

A Risk-Based Approach to Assessing Asset Performance of Flood Infrastructure

George Arthur Bowman,
Asset BowManagement Ltd
New Zealand



Introductions or “Mihimihi”



Source: tourism.net

1. Setting the Scene
2. Challenge
3. Solution
4. Results & beyond...



Global Flooding Risk

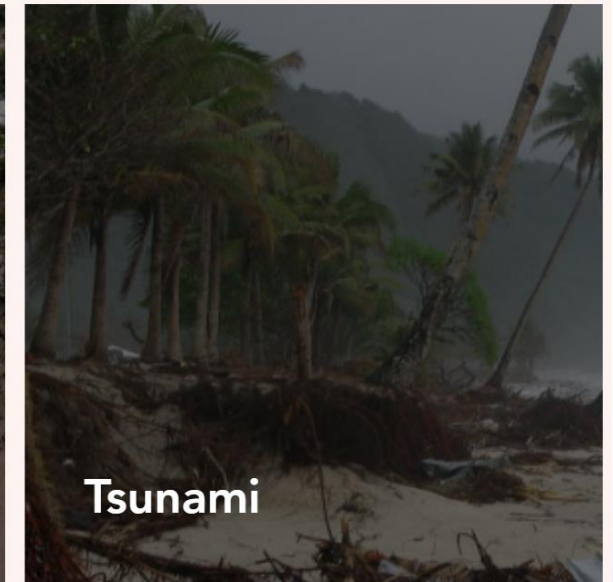
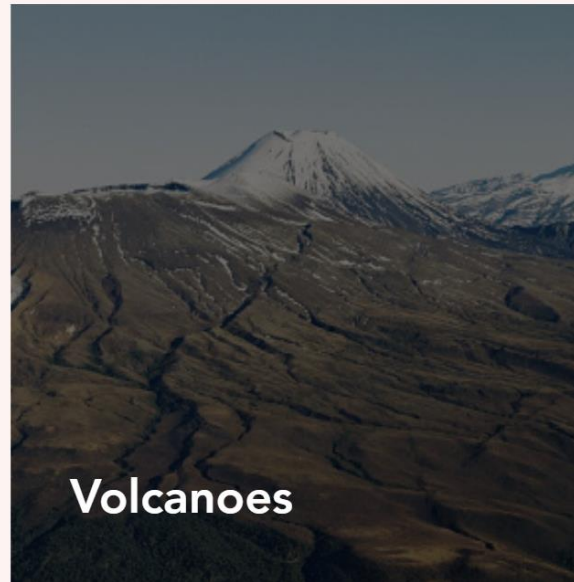
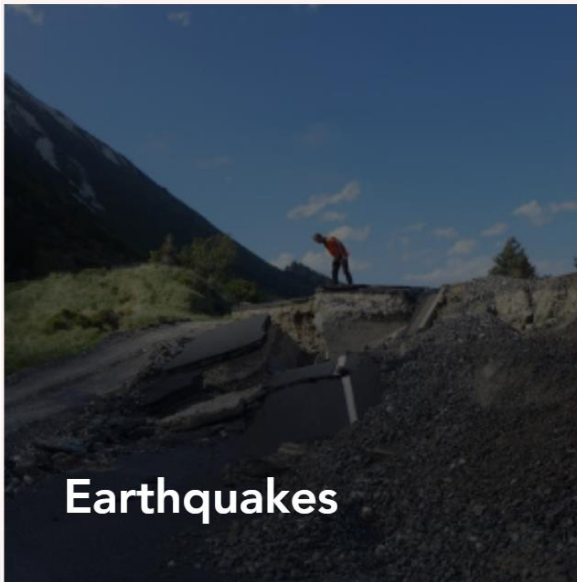
- ~1.5 billion people (2022)
- ~20% of the world
- 1 in 4 Colombians
- New Zealand??



Source: Rentschler, Salhab & Jafin (2022)

Nueva Zelanda

New Zealand's deadliest natural hazard?

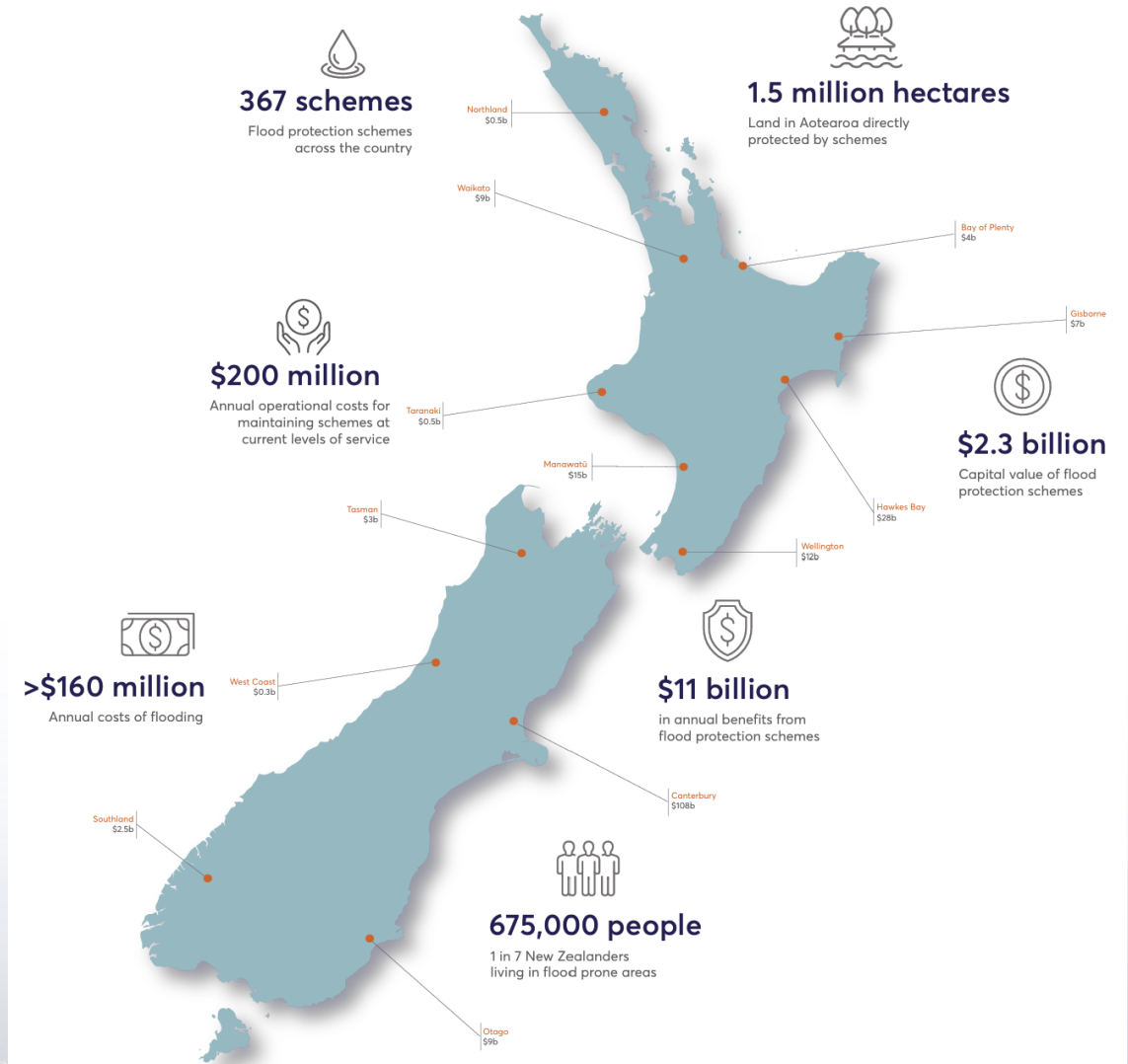
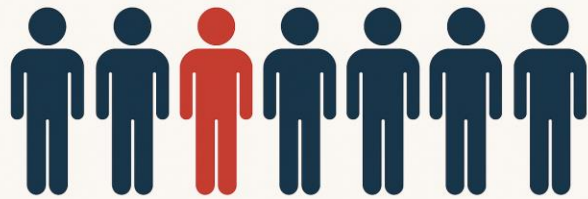


