

Riskscape 2 : Development and Application

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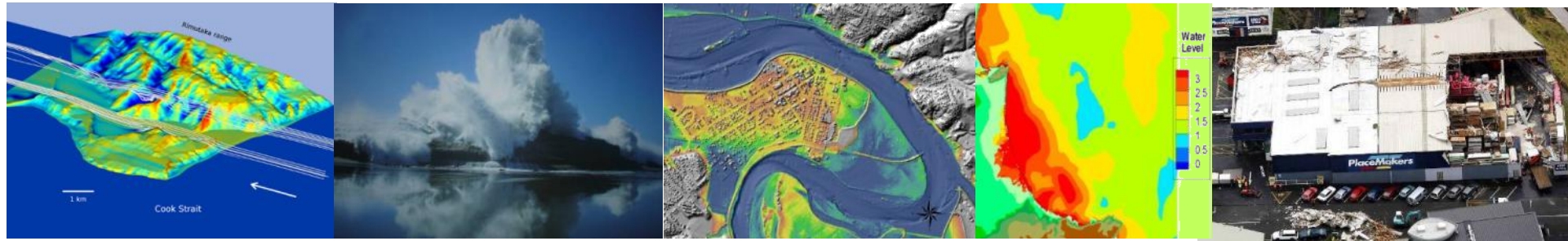
Distributed Infrastructure Meeting
14 September 2020



What is Riskscape?



- A research programme to study the impacts of natural hazards on communities and to develop models from this research to forecast future impacts, used as the basis for;
- RiskScape impact and loss modelling software that is a freely available tool that provides information about what could happen in a natural hazard event / disaster for end-users

