Modelling Firefighters

Addressing the mismatch between Fire Code and Hydraulic Model Outputs

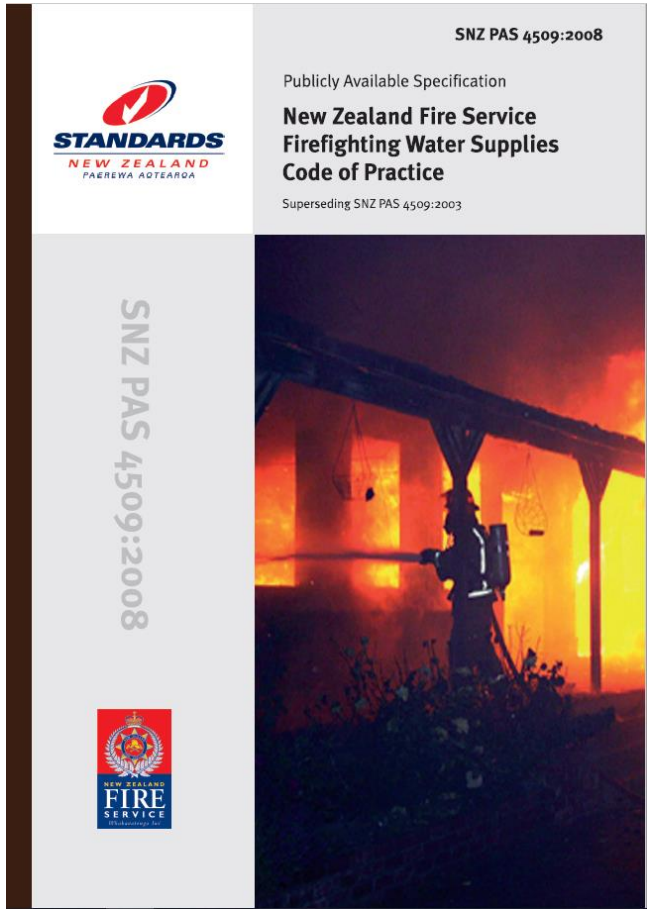
Wellington Water

CONNECT WATER

Stantec

ur future.

Fire flow availability – Fire flow requirements



Mismatch between Fire Code and Modelling Outputs

Fire Code

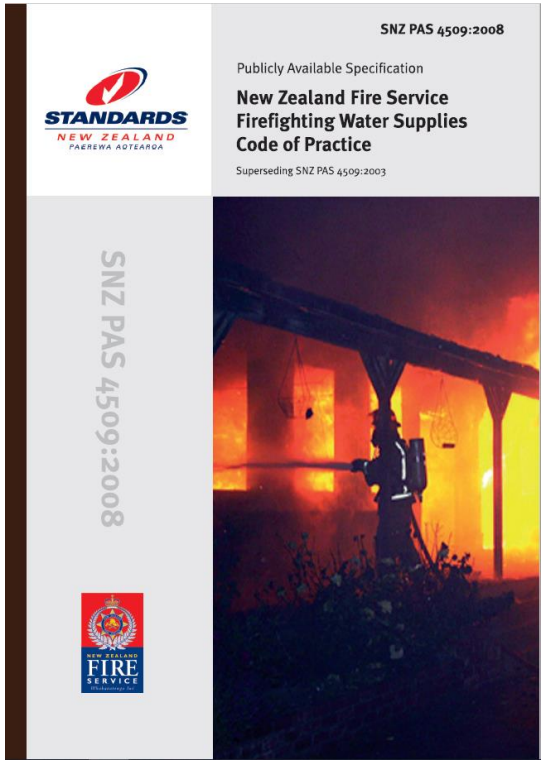
- Fire Code (SNZ PAS 4509:2008) is “Hazard” (building) focused
- Requires assessment of simultaneous flows from up to 8 hydrants, within acceptable distances (135m, 270m)
- Calculations of required flow depend on floor area, building use, etc.

Modelling

- Models are network focused.
- A calibrated network model can predict the available fire flow at 10m pressure
- Currently can only do this from one hydrant at a time
- Currently no method for applying this at the property level

Model outputs

Fire Code



Using the Fire Code to determine risk across a network

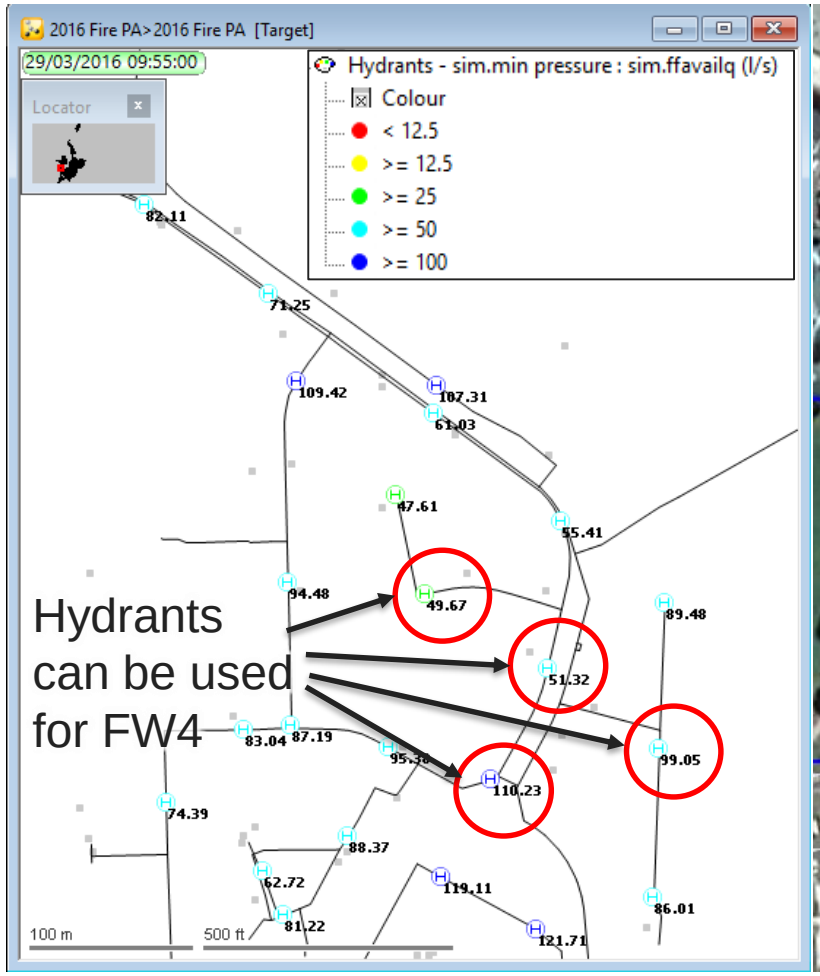
What we have done in the past

- We have assigned a required fire flow to properties based on planning information (generally what land use zone the building is in)
- We have assessed which hydrants can be used by eye or using a radial distance
- We have used “engineering judgement” to estimate the combined hydrant flow based on individual hydrant flows