Source: GNS Science



Nueva Zelanda

Major flood every 8 months



Source: Te Uru Kahika, 2022

Nueva Zelanda

Cyclone Gabrielle – February 2023



8 people died
9000 people evacuated
83 building destroyed

Total Damage = NZ\$14.5 BILLION (43.77 Trillion COP)

How big was the flood?



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Mocoa – 2017



Source: Floodlist, 2017



Source: Europa Press, 2017

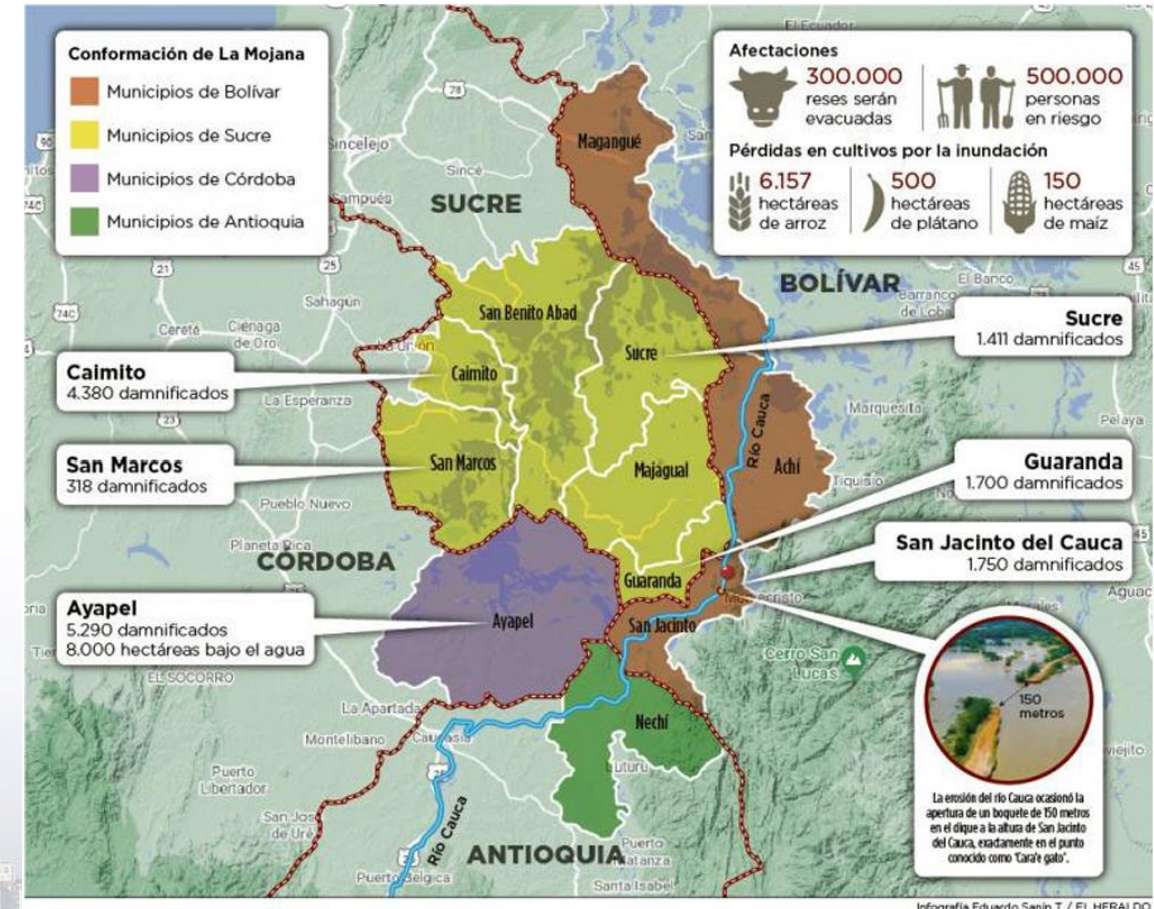


Source: ABC news, 2017

Colombia

Cauca River, La Mojana - 2021

On 27 August 2021, the Cauca River in the north of Colombia flooded, causing serious damage to five municipalities in La Mojana subregion. The flooding was a result of atypical rains during August and a rupture in a dam that functioned as a retaining wall for the river, affecting all municipalities of the subregion.





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Defensoría del Pueblo y Procuraduría exigen al Gobierno nacional acciones inmediatas y concretas.