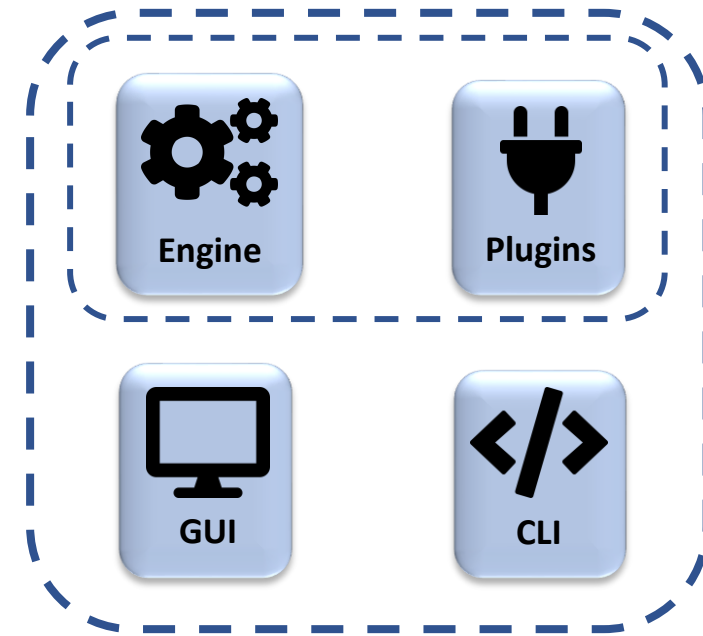


Riskscape 2.0 Components

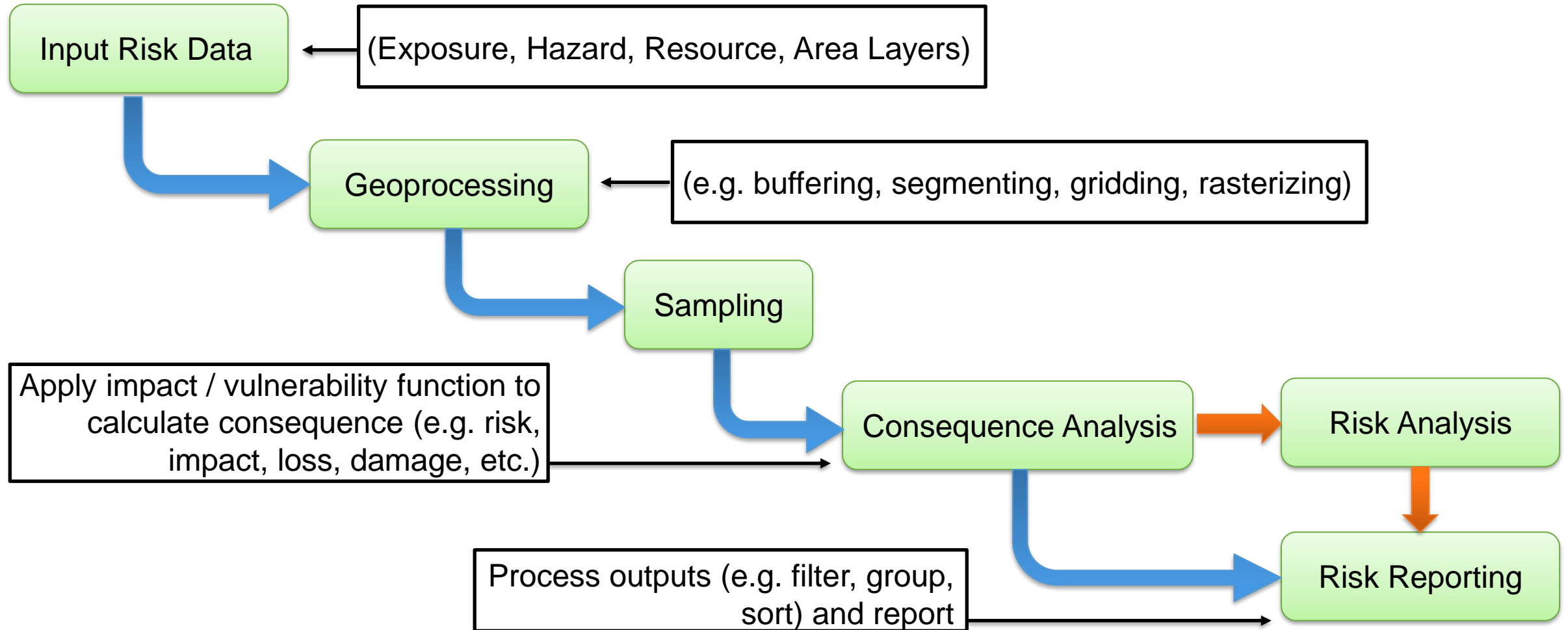
Science/Data – User Defined



Software – Enables the Science



Riskscape Model Workflow



Riskscape 2.0 Functions

Applied via Python scripts or custom RiskScape expression language:

```
3 import math
4
5 ID = 'ADB_Business_Disruption'
6 DESCRIPTION = 'Function to calculate damage states for buildings'
7
8 RETURN_TYPE = Struct.StructBuilder() \
9     .and('TotalDisruptionDays', Types.FLOATING) \
10    .and('TotalLossFJD', Types.FLOATING) \
11    .build()
12
13 ARGUMENT_TYPES = ['ADB_Buildings_Point', 'ADB_Hazards']
14
15 def function(asset, hazard):
16     DamageRatio = 0.00
17     DamageState = 'None'
18     ConstructionType = asset.get('CONSTRUCTI')
19     UseCat = asset.get('USE_CAT_NO')
20     Count = 1
21
22     if hazard is not None:
23         Depth = hazard.get('Depth')
24         if Depth > 0.0:
25             if ConstructionType == 5 or ConstructionType == 11:
26                 if UseCat == 1:
27                     DamageRatio = (1 / (1 + math.exp(3.5 - (1.55 * Depth - 0.01) ** 1.155)))
28                 elif UseCat == 4 or UseCat == 5:
29                     DamageRatio = (1 / (1 + math.exp(4.65 - (1.385 * Depth - 0.01) ** 1.255)))
30                 else:
31                     DamageRatio = (1 / (1 + math.exp(4.65 - (1.585 * Depth - 0.01) ** 1.255)))
32             else:
33                 if UseCat == 1:
34                     DamageRatio = (1 / (1 + math.exp(4.5 - (1.45 * Depth - 0.01) ** 1.255)))
35                 elif UseCat == 4 or UseCat == 5:
36                     DamageRatio = (1 / (1 + math.exp(4.5 - (2.43 * Depth - 0.01) ** 0.955)))
37                 else:
38                     DamageRatio = (1 / (1 + math.exp(4.5 - (1.65 * Depth - 0.01) ** 0.955)))
39
40     if DamageRatio < 0.1:
41         DisruptionDays = 0
42     elif DamageRatio >= 0.1 and DamageRatio < 0.5:
43         DisruptionDays = 16.093 * math.log(DamageRatio) + 46.447
44     elif DamageRatio > 0.5:
45         DisruptionDays = 45
46
47     DailyLoss = asset.get('EMPL_DAILY')
48     TotalLossFJD = DailyLoss * DisruptionDays
49
50     result = {}
51     result['TotalDisruptionDays'] = DisruptionDays
52     result['TotalLossFJD'] = TotalLossFJD
53
54     return result
55
```

```
1 id: Tsunami_Damage_Potential
2 description: Road damage potential from tsunami
3
4 argument-types:
5   -> asset: HB_Roads
6   -> hazard: HB_Tsunami
7
8 return-type: Damage_Potential
9
10 filter: hazard.Depth is not null
11   -> filter: hazard.Depth > 2.0
12     -> function:
13       -> Damage_Potential: 'Medium/High'
14       -> Exposed: 1
15   -> filter: hazard.Depth > 0.5 and hazard.Depth <= 2.0
16     -> function:
17       -> Damage_Potential: 'Medium'
18       -> Exposed: 1
19   -> filter: hazard.Depth <= 0.5 and hazard.Depth > 0.0
20     -> function:
21       -> Damage_Potential: 'Low'
22       -> Exposed: 1
23 default:
24   -> function:
25     -> Damage_Potential: 'None'
26     -> Exposed: 0
```

Riskscape 2.0 Pipelines

“Model Builder” tool for RiskScape allowing the user to create a model and manipulate the specific workflow and output.