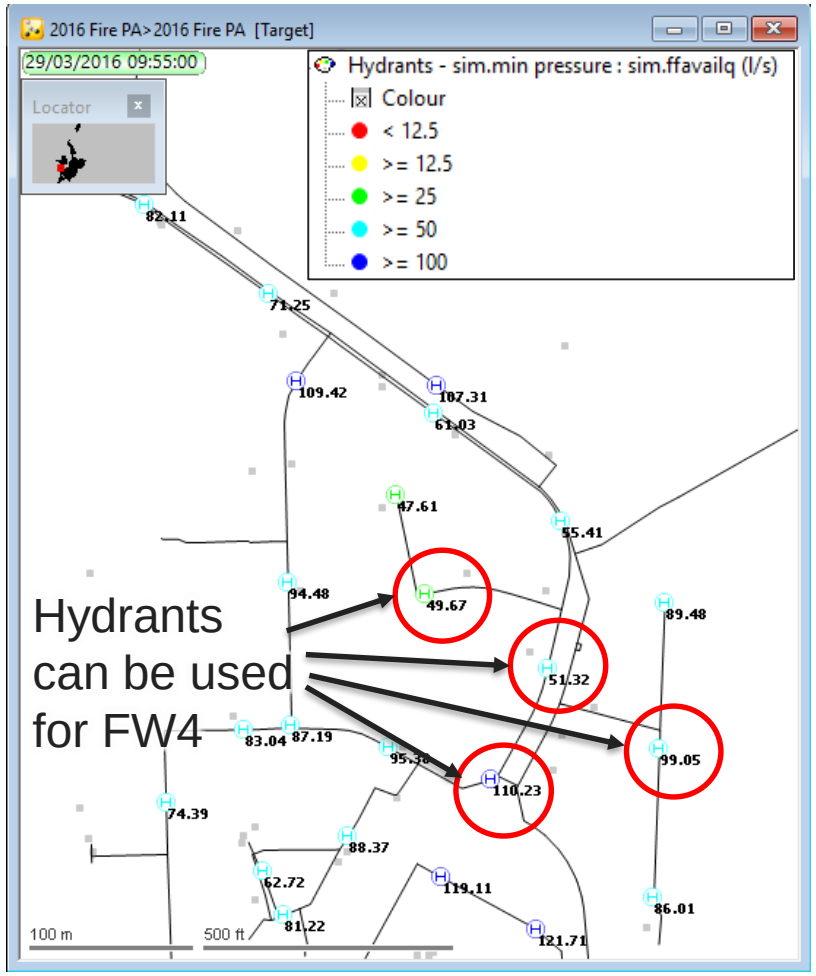
What we need

- A way to automatically determine the required fire flow for a property
- A way to determine which hydrants can be used to supply the required flow
- A way to determine what the combined flow of the hydrants is

Problems with current approach – multiple hydrants



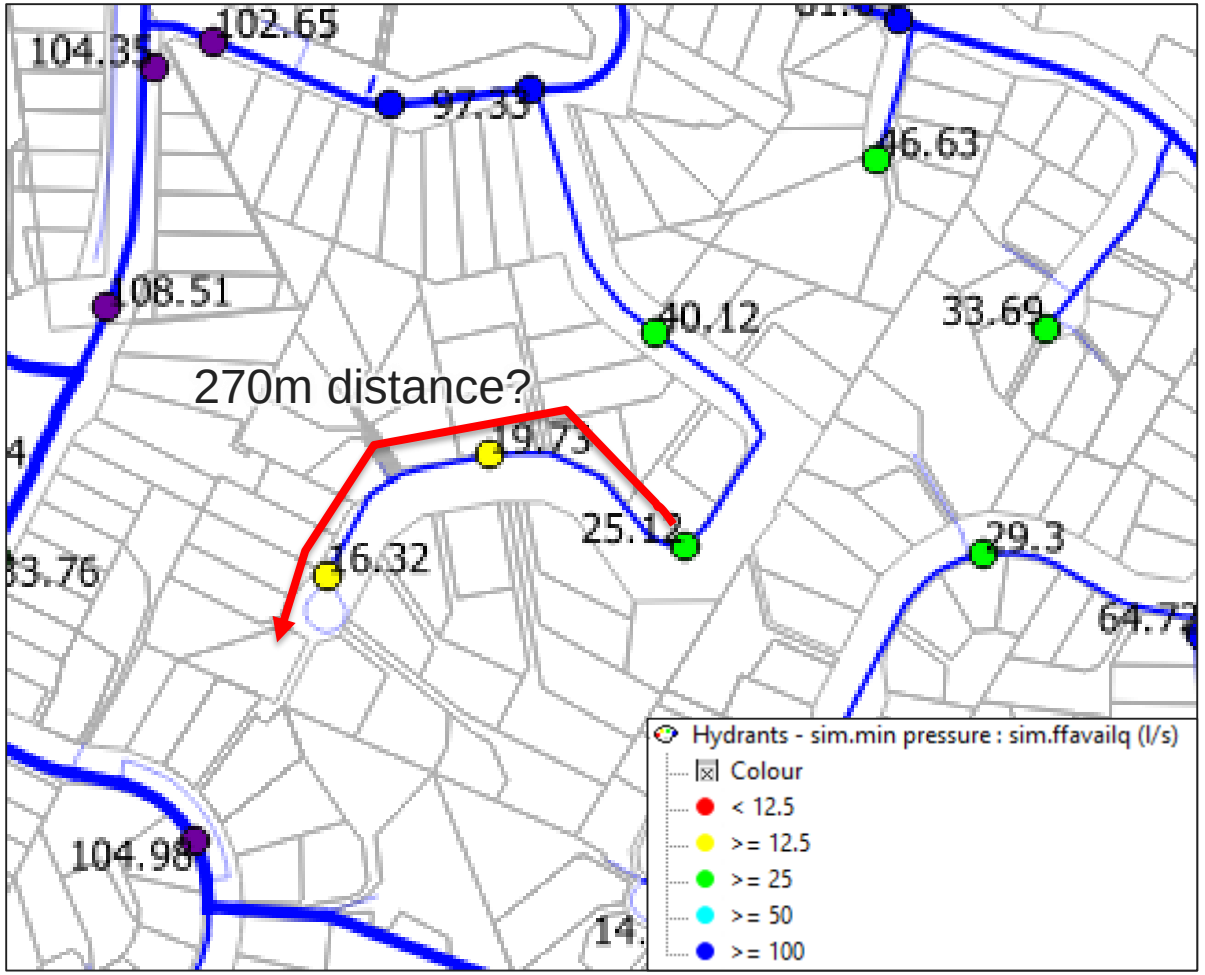
Problems with current approach – multiple hydrants