La Mojana May 2024

Nuevo rompimiento del dique 'Caregato' en La Mojana: se han perdido 35.000 hectáreas de cultivos y hay 400 familias damnificadas

Source: Semana, 2024

Colombia

November 2024

Colombia declares State of
Emergency amid torrential rains and
extreme weather



Source: ColombiaOne, 2024



Source: The City Paper Bogota, 2024

Massive Floods in Colombia Affect Tens of Thousands

Petro says natural disasters caused by “bad governance”

Source: ColombiaOne, 2024

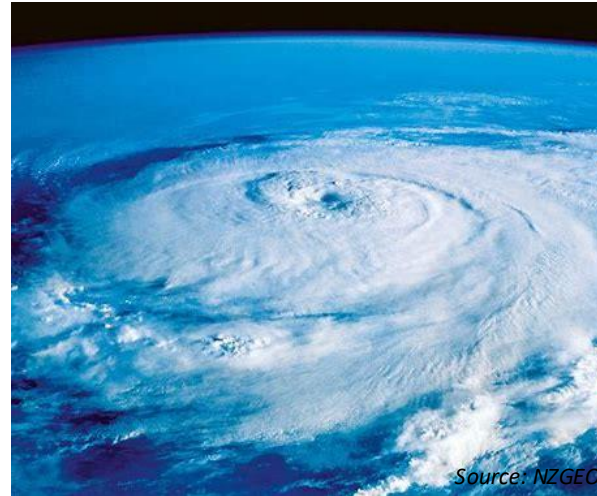


“Hazards are natural. Disasters are political.”

“Poor governance can turn hazards into disasters.”



Extreme
weather and
natural hazards
are driven by
natural and
climate-related
processes,
not governance.



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The impact of extreme weather events is greatly shaped by...

El impacto de los fenómenos meteorológicos extremos está profundamente determinado por...

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**Hazard
knowledge &
understanding**



**Land use
decisions**



**Infrastructure
asset
management**



**Emergency
preparedness
response &
recovery**



**Community
resilience**



Nueva Zelanda VS Colombia

- New Zealand: ~268,000 km²
- Colombia: ~1.14 million km²
- **Colombia = 4x larger**