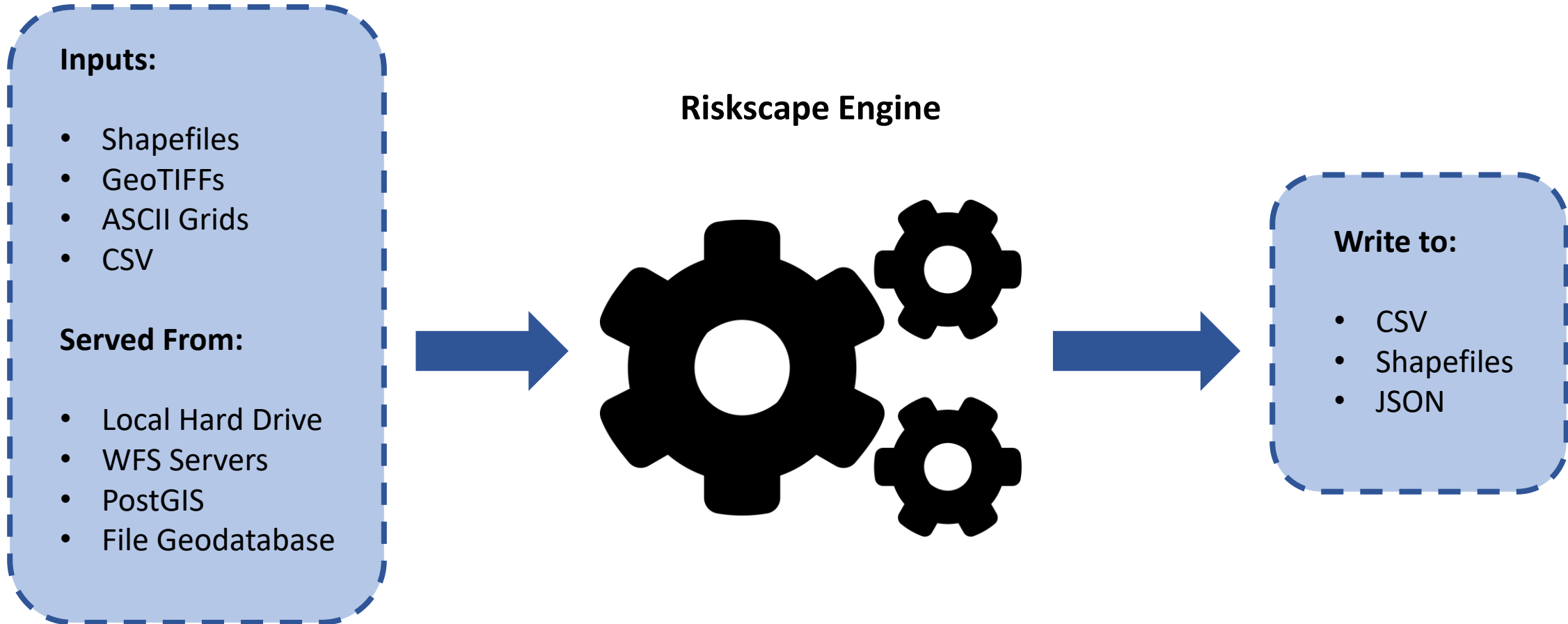
```
[pipeline.Asset_Maximum_Ashfall]
description.=.Pipeline.to.evaluate.ashfall.damage.based.on.maximum.intersecting.ashfall.depth.of.farm.polygon

pipeline.=.\
→input(name:.'asset',.relation:.'Farms_Agribase')as.assets.\
→->.select({.asset,.sample(geometry:.asset.the_geom,.coverage:.relation_to_coverage(bookmark('Kaharoa_Isopachs'))).as.hazard}).\
→->.unnest(to-unnest:.'hazard').\
→->.aggregate(group-bys:.{asset},.aggregate-functions:.'max(hazard.sampled.AshDepth)as.hazard').\
→->.function(function:.'Ashfall_Coverage',.result_name:.'DamageState')as.damage.
```

What is this doing?

1. Input – Getting ‘asset’ dataset input
2. Select – Selecting all asset features and applying a ‘Sample’ function to get hazard values at each asset
3. Unnest – This is a deprecated pipeline step that was required to interpret lists of data
4. Aggregate – This is applying an aggregation function (max) to choose which hazard value to use
5. Function – Applying the function to the asset and sampled hazard value