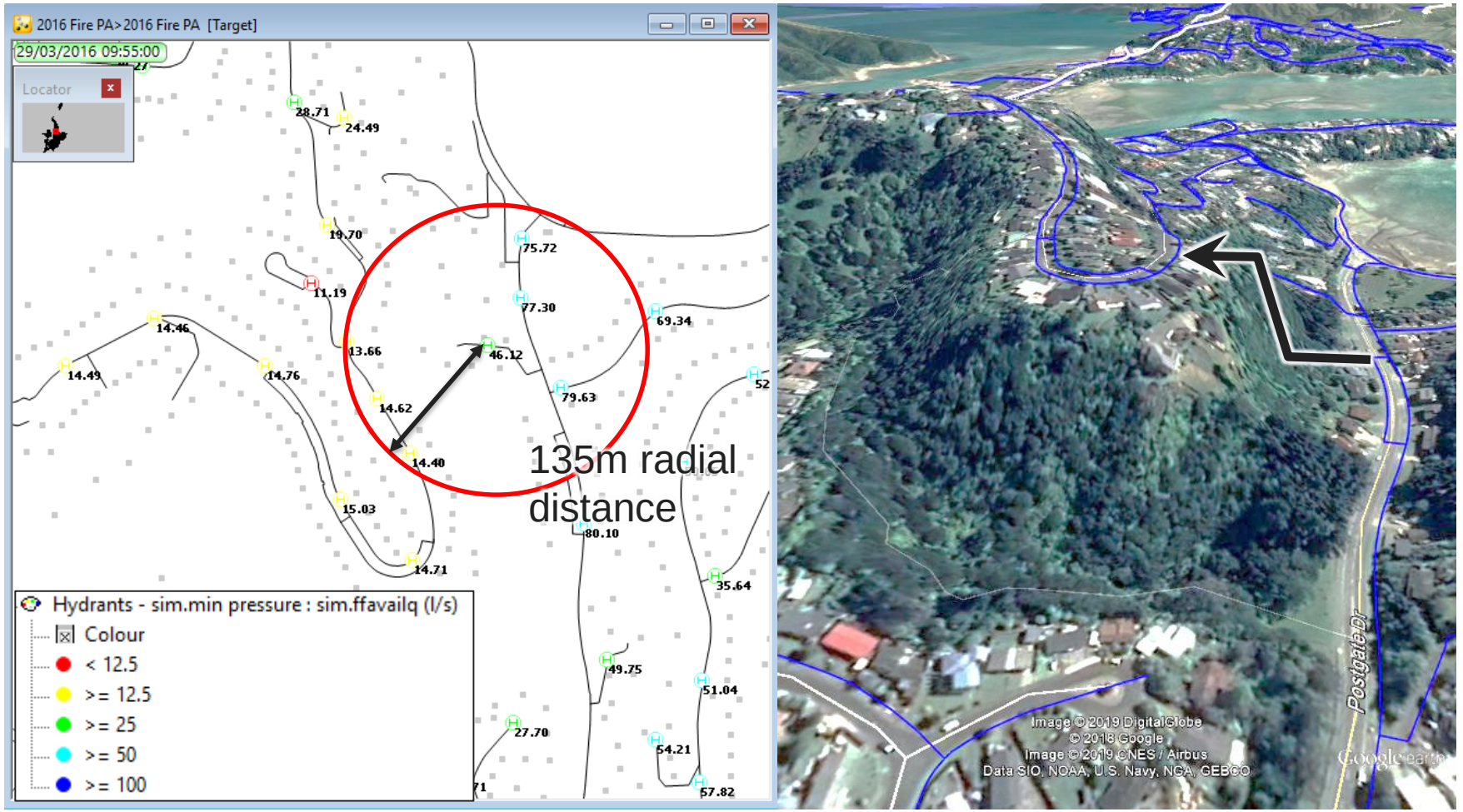
- Modelled flow represents demand which will draw network to 10m, not actual hydrant flow.
- Max actual hydrant flow should be assumed around 35 l/s (Fire Code)
- Flow at one hydrant will affect flow at the next hydrant
- If hydrants are at different elevations, 10m delivery pressure at one hydrant is at different HGL than 10m at the next hydrant.

Problems with current approach – linear pipe distance

- No info on property level
- Manual checks where hydrant flows seem low
- Guesswork!



Problems with current approach – radial distance



Comprehensive approach to applying the CoP

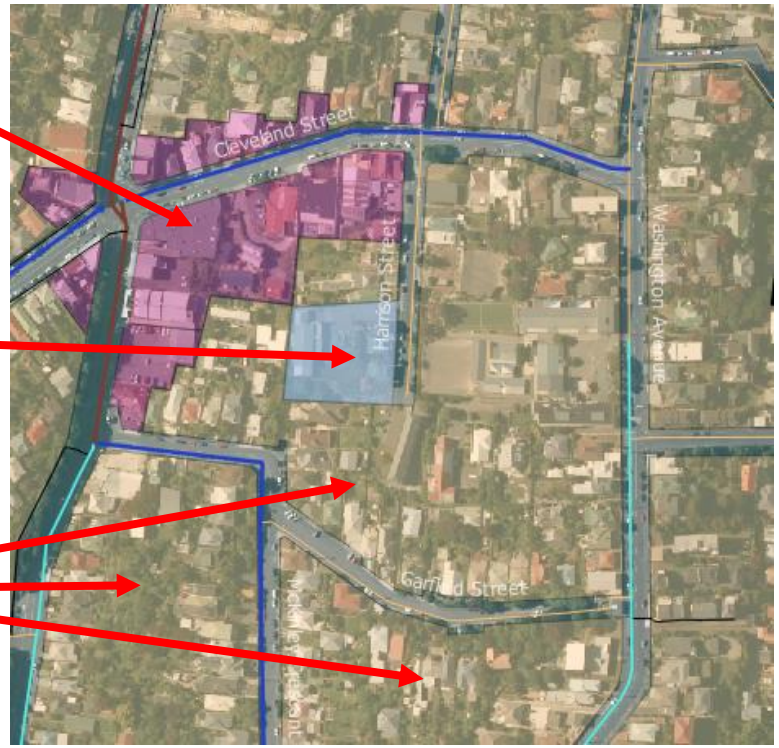
NZ Fire Service Code of Practice (CoP)