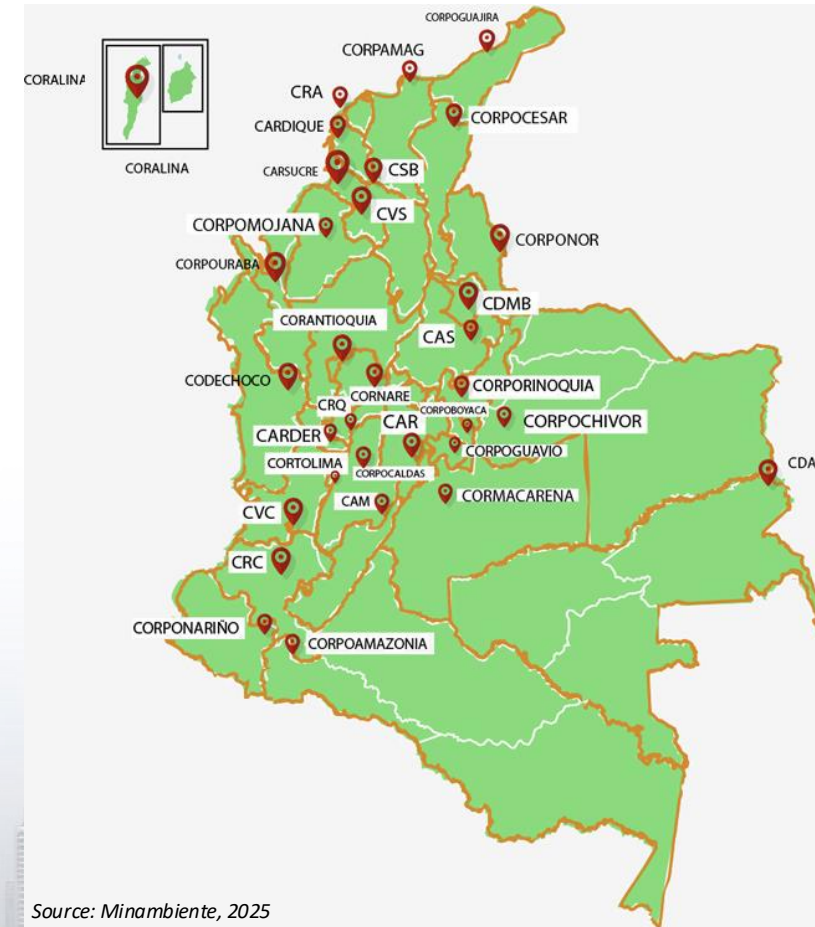
Flood Risk Management

Nueva Zelanda



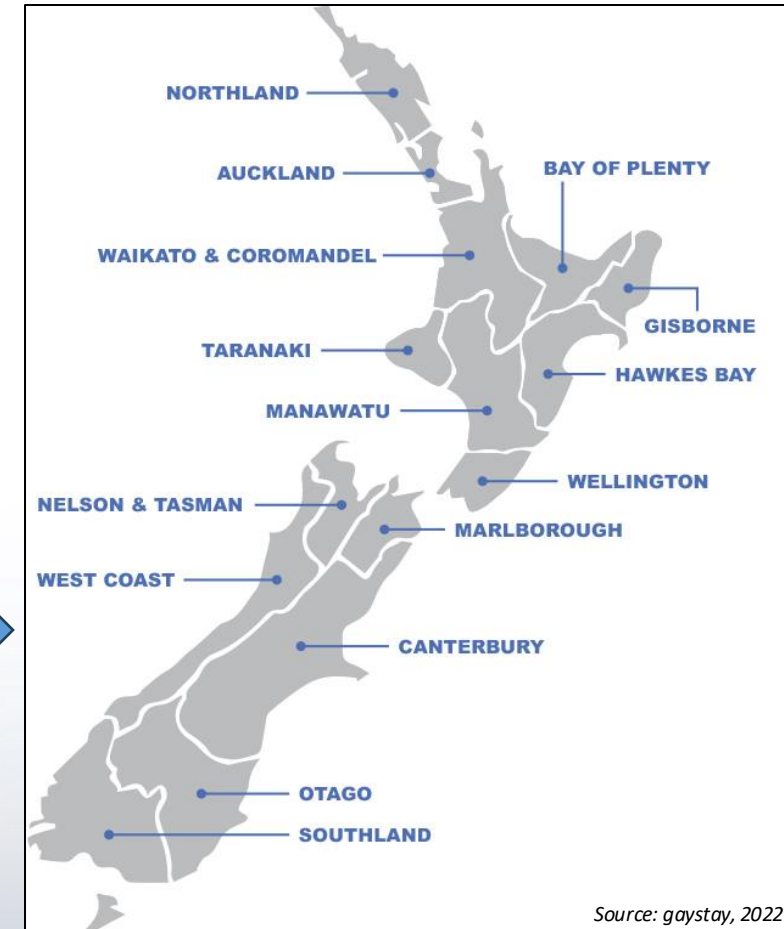
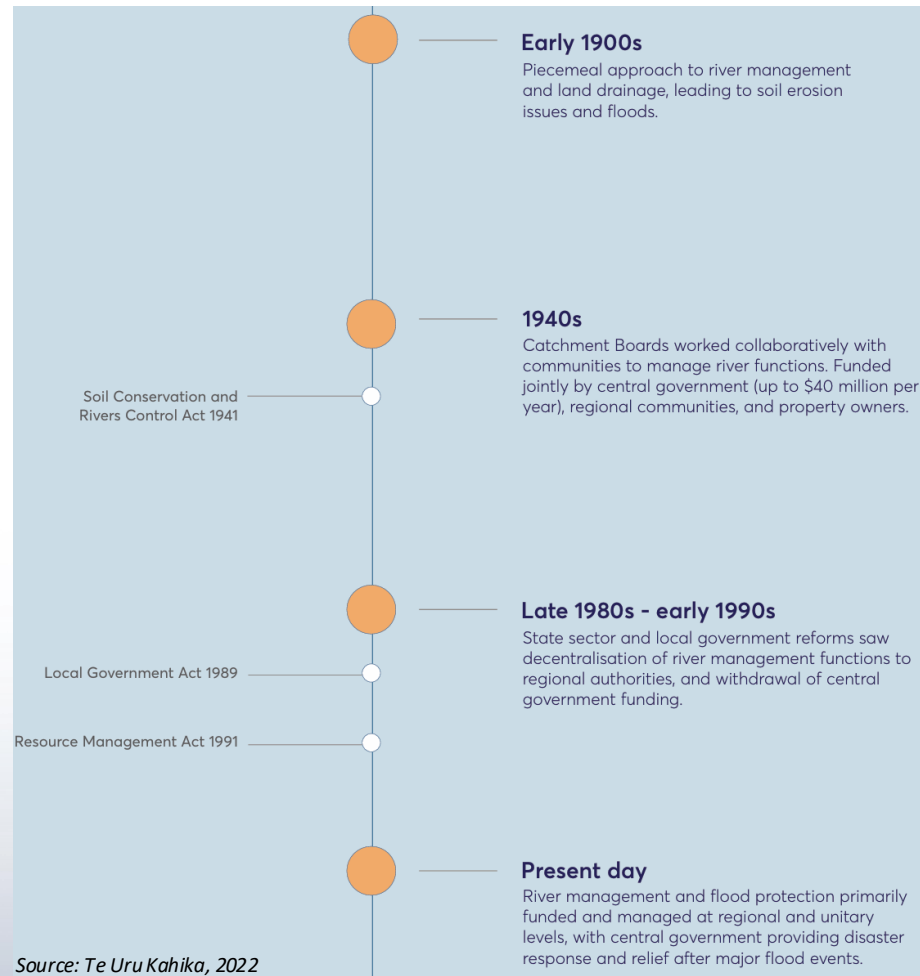
Source: gaystay, 2022

Colombia

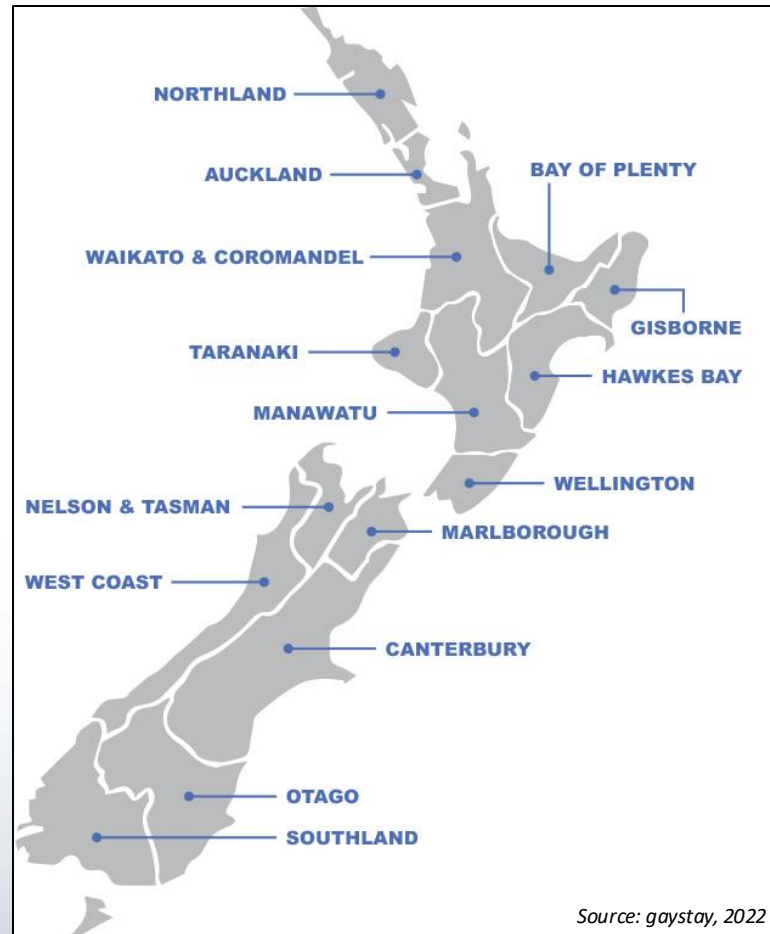


Source: Minambiente, 2025

Flood Risk Management en Nueva Zelanda



The Challenge?



- 16 different approaches
- Comparing risks
- Securing & prioritising funding
- Climate change

A Solution...



Flood Protection Assets Performance Assessment Code of Practice



River Managers Forum
March 2015

A Solution...