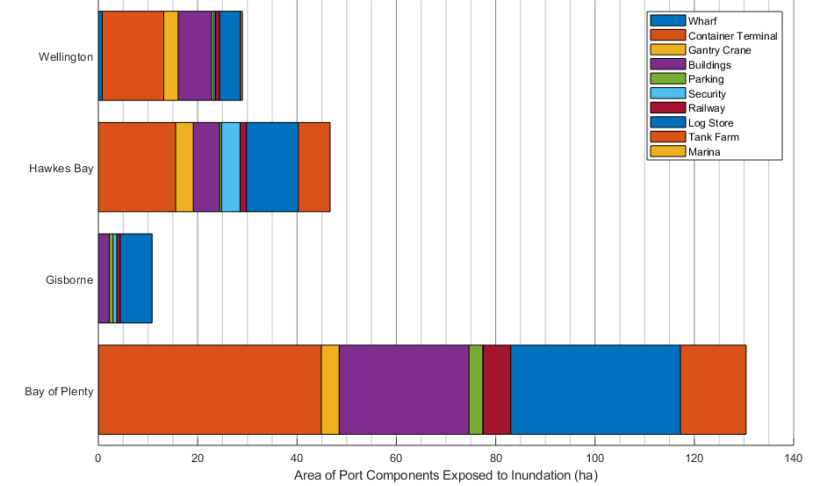
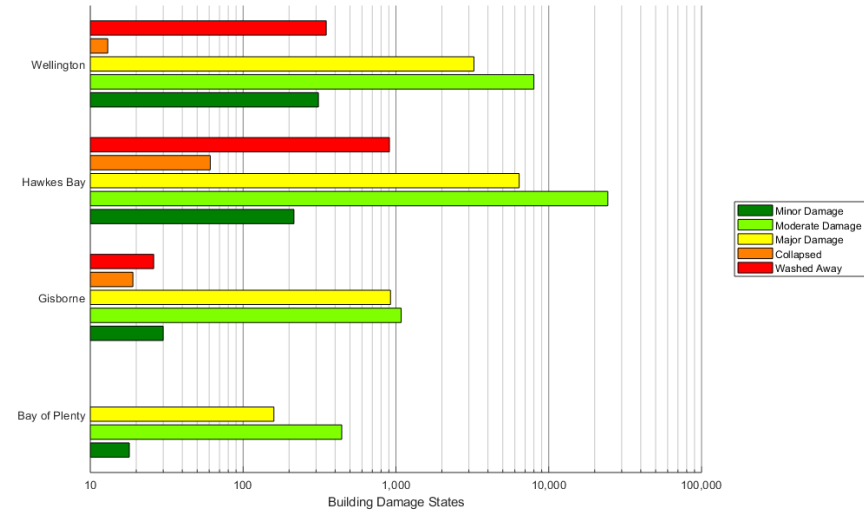
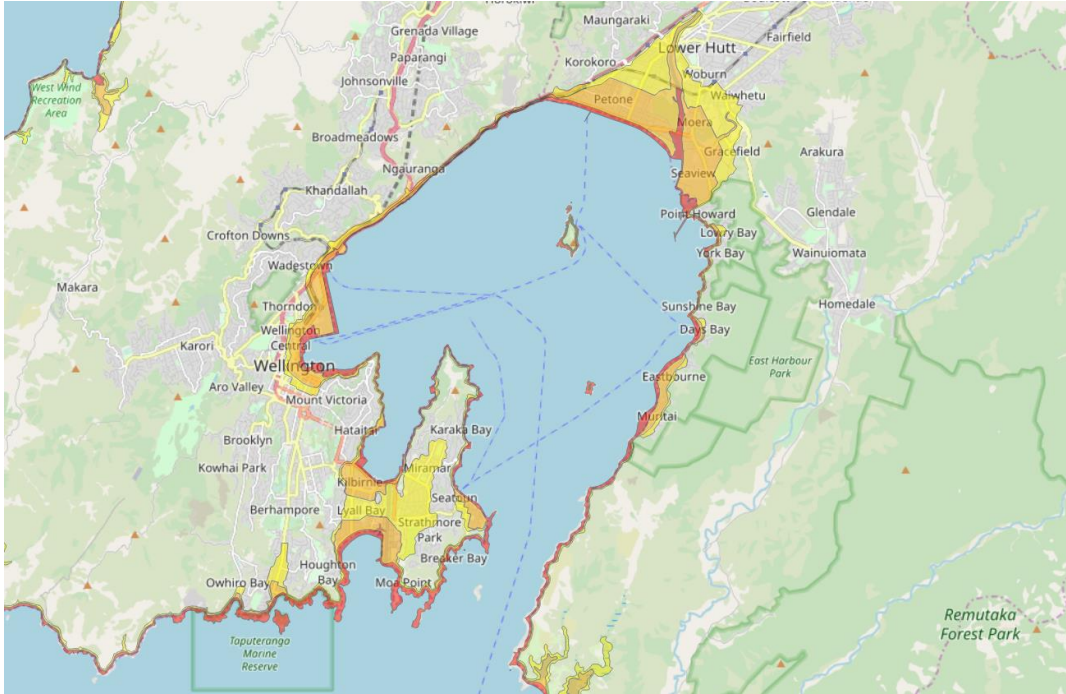
Riskscape 2.0 Supported Formats