ZONE-BASED

Commercial Zone

Industrial Zone

Residential Zones



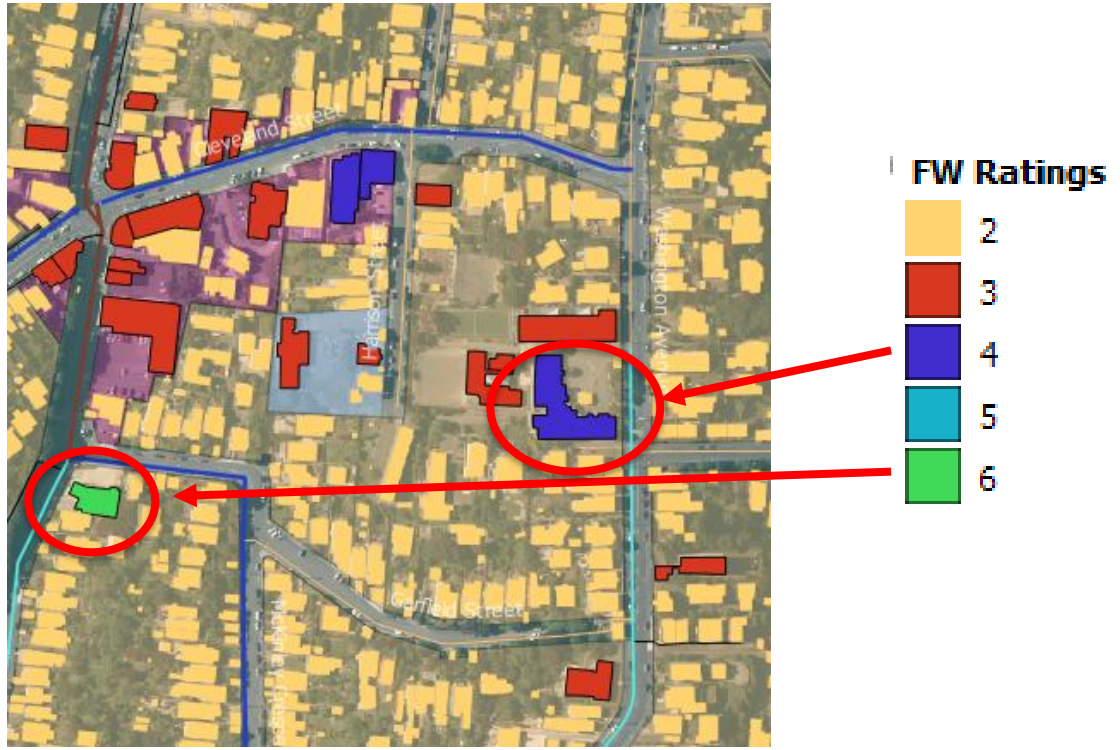
NZ Fire Service Code of Practice (CoP)

BUILDING-BASED

Commercial Zone ?

Industrial Zone ?

Residential Zones ?



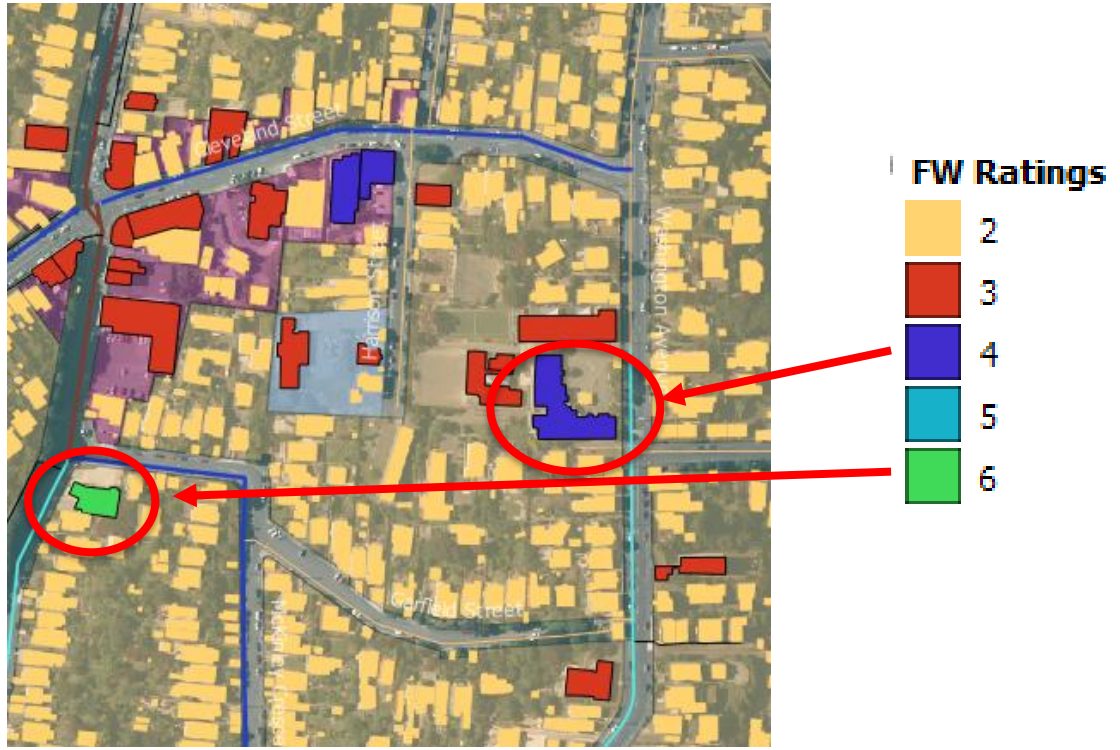
NZ Fire Service Code of Practice (CoP)

BUILDING-BASED

Commercial Zone ?

Industrial Zone ?

Residential Zones ?



