



Presenting:

The Times They Are A Changin': A Structured Decision Making (SDM) Approach to Managing Coastal Flood Risks from Sea-Level Rise In Vancouver, British Columbia

by Christian Beaudrie, Tamsin Lyle, Graham Long, Tamsin Mills

DAAG Conference 2018

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The Times They Are A Changin'

A Structured Decision Making (SDM) Approach
to Managing Coastal Flood Risks from Sea-Level
Rise In Vancouver, British Columbia

Society of Decision Professionals – DAAG 2018

Vancouver, BC April 13, 2018



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A Coastline In Peril

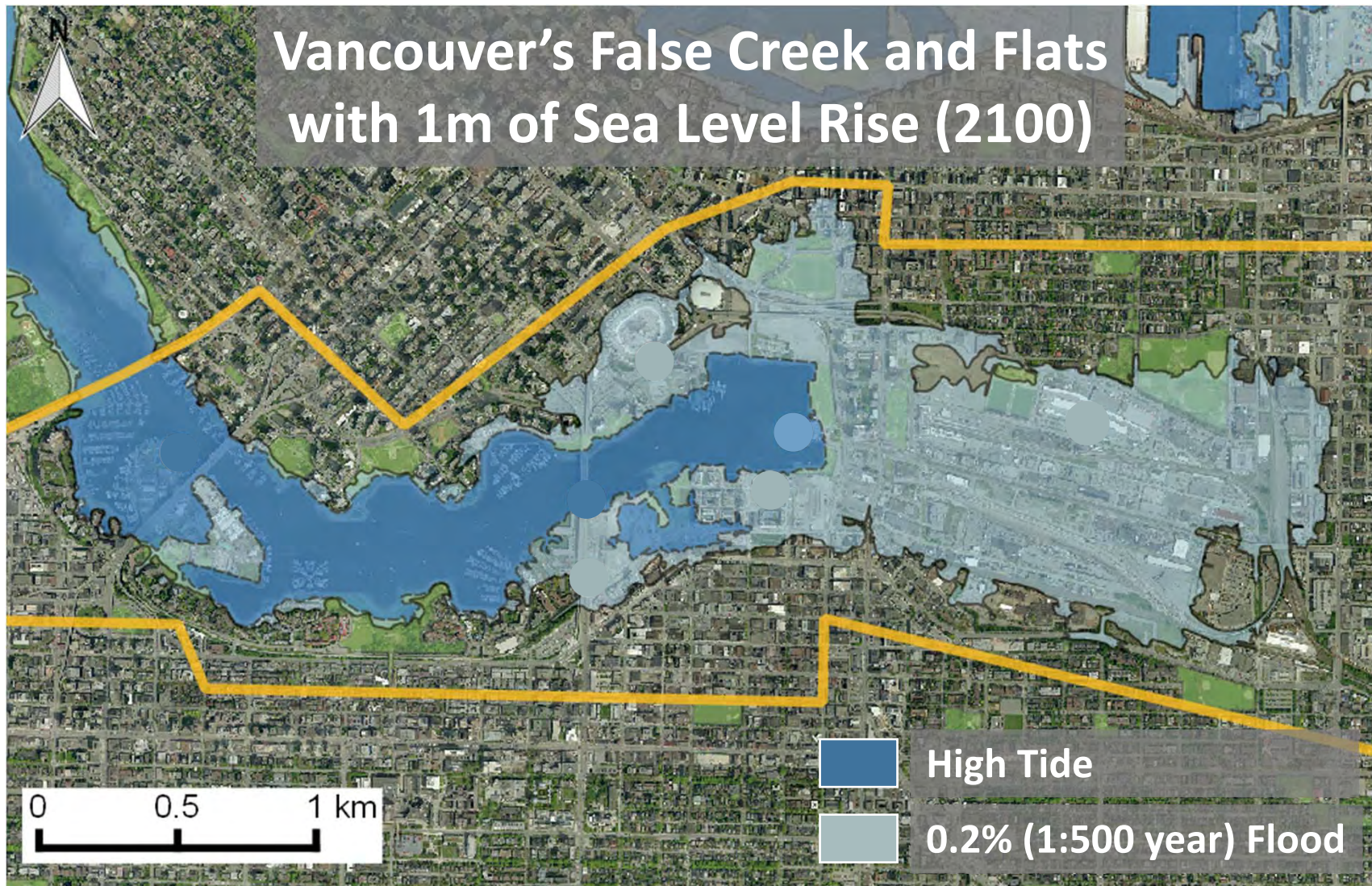


Image: Ebbwater Consulting (used with permission)



Adaptation Planning for a Changing Environment

Phase 1

- Understanding flood **hazards** (mapping)

Phase 2

- Evaluating **vulnerabilities and consequences**
- Identifying suitable **adaptation options**
- Analyzing **trade-offs**
- Identifying **preferred options**

Phase 3

- Developing an **adaptive SLR planning framework** to guide actions and timing



Complexity on Many Levels

Understanding Risks

- Uncertain nature of climate change
- Unknown timescales
- Intangibility of impacts (environment, society, economy)
- Changing neighbourhoods

Engaging Affected Communities

- What do people care about?
- Changing communities, tolerances, preferences
- Communicating risks, informing decisions