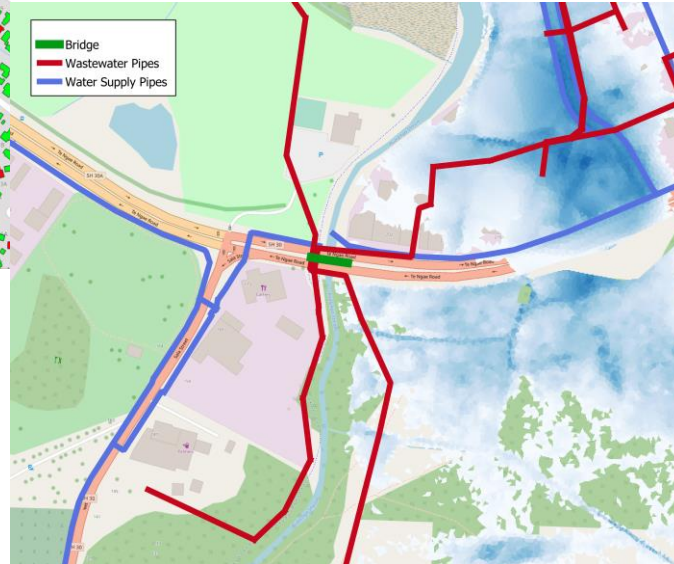
Riskscape 2.0 – Current Development

- Probabilistic / stochastic modelling features
- Simplification of user interaction
- Initial work required for GUI development
- Deployment Model