Problem: There needs to be a practical and efficient way to model fire flow for large areas

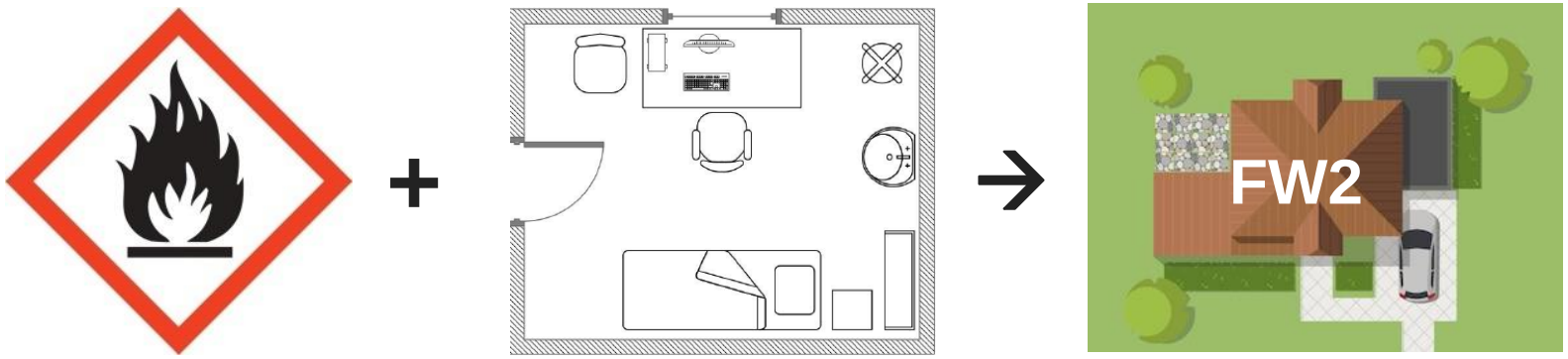
NZ Fire Service Code of Practice (CoP)

How much water is required per building??

NZ Fire Service Code of Practice (CoP)

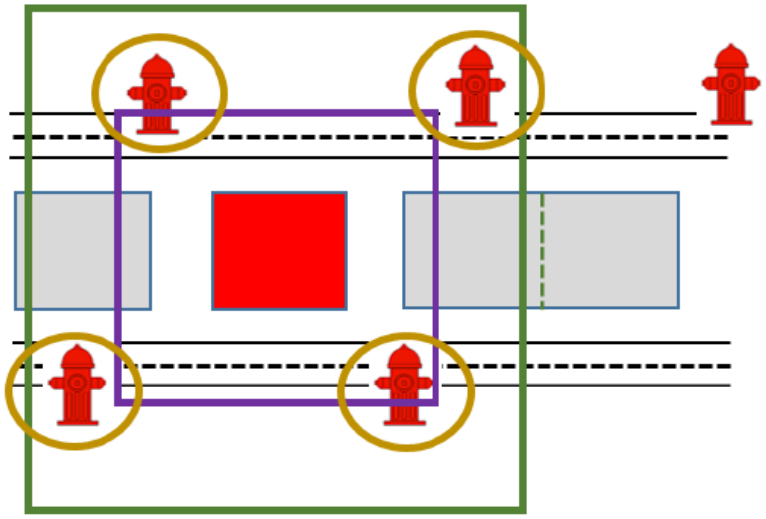
How much water is required per building??

Fire Load + Fire Cell → FW Classification

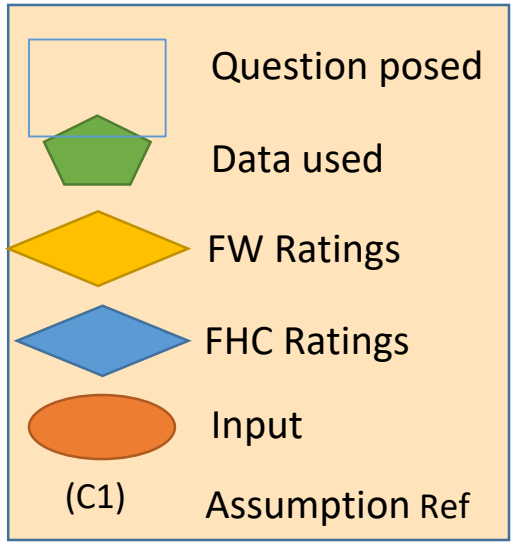


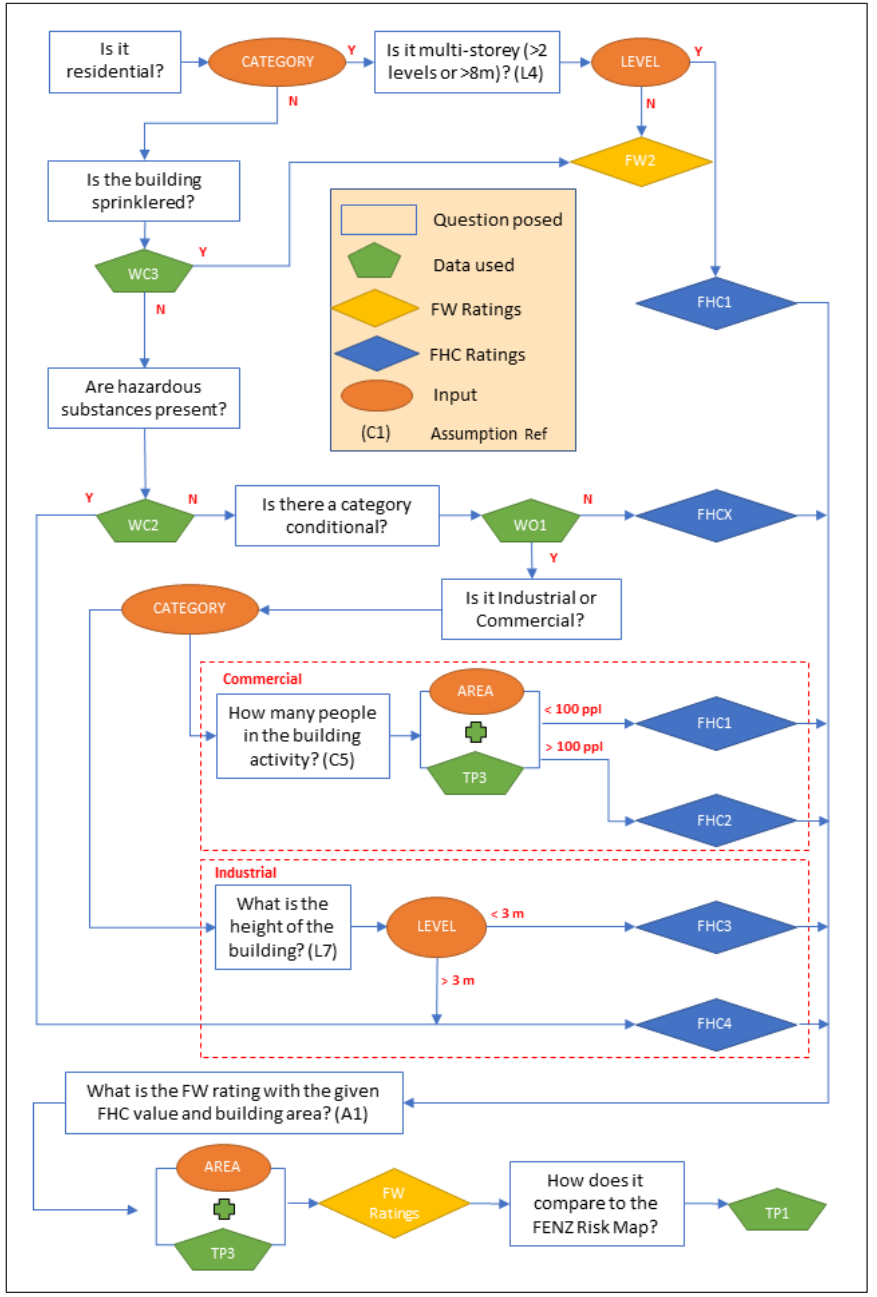
Our Approach Applying Fire Service.. CoP