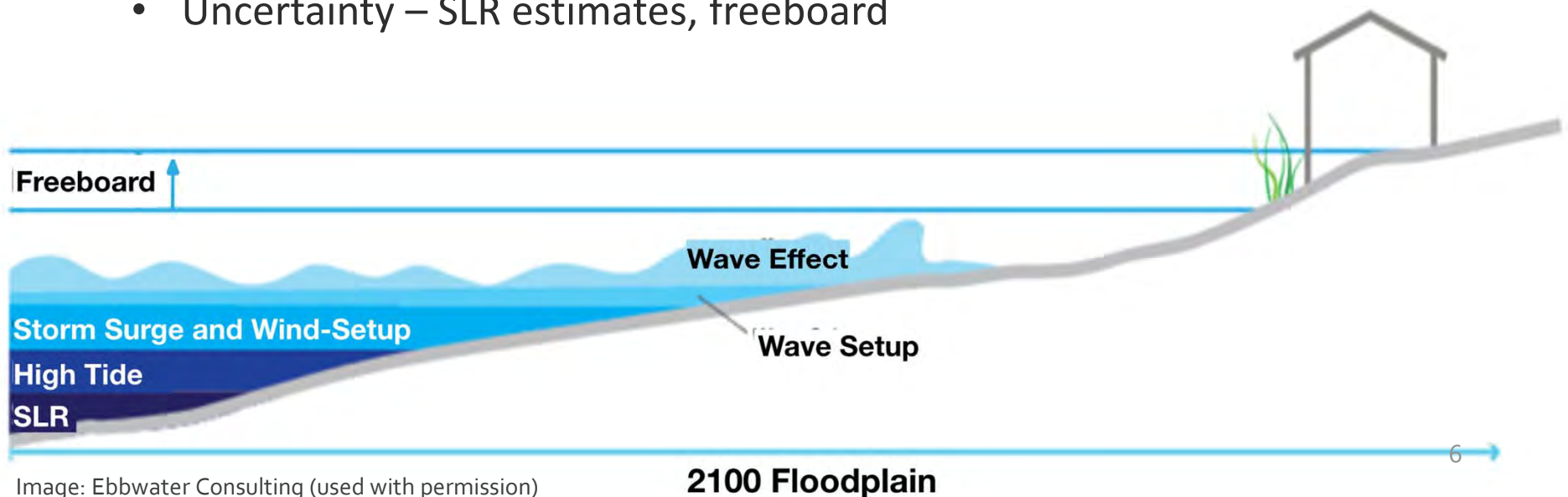
Risk and Uncertainty

Communicating risk is a challenge in the best of circumstances

- Probability – flood intensity vs return period
- Cumulative impacts – small frequent events
- Cognitive biases – affect understanding and decisions

Sea level rise adds a dimension of complexity: non-stationary risk

- Increasing risk over time - what's safe today is not tomorrow
- Uncertainty – SLR estimates, freeboard





Core Questions for Adaptation Planning

What's valued that should be protected?

How should they be protected?

When?

Understanding Through Engagement

Develop a clear understanding of the *values*, *perspectives*, and *preferences* of affected communities



“Wisdom of the Crowd” – required knowledge is diverse and found in different places

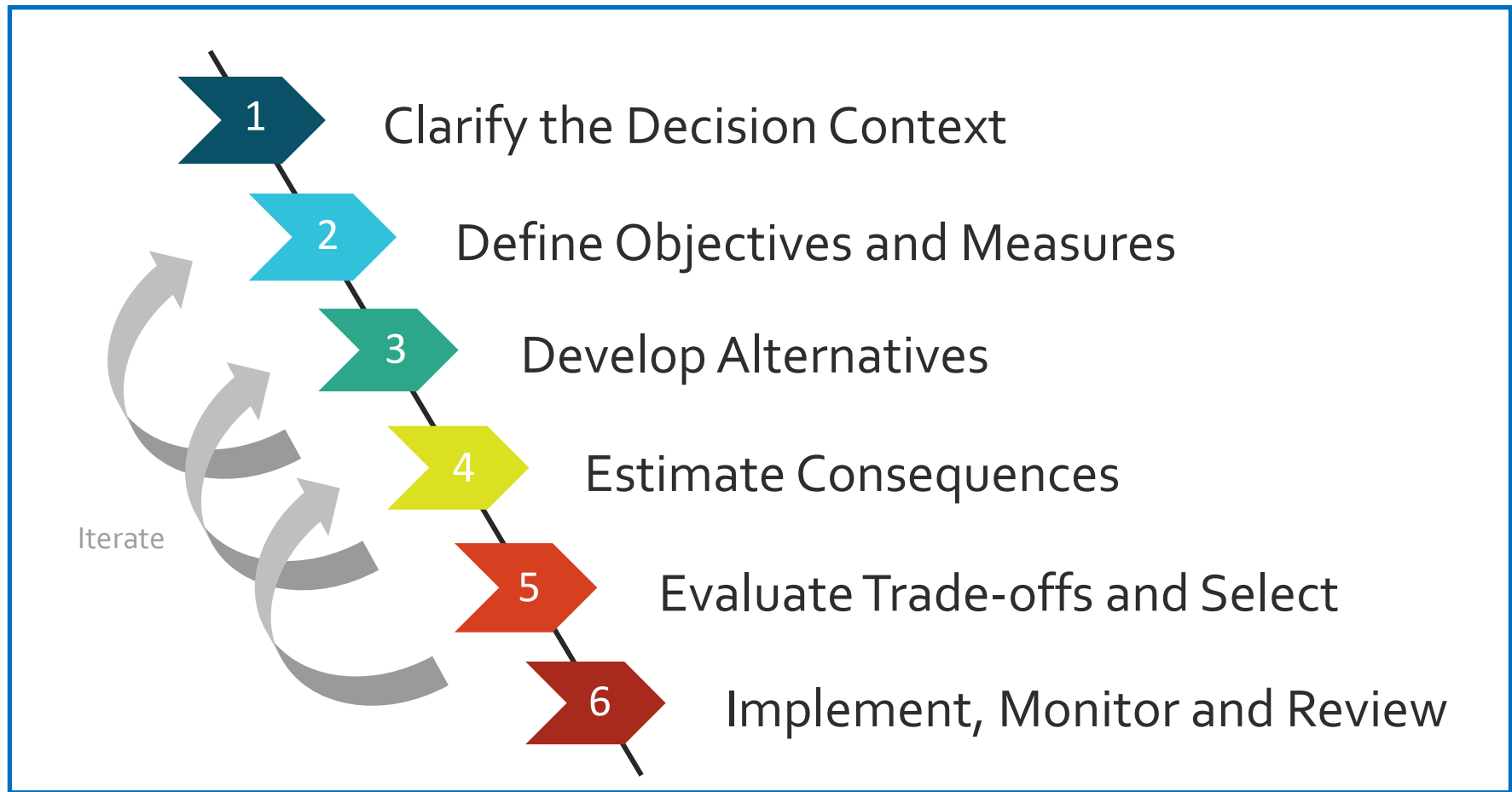
Engage a diversity of ‘internal’ stakeholders and ‘external’ communities of interest to inform decisions