Some things we have done so far: Hikurangi Response Plan

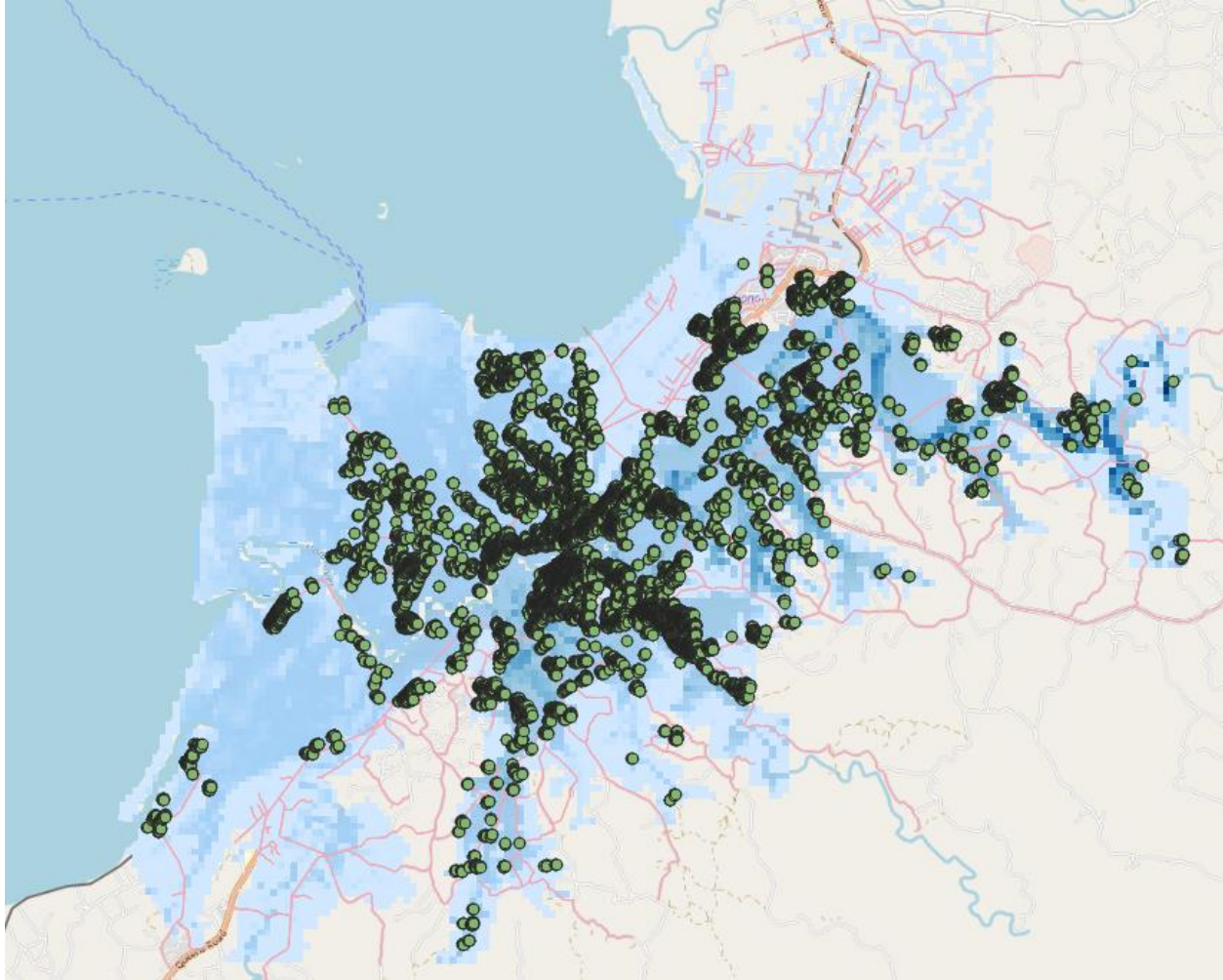


Some things we have done so far: Rotorua Lakes Council



Consequence level	Built			Lifelines utilities	Health & safety
	Social/cultural	Buildings	Critical buildings		
Catastrophic	≥25% of buildings of social/cultural significance within hazard assessment area have functionality compromised.	≥50% of buildings within hazard assessment area have functionality compromised.	≥25% of critical buildings within hazard assessment area have functionality compromised.	A lifeline utility service is out for > 1 month (affecting ≥ 20% of the town/city population) OR out for > 6 months (affecting < 20% of the town/city population).	>101 dead and/or >1001 injured
Major	11–24% of buildings of social/cultural significance within hazard assessment area have functionality compromised.	21–49% of buildings within hazard assessment area have functionality compromised.	11–24% of critical buildings within hazard assessment area have functionality compromised.	A lifeline utility service is out for 1 week – 1 month (affecting ≥ 20% of the town/city population) OR out for 6 weeks to 6 months (affecting < 20% of the town/city population).	11–100 dead and/or 101–1000 injured
Moderate	6–10% of buildings of social/cultural significance within hazard assessment area have functionality compromised.	11–20% of buildings within hazard assessment area have functionality compromised.	6–10% of critical buildings within hazard assessment area have functionality compromised.	A lifeline utility service is out for 1 day to 1 week (affecting ≥ 20% of the town/city population) OR out for 1 week to 6 weeks (affecting < 20% of the town/city population).	2–10 dead and/or 11–100 injured
Minor	1–5% of buildings of social/cultural significance within hazard assessment area have functionality compromised.	2–10% of buildings within hazard assessment area have functionality compromised.	1–5% of critical buildings within hazard assessment area have functionality compromised.	A lifeline utility service is out for 2 hours to 1 day (affecting ≥ 20% of the town/city population) OR out for 1 day to 1 week (affecting < 20% of the town/city population).	≤1 dead and/or 1–10 injured
Insignificant	No buildings of social/cultural significance within hazard assessment area have functionality compromised.	<1% of buildings within hazard assessment area have functionality compromised.	No damage within hazard assessment area, fully functional.	A lifeline utility service is out for up to 2 hours (affecting ≥ 20% of the town/city population) OR out for up to 1 day (affecting < 20% of the town/city population).	No dead No injured