- A Conservative ‘First Pass’ Approach
- Not perfect – Developing & Improving
- BUT Practical and Efficient
- Backed by Modelling Analysis
- Criteria Developed

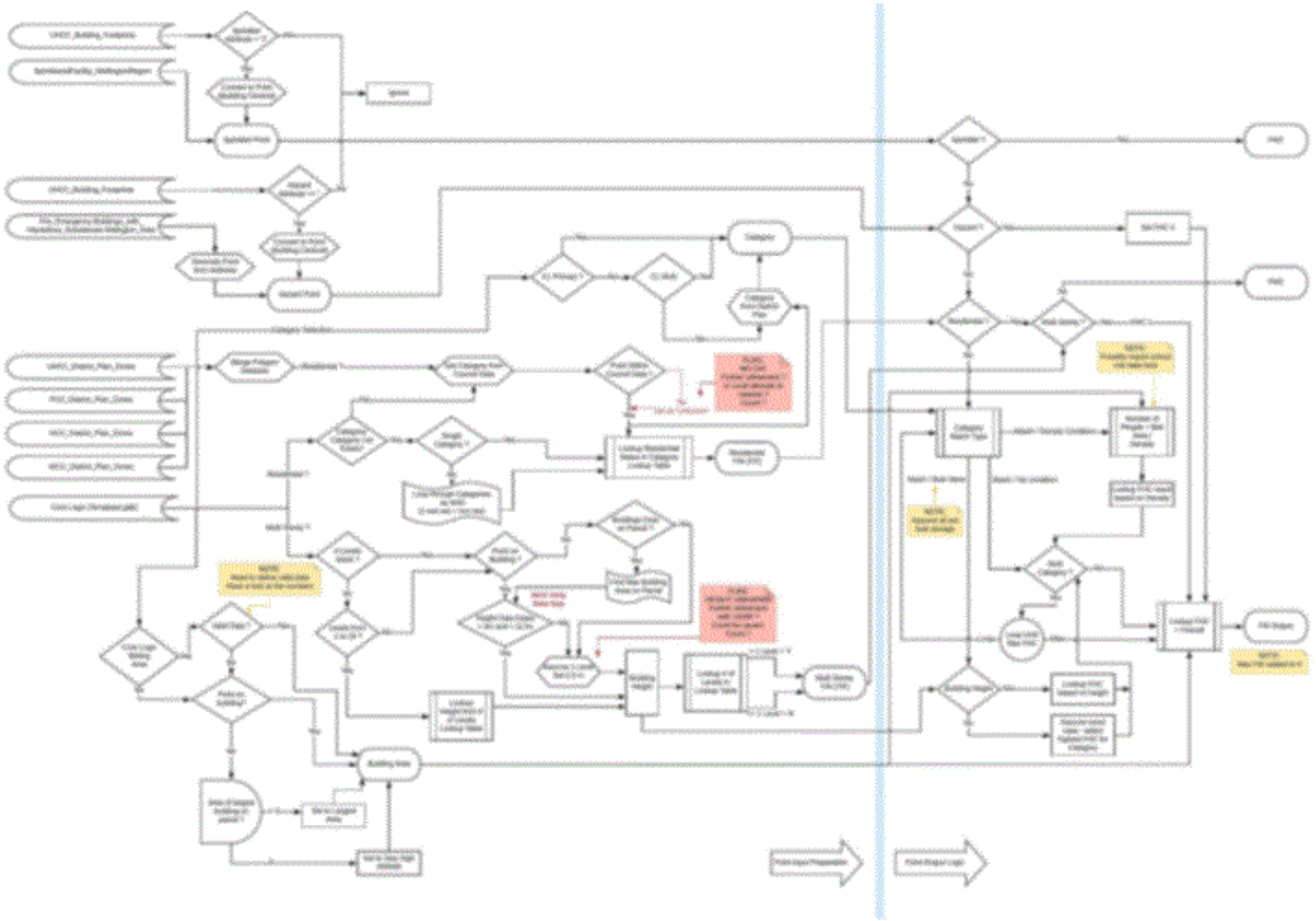


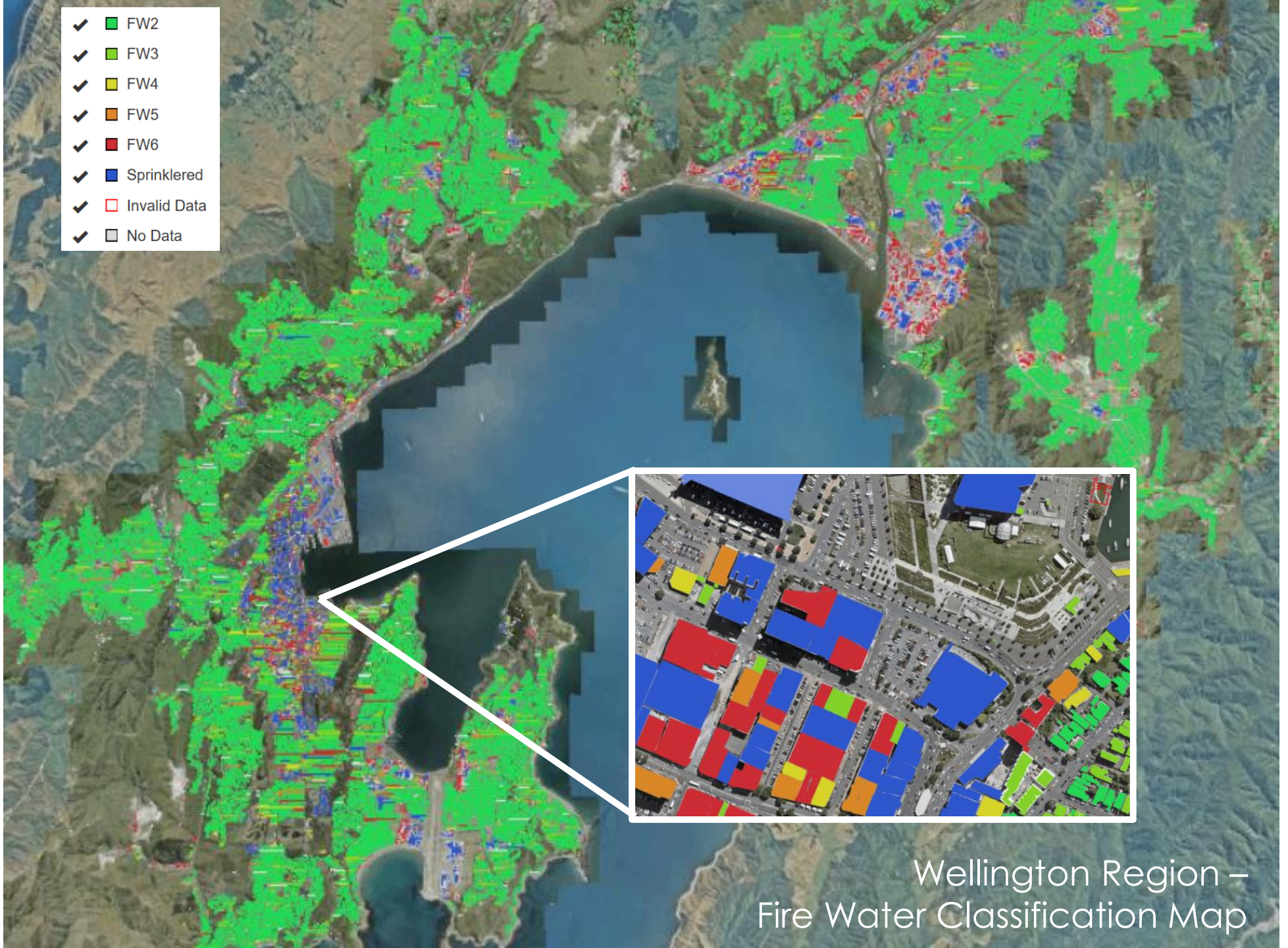
FW Classification – Process Map





Behind the scenes





Wellington Region – Fire Water Classification Map

Fire Emergency NZ (FENZ)

- Risk Classification Map
- Different criteria for fire risk – likelihood, consequence
- Works with FW Classification not instead of
- Allows prioritisation of upgrades

Fire Flow Modelling – A Comprehensive Approach

FW2 (Residential)

1. Check at least 1 hydrant within 135 m
2. Run an automated fire flow test
3. Apply criteria and assess

FW3-6

1. Check at least half the max no. of hydrants within 135 m
2. Run an automated fire flow test
3. Apply criteria and assess

	Reticulated water supply		
Fire water classification	Required water flow within a distance of 135 m	Additional water flow within a distance of 270 m	Maximum number of fire hydrants to provide flow
FW1	450 L/min (7.5 L/s) (See Note 3)	–	1
FW2	750 L/min (12.5 L/s)	750 L/min (12.5 L/s)	2
FW3	1500 L/min (25 L/s)	1500 L/min (25 L/s)	3
FW4	3000 L/min (50 L/s)	3000 L/min (50 L/s)	4
FW5	4500 L/min (75 L/s)	4500 L/min (75 L/s)	6
FW6	6000 L/min (100 L/s)	6000 L/min (100 L/s)	8