Flood Protection Assets Performance Assessment Code of Practice

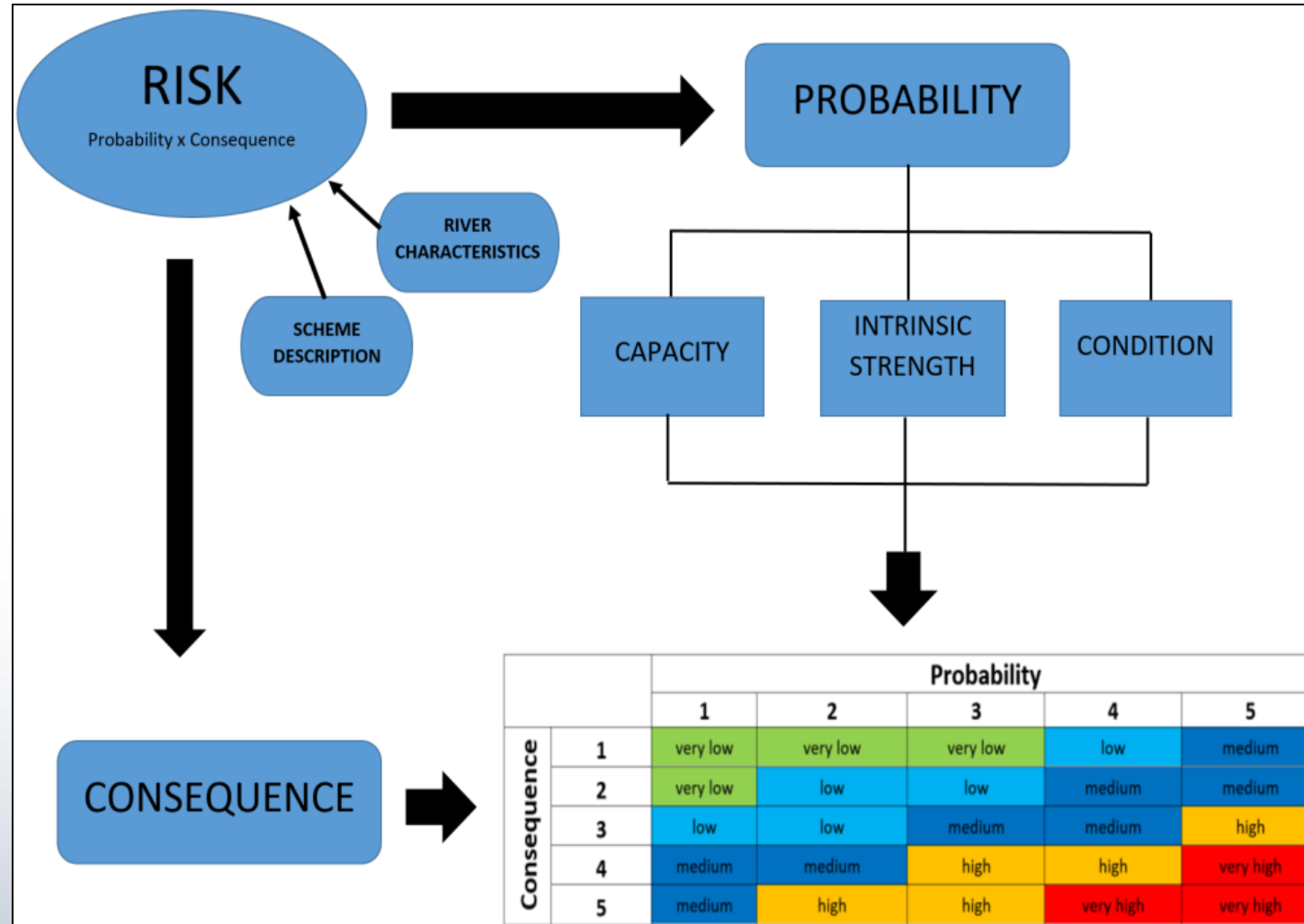


River Managers Forum
March 2015

ASSET PERFORMANCE TOOL

Assessment for Waikanae V1										Condition										Risk Score				
December 2017										0.380952381														
All blue coloured cells contain formulas and are not to be edited. Cells with a red triangle in the corner have further Comments when you hover over the cell. To add additional rows please enter the new Reach ID directly below the last entry and the table will automatically grow.																								
Reach ID	Bank	Asset ID	Reach Purpose	Start m	End m	Length	Reach Common Name	Target Protection Level	Consequence of Reach Failure	Modified Intlink Strength	In River Conversion	Active Edge Assets Eval	Condition of Active Edge Assets	Condition of Actual Active Edge	Condition of Berms	Risk 5 yr	Risk 10 yr	Risk 20 yr	Risk 50 yr	Risk 100 yr				
41	15.5	Right	Erosion Control	1984	2076	92		5 yr	3	0	4	None Required	2	2	1	medium	medium	medium	high	high				
42	15.5	Left	Erosion Control	2098	2338	240		20 yr	2	0	3	Yes - mature/appropriate	2	2	2	low	low	medium	medium	medium				
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52	21	Left	Erosion Control	2820	2954	134		10 yr	1	0	4	Yes - mature/appropriate	3	2	4	very low	very low	very low	low	low				
53	21	Right	Erosion Control	2778	2953	175		10 yr	1	0	4	Yes - mature/appropriate	3	4	2	medium	medium	medium	medium	medium				
54	22	Left	Erosion Control	2954	3064	110		10 yr	1	0	4	Yes - mature/appropriate	3	4	4	very low	very low	very low	low	medium				
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56	23	Left	Erosion Control	3064	3184	120		10 yr	1	0	3	Yes - mature/appropriate	3	3	4	very low	very low	low	medium	medium				
57	23	Right	Flood Control	3083	3237	154		100 yr	4	1	3	Yes - mature/appropriate	3	1	1	medium	medium	medium	medium	medium				
58	24	Left	Erosion Control	3184	3288	104		10 yr	1	0	3	Yes - mature/appropriate	3	1	4	very low	very low	low	medium	medium				
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62	26	Left	Erosion Control	3426	3503	77		10 yr	1	0	4	No - none exist but requires	3	4	4	low	low	medium	medium	medium				
63	26	Right	Flood Control	3487	3562	75		100 yr	4	1	4	ome - immature/inadequate	3	1	1	high	high	high	high	high				
64	27	Left	Flood Control	3503	3592	89		100 yr	1	4	2	Yes - mature/appropriate	2	2	3	low	low	low	medium	medium				