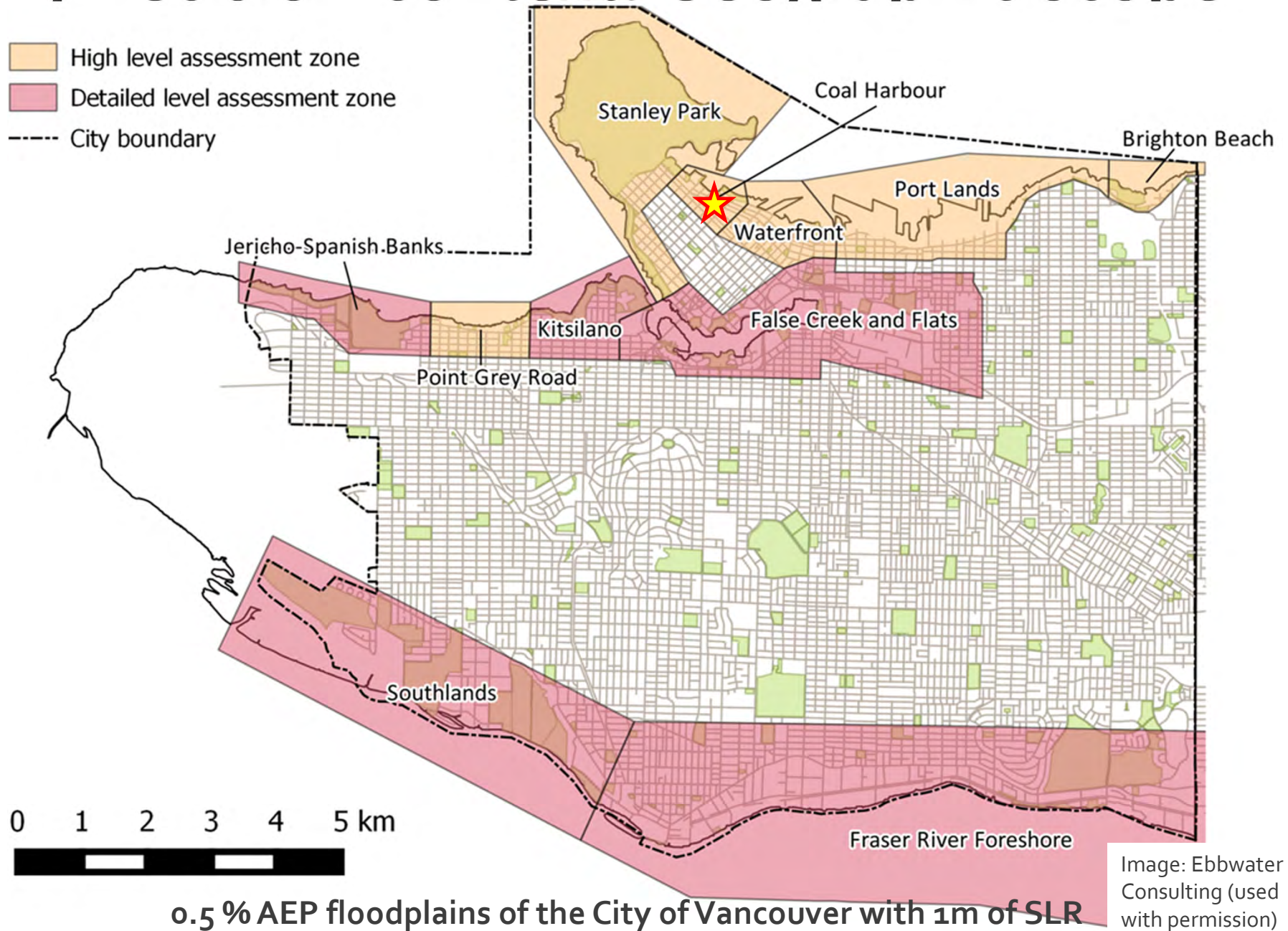
Phase 2: Coastal Flood Risk Assessment & Adaptation Options



A Structured Decision Making (SDM) Approach



1) Decision Context: Geographic Scope





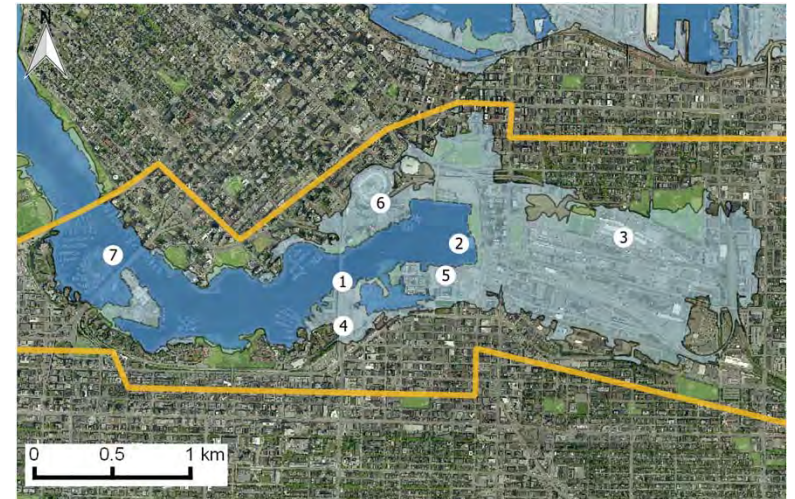
1) Decision Context: Flood Scenarios

	TODAY (0 m SLR)	2060 (0.6m SLR)	2100 (1m SLR)
King tides	*		*
1-in-15 year events			
1-in-500 year events	*		*

Each scenario considered the effects of sea level rise (SLR), high tide, storm surge and wind set-up, wave set-up, wave effect, and 0.6 m freeboard.

** indicates scenarios considered in the workshops*

2) Define Objectives and Measures



Images: Compass, Ebbwater Consulting (used with permission)



2) Define Objectives and Measures

Flood Protection (Per Event)

Objectives and Evaluation Criteria	Scale
PEOPLE	
People displaced temporarily	# of people displaced from flood events
“at risk” people impacted	Social Vulnerability Index (SVI) weighted displacement
Park and recreational amenity value	Value-weighted area affected per event
Loss of critical services	# of pieces of infrastructure impacted
ENVIRONMENT	
Risk of contaminant release	# of sites with potential contaminants
Environmental benefits	-2 to +2 (constructed scale)
ECONOMY	
Damage to infrastructure	Value-weighted km of roads impacted
Damage to buildings	\$M
Business disruption	# of employees working in impacted businesses
Loss of inventory	\$M
Emergency response costs	Estimated cost per event