Fire Flow Modelling – A Comprehensive Approach

FW2 - Residential

- Take **average** of closest two hydrants

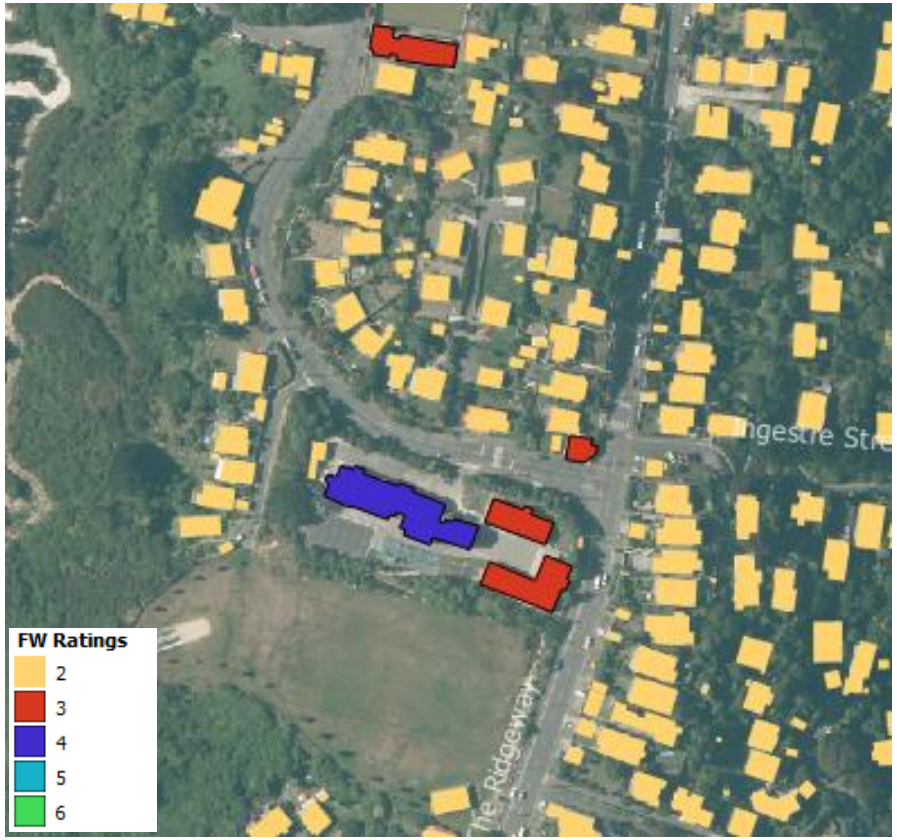
FW3-6 – Non Residential

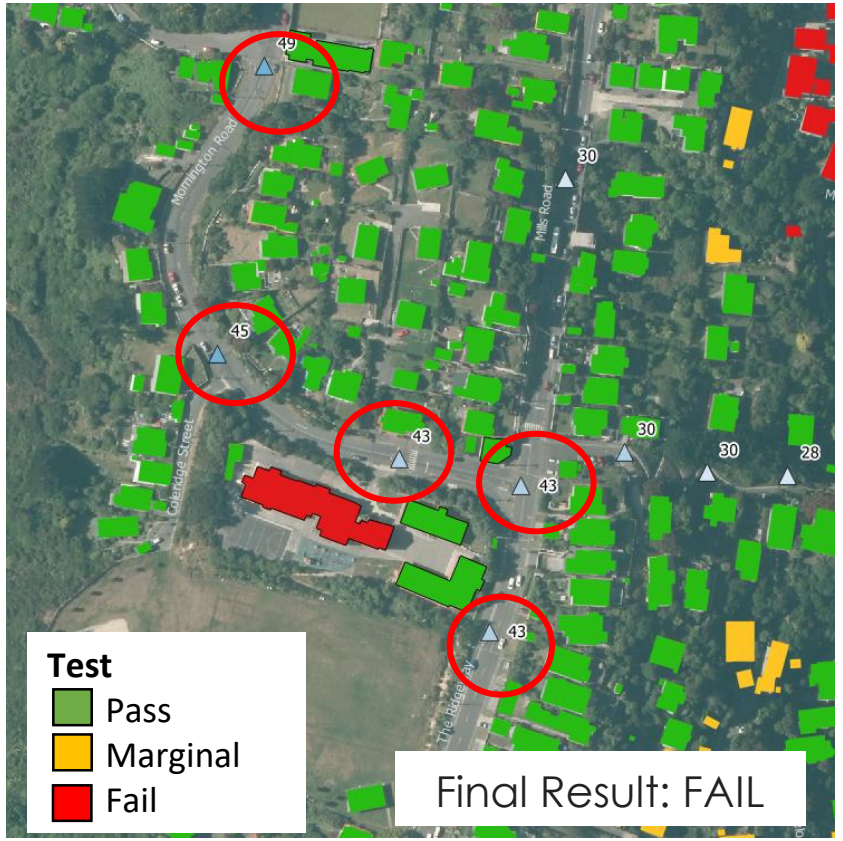
- Take **median** of max. allowed hydrants

Manual check critical sites / or where point flow approach may not be accurate to verify the process

FW Rating	FAIL (<90%)	MARGINAL (90-110%)	PASS (>110%)
2	< 18	18 < x < 25	> 25
3	< 45	45 < x < 55	> 55
4	< 90	90 < x < 110	> 110
5	< 135	135 < x < 165	> 165
6	< 180	180 < x < 220	> 220

Example – Wellington suburb

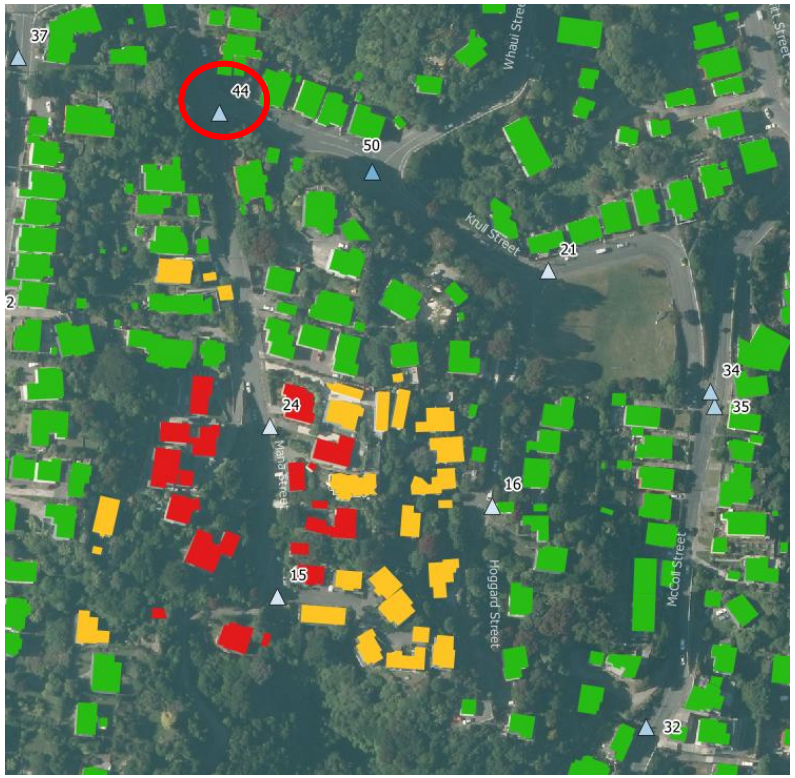




Example – Wellington suburb

Residential clusters

- Many with > 25 L/s within 135 m
- Looking at using hydrant with highest flow not just closest
- Trying ‘street tracing’ approach to improve



Solution – which hydrants to use?

- Main assumption: the primary access route for firefighters to all properties will be from the road.
- GIS data sets required:
  - Properties with fire class assigned
  - Hydrants with model outputs assigned (available fire flows at 10m residual pressure)
  - Roads – must be a “connected” data set (We have used OpenStreetMap)

Solution – which hydrants to use?

- Methodology

1. Assign each property to a road
2. Assign each hydrant to a road
3. From each property, measure linear length along the road to determine which hydrants are available
4. Determine available fire flow from the set of available hydrants using the WSP-Opus method

Solution - which hydrants to use?

- Lessons learned:

  Use the right roads

  Use the right hydrants

  Manual checks using aerials where things look off

Solution - which hydrants to use?

Next Steps / Potential Issues

- More testing!
- Other water authorities property data sets may not be as consistent as WWL
- Discussions with Fire and Emergency

Conclusions

The Wellington Water panel has worked together to develop a way to apply the Fire Code consistently across an entire water network on a property basis.

- Fire Class can be automatically assigned
- Combined fire flow for a set of hydrants can be calculated from model outputs
- The set of hydrants for each property can be automatically identified