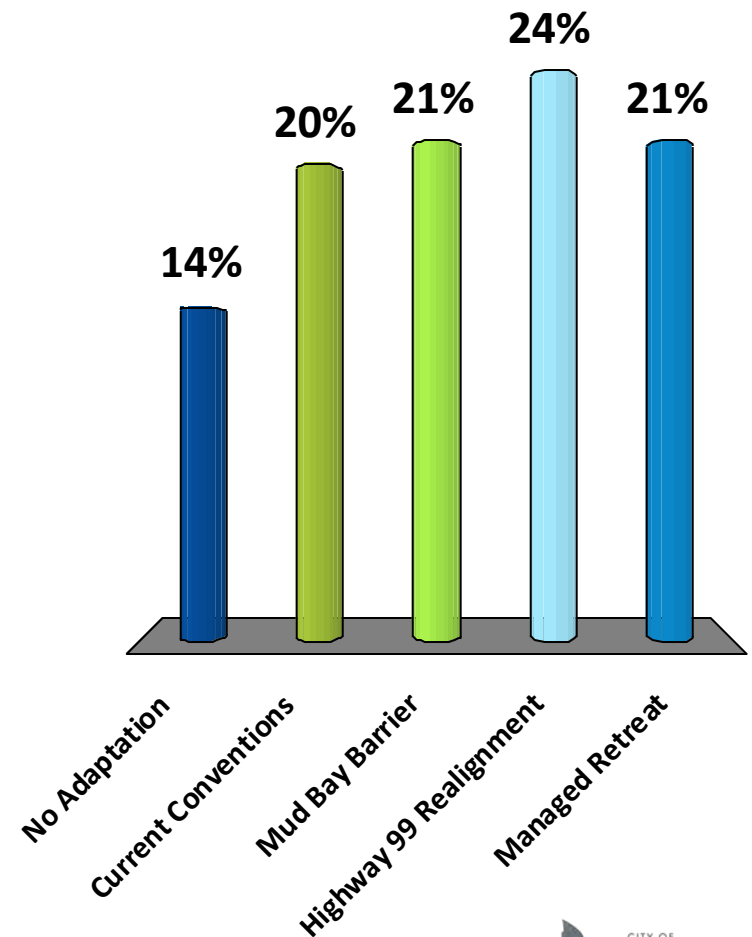
How are you feeling?

- A. Great!
- B. OK
- C. Tired
- D. Exhausted!



Option preference by 2100 (rank)

- A. No Adaptation
- B. Current Conventions
- C. Mud Bay Barrier
- D. Highway 99
Realignment
- E. Managed Retreat



Activity #5

- In tables, discuss:
 - If the option you selected is not the top option, what changes would make the option better from your point of view?



Mud Bay

Next Steps

Next Steps Phase 3

- Mud Bay Survey (live now)
- Crescent Beach Survey (TBD)
- Open house (April 10th, 2018)



More information?





SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

Thank you!