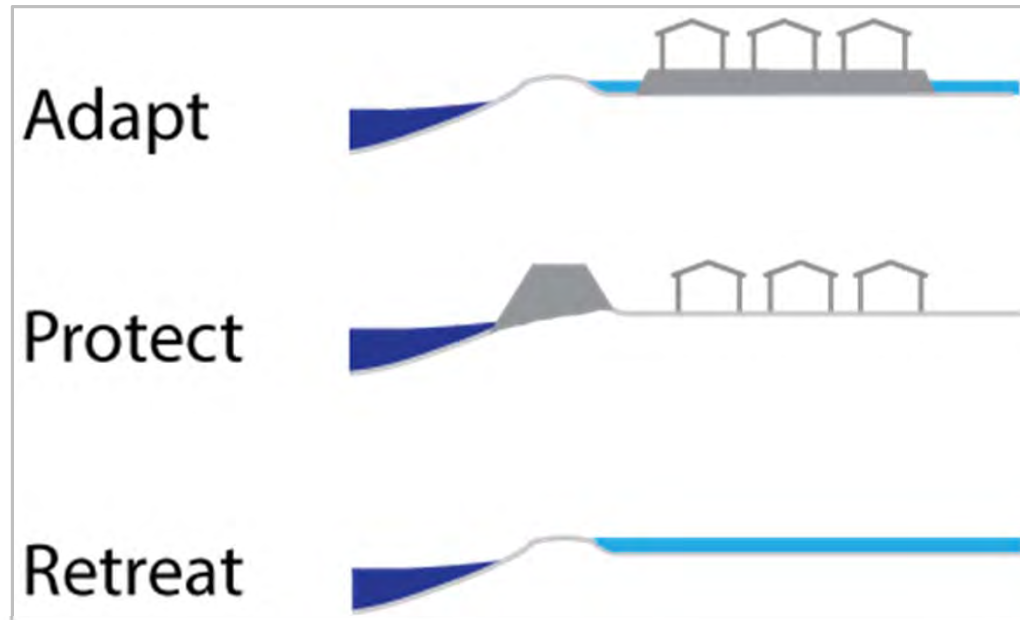


2) Define Objectives and Measures

Implications of the Flood-Management Action (or Inaction)

Objectives and Evaluation Criteria	Scale
PEOPLE	
People displaced permanently	# of people displaced permanently (by SLR or flood-management action)
Aesthetics	-2 to +2 (constructed scale)
IMPLEMENTATION	
Capital costs	\$M
Maintenance costs	\$M
Adaptability	1 to 4 (constructed scale)
Ease of implementation	1 to 5 (constructed scale)