Risk-based framework





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CONSEQUENCE

Modelling
Breach Analysis
Flood Hazard Maps



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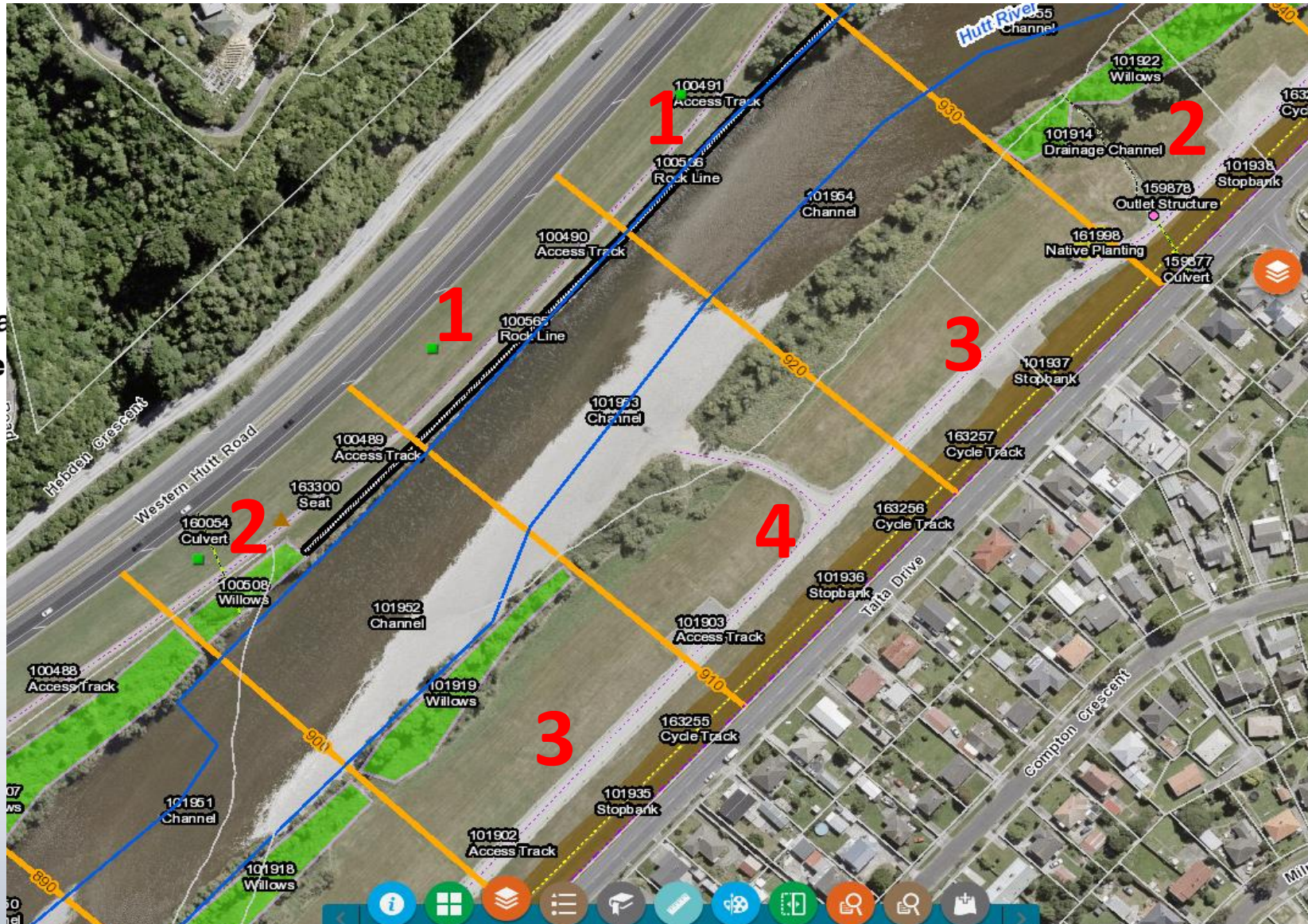
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PROBABILITY

CAPACITY

Modelling
Surveying
LiDAR



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PROBABILITY

INTRINSIC
STRENGTH

Geotech
Investigation
As-builts



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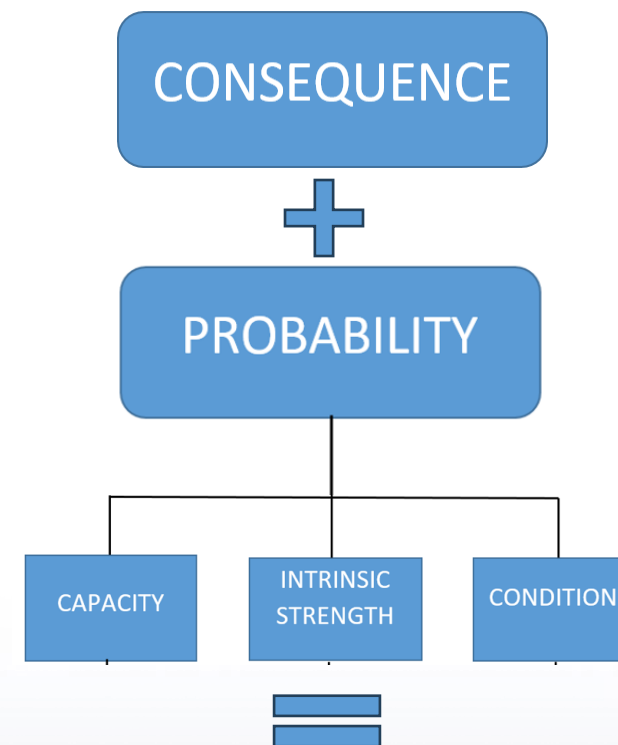


PROBABILITY

CONDITION

Inspections
Assessment
Desktop

Results



		Probability				
Consequence	1	very low	very low	low	medium	medium
	2	very low	low	low	medium	medium
	3	very low	low	medium	high	high
	4	low	medium	medium	high	very high
	5	medium	high	high	very high	very high