Nadi Fluvial Flood Assessment

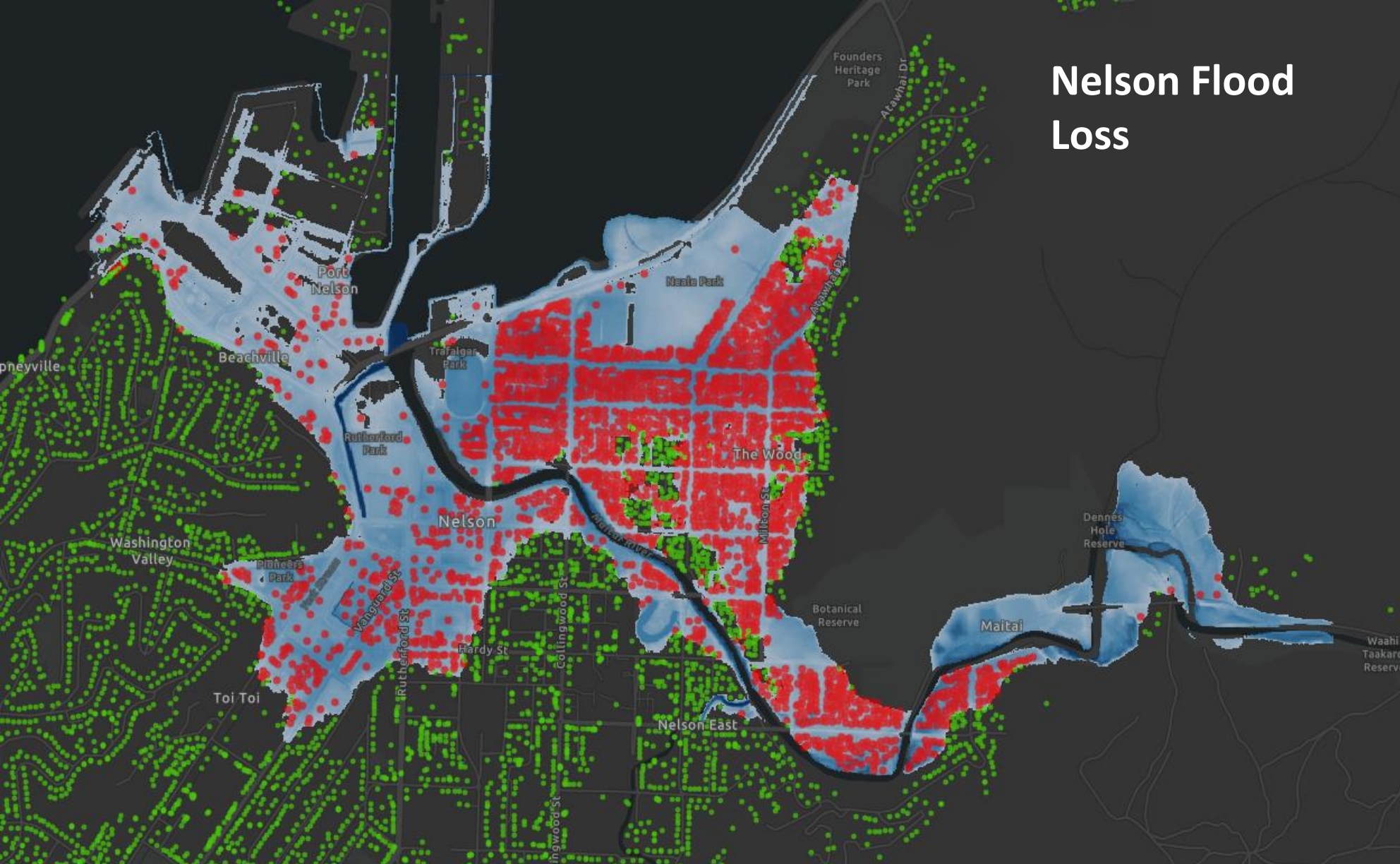


Assessed:

- Buildings
- Roads
- Runways
- Land Use

to analyze Nadi River flood mitigation strategies

Nelson Flood Loss



For another example of how Riskscape 2.0 has been applied, visit:

<https://arcg.is/0THrue>

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