3) Develop Alternatives



Menu w/
~40 options

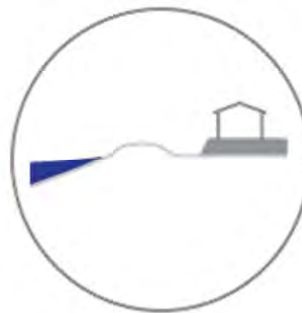
Cornerstone Idea



e.g. a dike



Brick Idea



complemented with
property-level-protecton

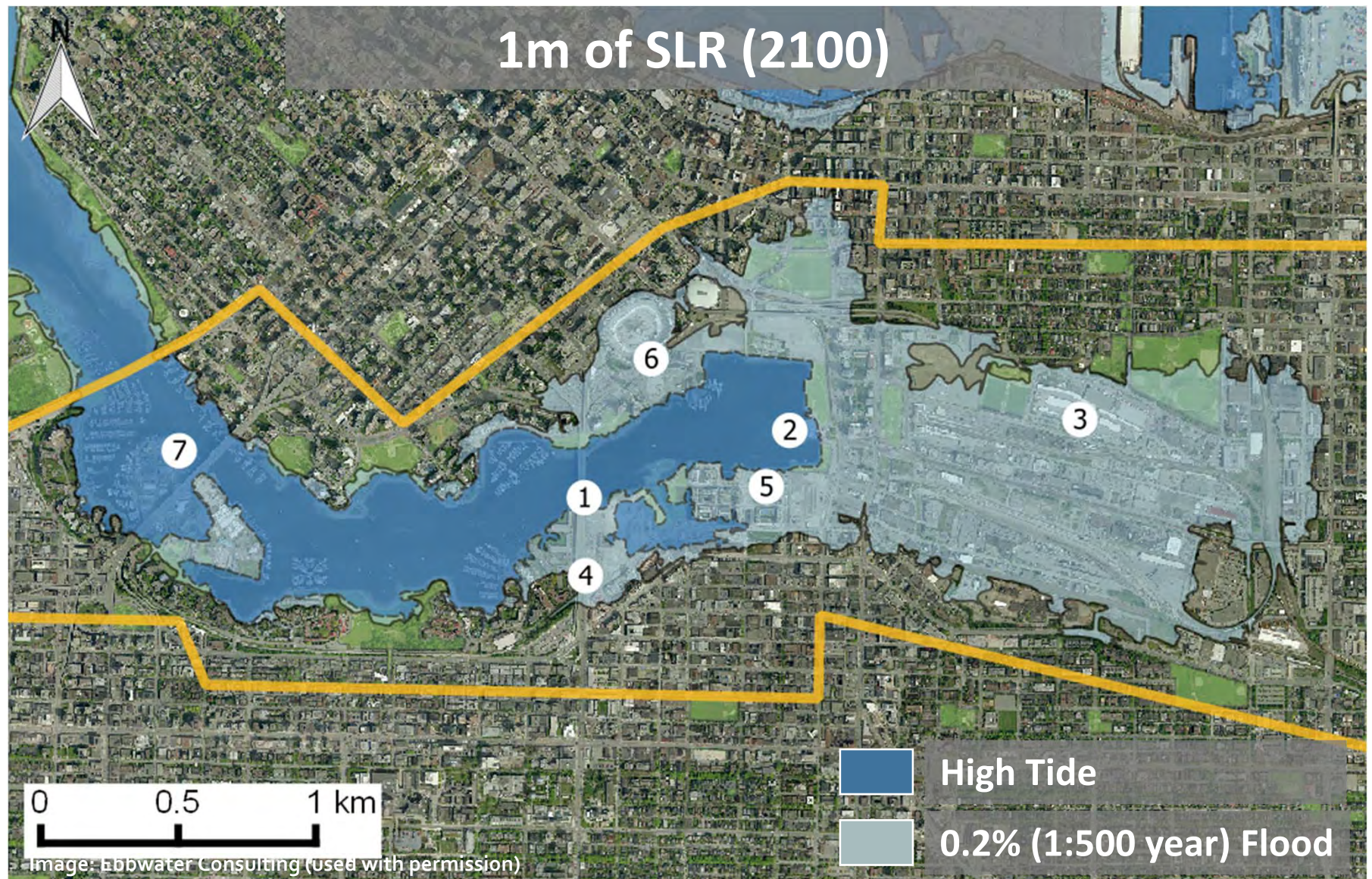


Brick Idea

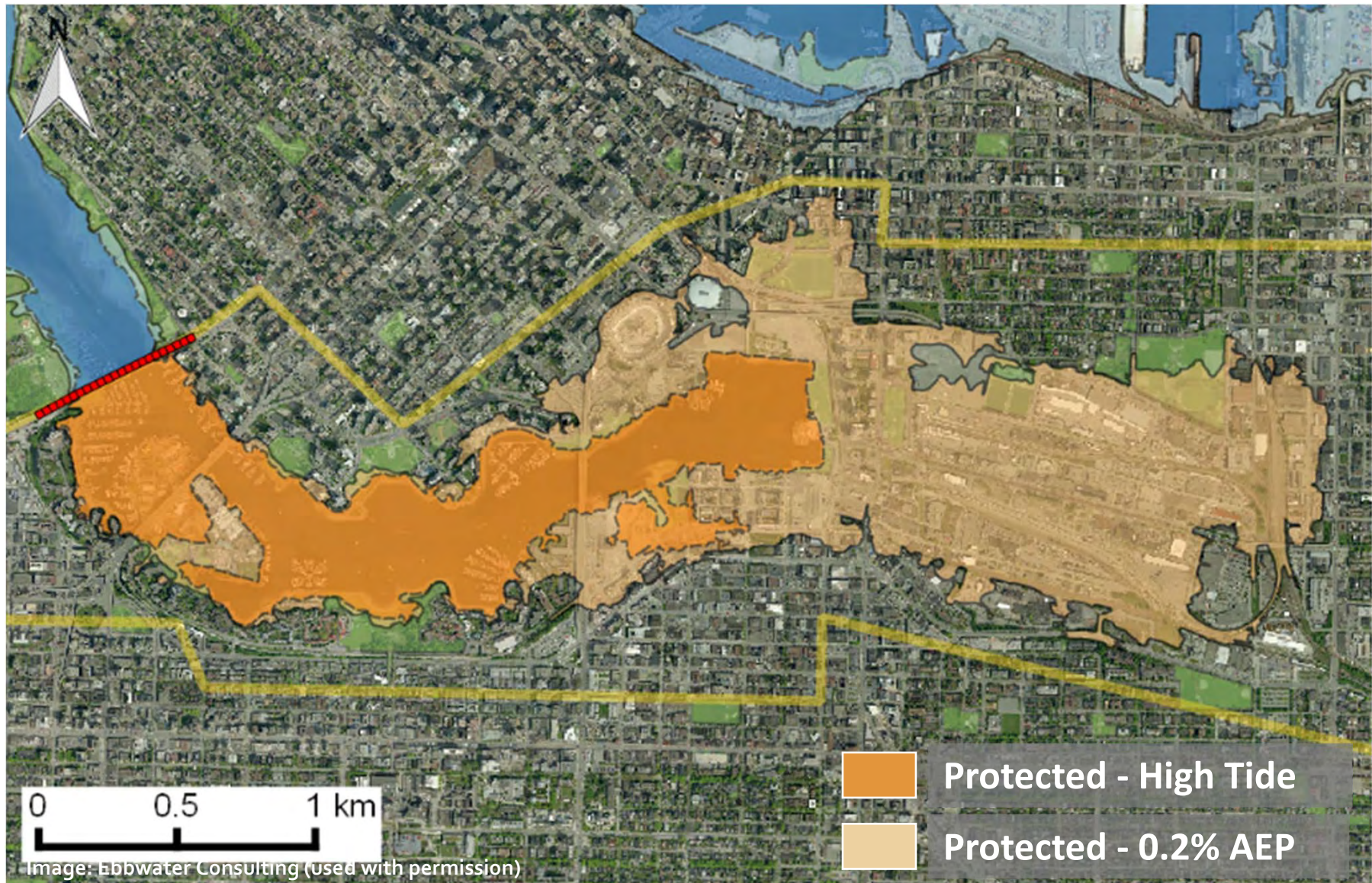


improved with habitat
enhancement and a bike path

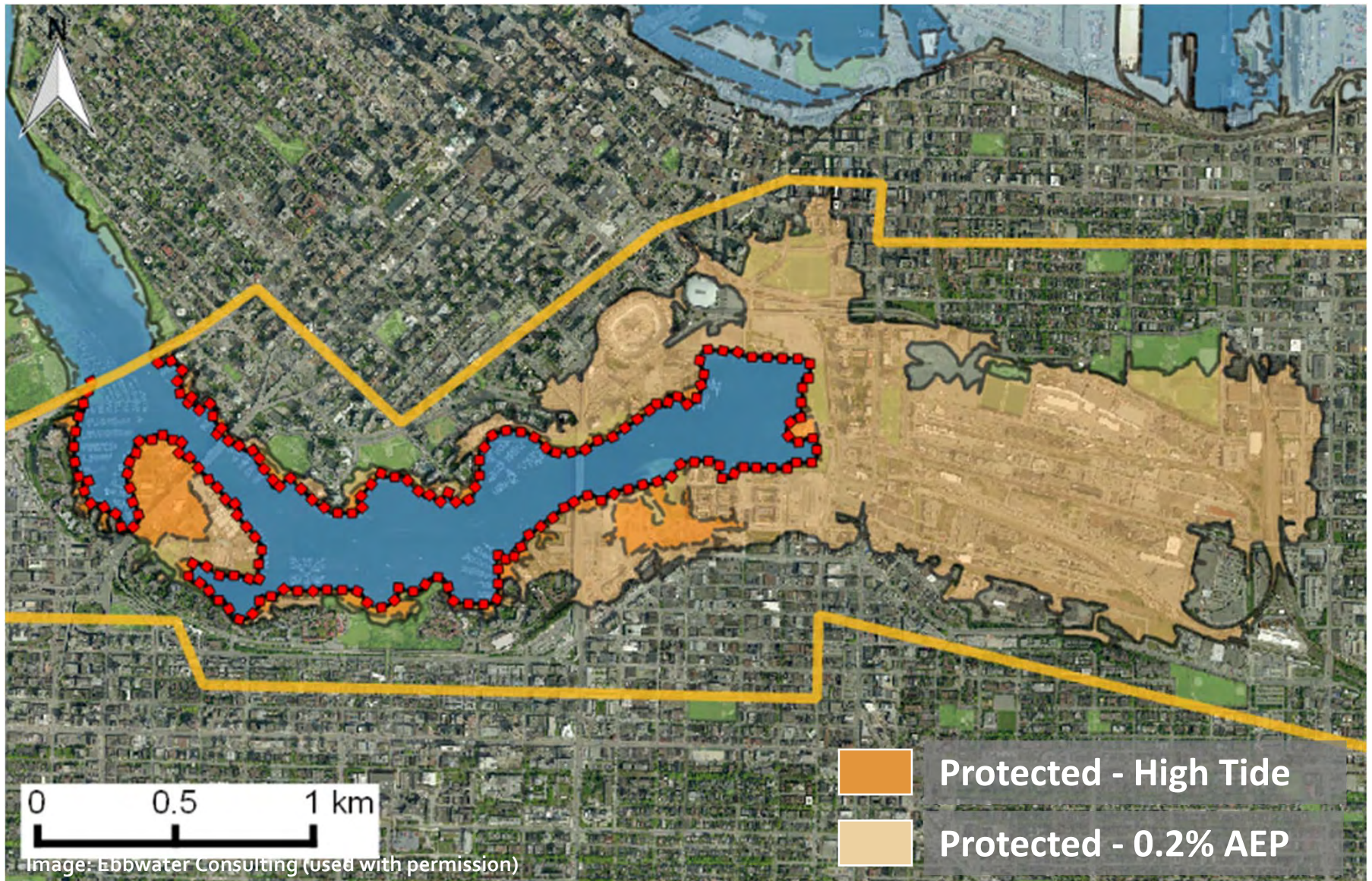
Vancouver's False Creek and Flats



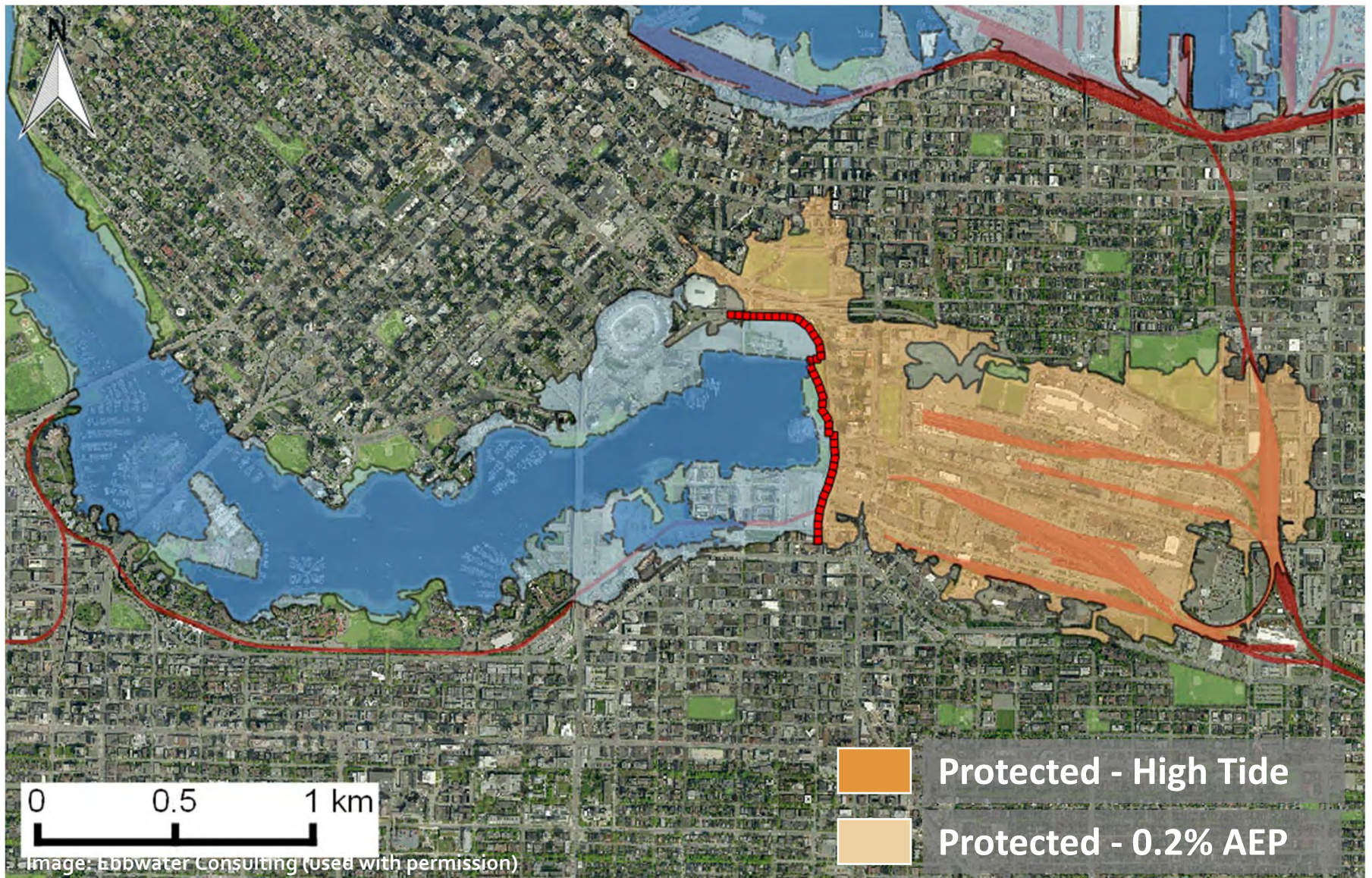
Alt A - False Creek Sea Barrier



Alt B - False Creek Seawall

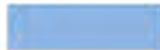



Alt C - False Creek Partial Dike



4) Estimate Consequences & Evaluate Trade-offs

	Scale	Dir	BASELINE	PROTECT Sea Barrier	PROTECT Raised Seawall	PROTECT Partial Dike	ADAPT Multiple Tools
PEOPLE							
People Displaced - Flood Events	# of people displaced	L					
People Displaced - Permanently at risk' people impacted	# of people displaced SVI weighted displacement	L					
Park and Recreational Amenity Value	Value-weighted area affected per	L					
Loss of critical services	# of pieces of infrastructure impacted	L					
Aesthetics	-2 to 2	H					
ENVIRONMENT							
Risk of Contaminant Release	# of sites w/ potential contaminants	L					
Environmental Benefits	-2 to 2	H					
ECONOMY							
Damage to Infrastructure	Value-weighted km of roads	L					
Damage to buildings	\$M	L					
Business disruption	# employees in impacted businesses	L					
Loss of inventory	\$M	L					
Emergency response costs	\$M	L					
IMPLEMENTATION							
Capital Costs	\$M	L					
Maintenance costs	\$M	L					
Adaptability	1 to 4	H					
Ease Of Implementation	1 to 5	H					