Results



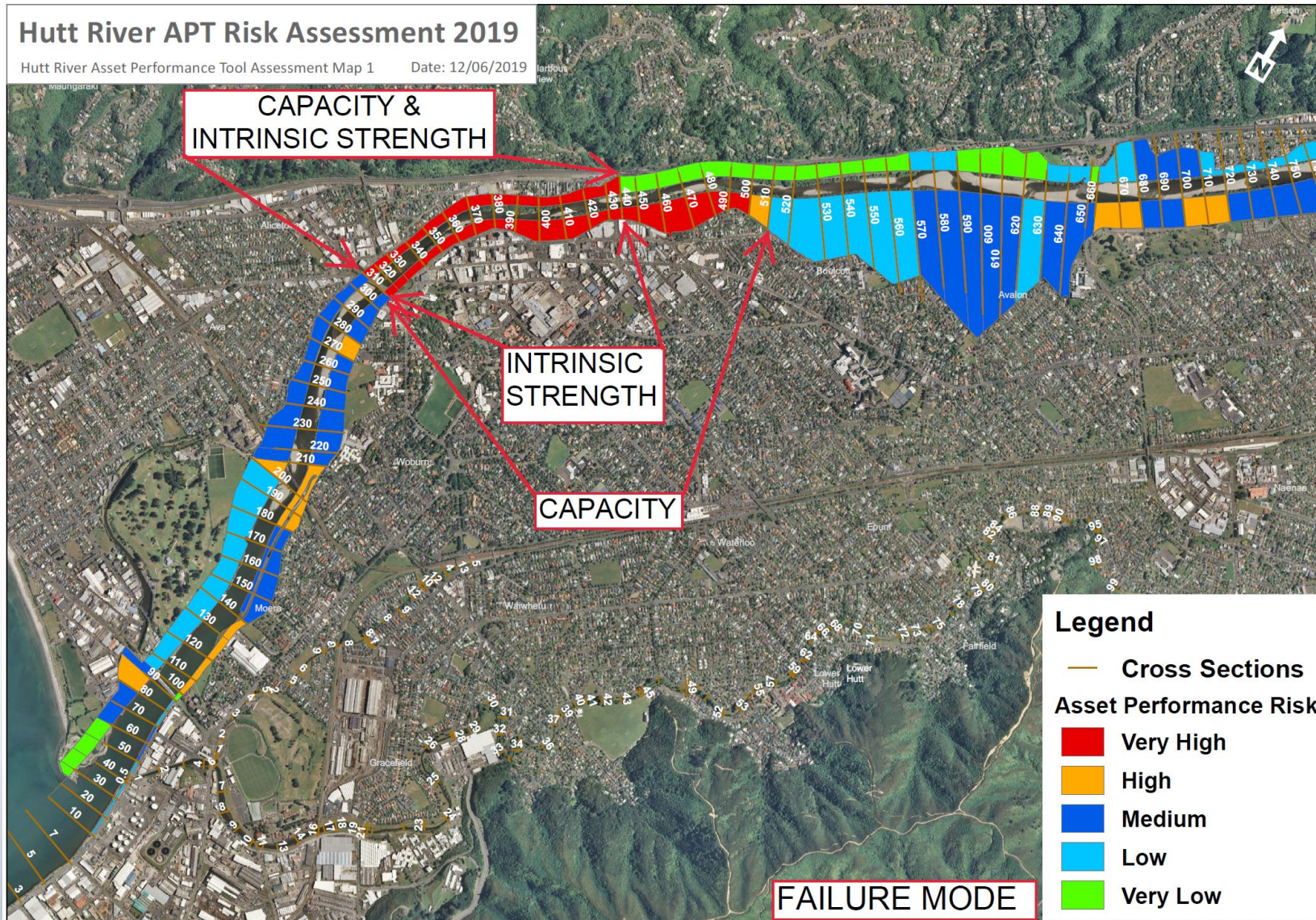
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- Risk communication
- Work program prioritisation
- Risk-based inspection frequency
- Identifies critical asset systems
- Exposes missing information
- [Government reporting](#)



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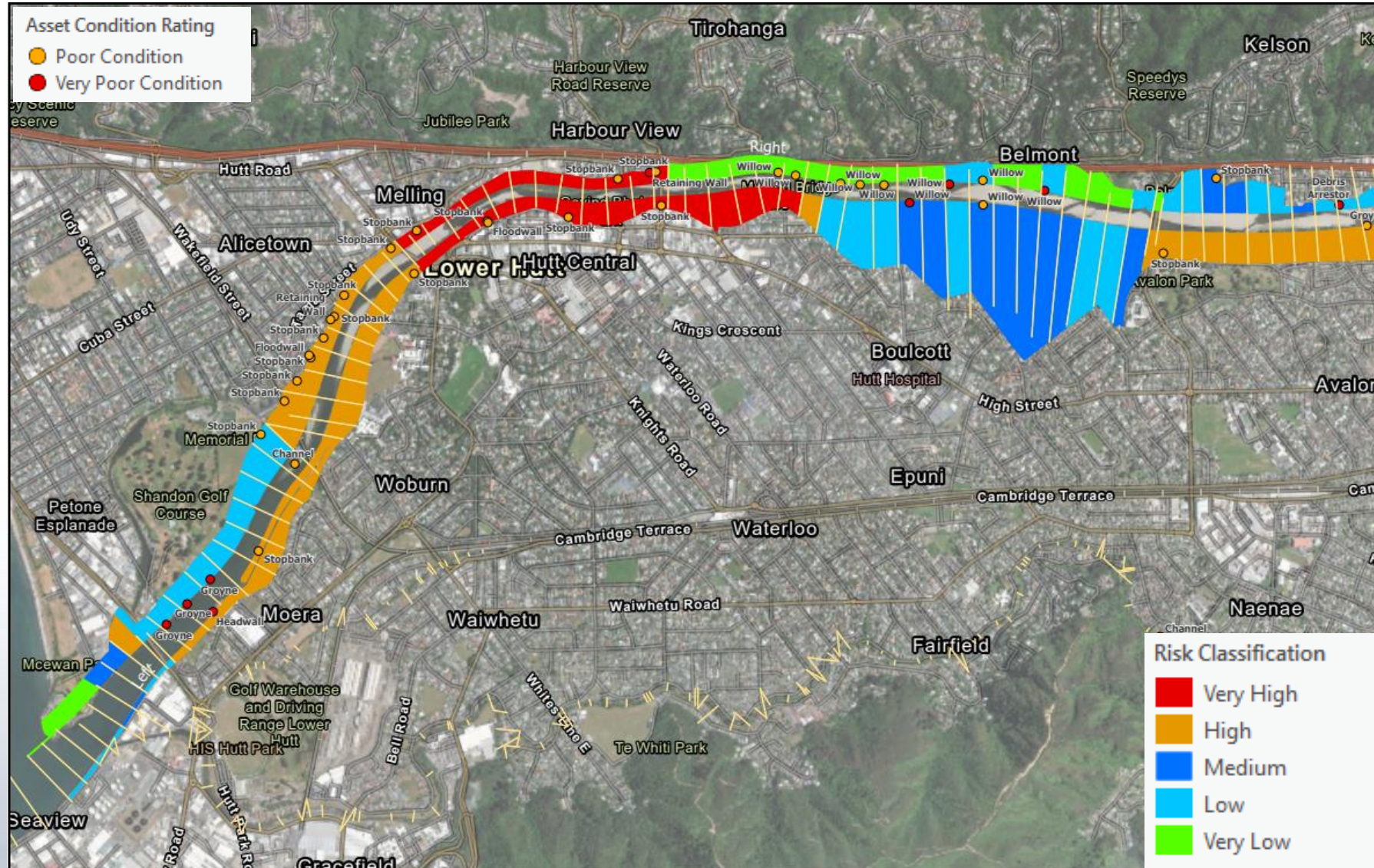
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Risk Communication