 Best Performance
 Worst Performance

Consequence Table for False Creek Adaptation Alternatives

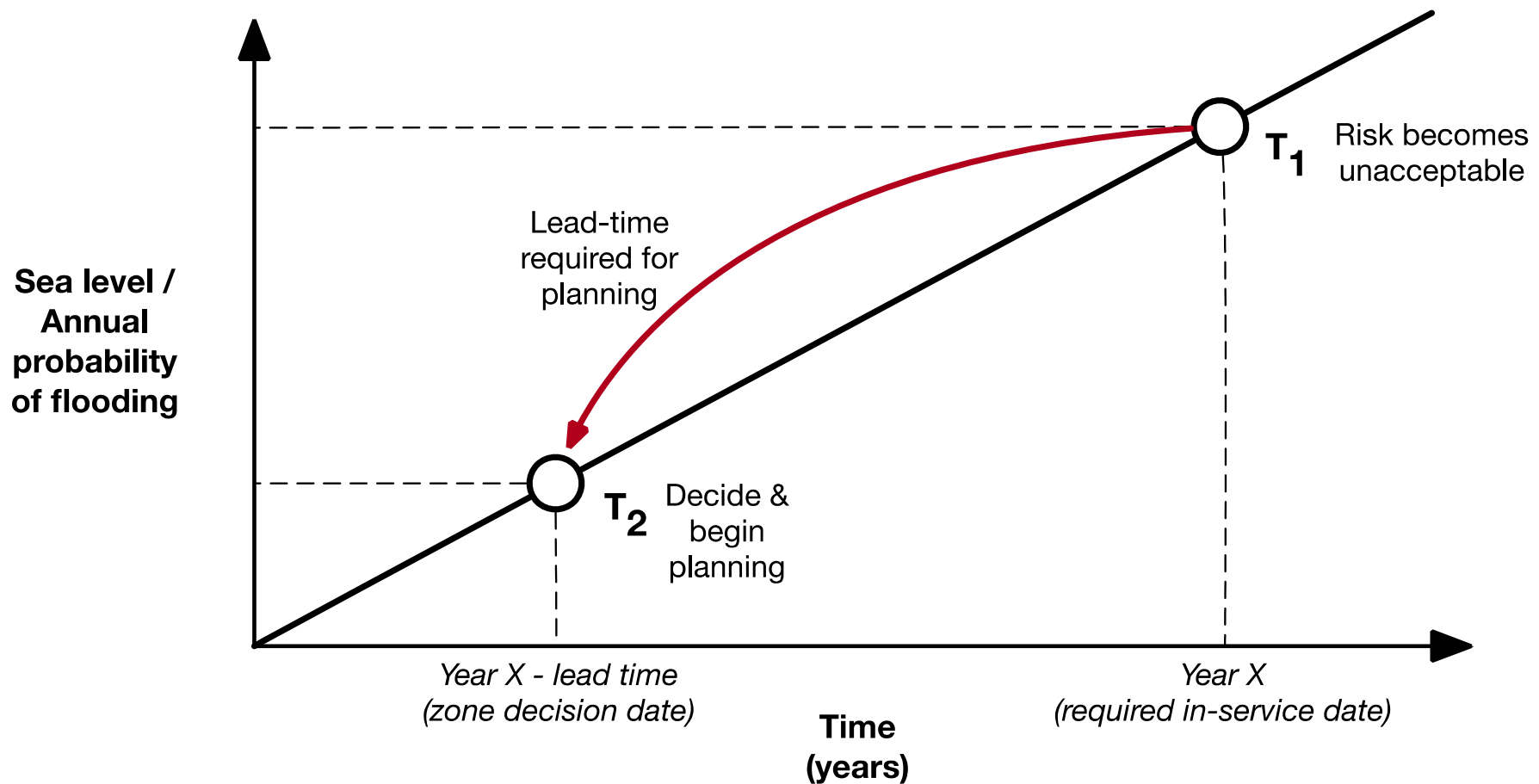
Image: Compass Resource Management (used with permission)



Phase 3: SLR Adaptation Framework

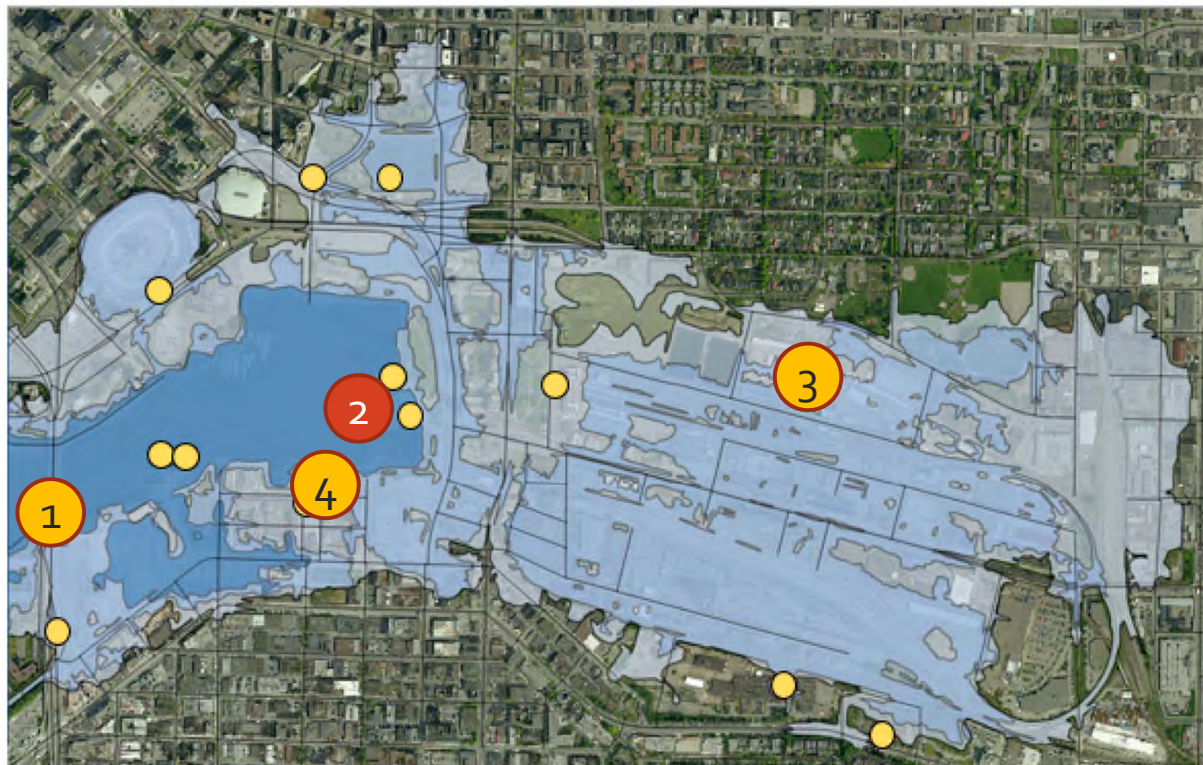
Planning timeline, thresholds, and triggers for action

Risk Thresholds and Triggers



Flood Extent & Key Assets

Flood Extent for Zone 10: False Creek Flats, 2100 1m SLR



Science World decking west

(3.6m)



Pick a year / SLR scenario

Select year

<input type="checkbox"/>	Sea Level	<input type="radio"/>	Map only
<input type="checkbox"/>	1/15 year event	<input type="radio"/>	0m SLR (2000)
<input type="checkbox"/>	1/500 year event	<input type="radio"/>	0.6m SLR (2060)
<input checked="" type="checkbox"/>		<input checked="" type="radio"/>	1m SLR (2100)

POI Curves

Annual probability of inundation at representative locations in Zone 10: False Creek Flats, with 0.6m freeboard

Return Period (yr)	Annual Probability(%)
1	100.0
10	10.0
15	6.7
30	3.3
40	2.5
50	2.0
100	1.0
200	0.5
300	0.3
400	0.25
500	0.2
1000	0.1

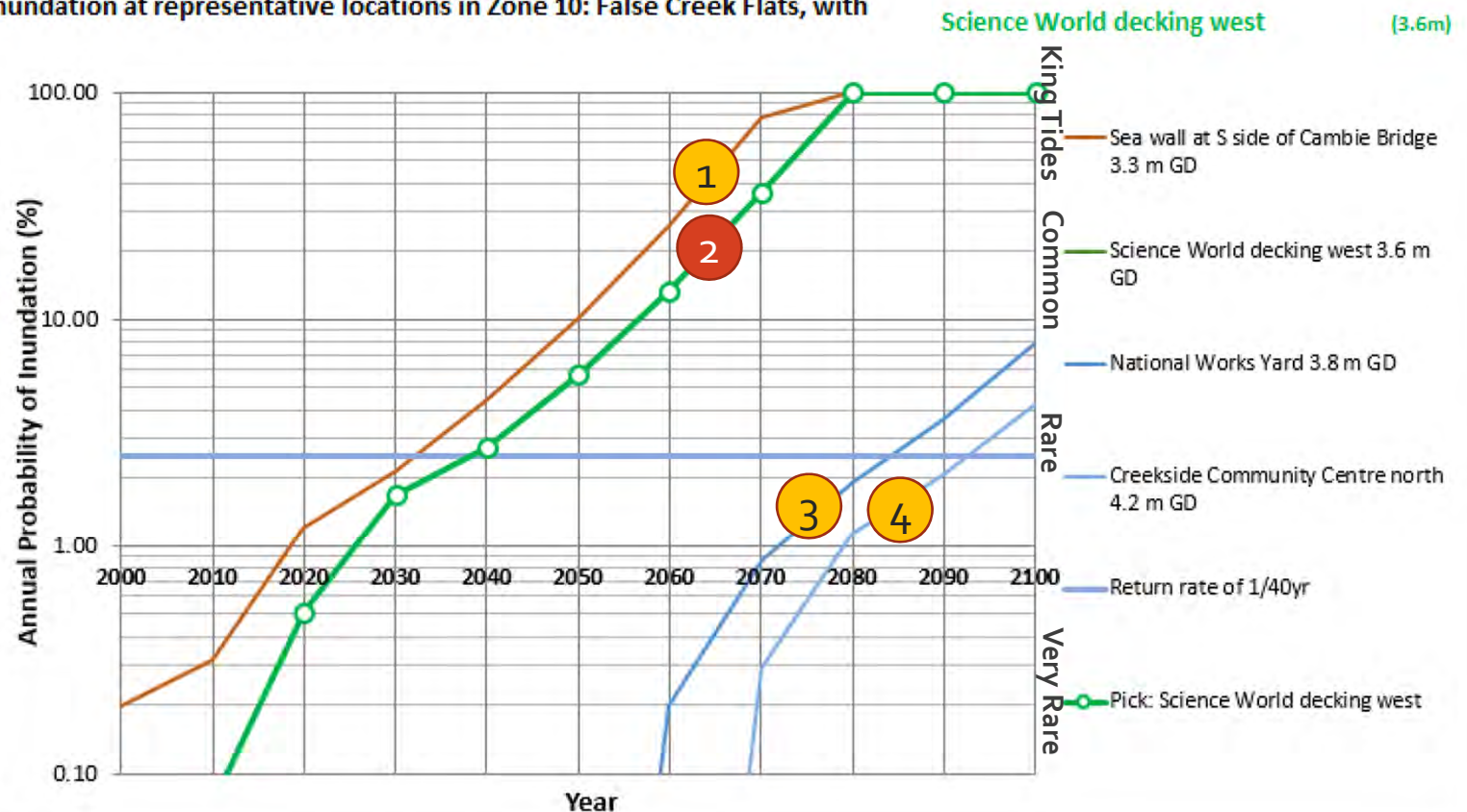
☒ Return Period Guide Line

Choose Flood Curve

☒ All flood depths

☐ Floods >30cm in depth

☐ Floods >100cm in depth





Conclusions

- An SDM approach can aid in decision structuring, understanding what matters, developing good alternatives, evaluating trade-offs
- Understanding of diverse perspectives through ‘Internal’ engagement with City planners and engineers, and ‘External’ engagement with communities of interest
- ‘Internal’ group very similar to ‘external’ group – diverse cultures, interests and motivations, values and perspectives
- Multiple methods to grapple with challenges of communicating probabilistic risk and uncertainty



Acknowledgements


- Special thanks to Tamsin Lyle – Ebbwater Consulting
- City of Vancouver, NR-Canada



Natural Resources Canada
Ressources naturelles Canada

Canada





*Come gather 'round people where ever you roam
And admit that the waters around you have grown
And accept it that soon you'll be drenched to the bone
If your time to you is worth savin'
Then you better start swimmin' or you'll sink like a stone,
For the times they are a' changin'!*

- Bob Dylan