Condition VS Risk



Work Prioritisation

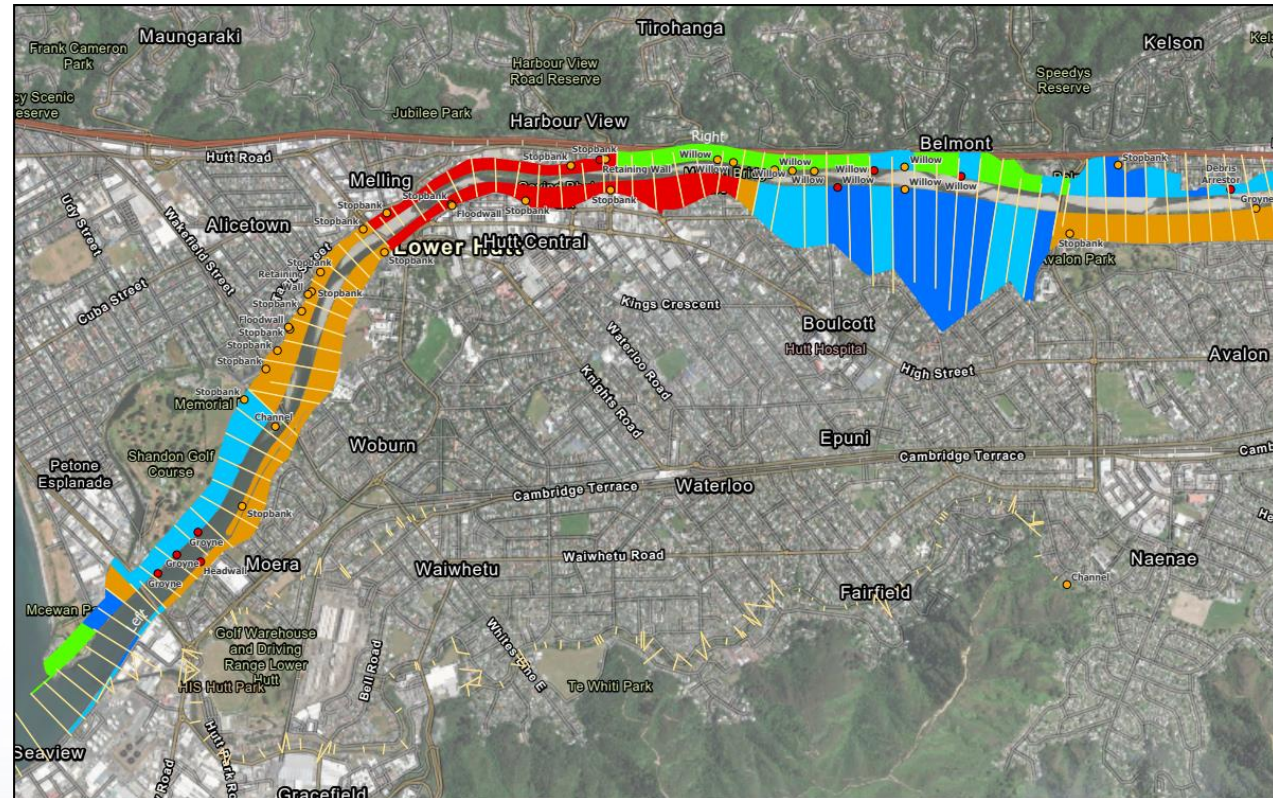
Defects



	A	B	C	D	E	H	I	J	O
1	Action	Action Comment	Asset ID	CR of Asset	Scheme	Functional Description	Asset Description	Damage Description	Risk Score
15	Awaiting Decision		102873	3	Otaki River	Otaki River - LWR - Gasline	Riprap Rk - L 130	BOULDER COLLAPSE	Very High
16	Awaiting Decision		103556	4	Otaki River	Otaki River - UPR - Wallaces	Debris Fence - R - 710+115	Broken wire BANK INVASIVE-ROOTS TREE	Very High
17	Awaiting Decision		100417	2	Hutt River	Hutt - LWR - KGB to Pomare	Stopbank - L 700		Very High
18	Awaiting Decision		103402	4	Otaki River	Otaki River - MID -Stresscrete	Willow - R 420	Some dead	Medium
19	Awaiting Decision		103563	4	Otaki River	Otaki River - UPR - Wallaces	Debris Fence - R - 720	Broken wire BANK INVASIVE-ROOTS TREE	Medium
20	Awaiting Decision		100802	2	Hutt River	Hutt - LWR - KGB to Pomare	Stopbank - L 810		Medium
21	Awaiting Decision		102246	2	Hutt River	Hutt - UPR - Silverstream to Moonshine	Stopbank - L 1650	BANK WORN NORMAL WEAR & TEAR	Medium
22	Awaiting Decision		102216	2	Hutt River	Hutt - UPR - Silverstream to Moonshine	Stopbank - L 1660	BANK HOLE NORMAL WEAR & TEAR	Medium
23	Awaiting Decision		102042	2	Hutt River	Hutt - UPR - Totara Park to Gemstone	Stopbank - R 2360	BANK INVASIVE-ROOTS TREE	Medium
24	Awaiting					Hutt - UPR - Silverstream to			

Continuous Improvement

- Risk-based inspection frequency



		Consequence				
		1	2	3	4	5
Probability	1	24	24	24	12	12
	2	24	24	24	12	6
	3	24	24	12	6	6
	4	24	12	12	6	6
	5	12	12	6	6	6

Continuous Improvement

- AMIS integration

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64	27	Left	Flood Control	3503	3592	89		100 yr	1	4	2	Yes - mature/appropriate	2	2	3	low	low	low	medium	medium				

GRACIAS

¿ALGUNA PREGUNTA?

