MODELLING FIREFIGHTERS – USING YOUR NETWORK MODEL TO KEEP PEOPLE SAFE

"[Click here to Enter Author/s & Affiliation/s]"

ABSTRACT (500 WORDS MAXIMUM)

The Fire Code (SNZ PAS 4509:2008) has long been the go-to document for determining fire flow requirements in urban water networks. However, the focus of the Fire Code itself is on individual buildings - the puzzle for network analysts has always been how to run a system-wide analysis with consideration of individual buildings.

In particular, the Fire Code talks about the number of hydrants within a certain distance of the building. Interpreted literally this means you can use any hydrant within a certain radius, and this is easily done with simple GIS tools. However, reality in the field can look very different - the whole purpose of having a hydrant nearby is to ensure firefighters can plug one end of a fire hose into the network and get to the fire with the other end.

As a first responding appliance to any structure fire there are a number of considerations the officers need to think about. On the way to a call information may be relayed via Firecom, including, location of fire hydrants in the area of the address and if there are any recorded hazards as part of the risk identification carried out at the address particularly if it is a commercial or industrial building.

Several considerations and risks need to be considered by the Fire Emergency officer; number of persons reported, building size, fuel loading, neighboring buildings, access, and location of hydrants and available water supplies.

To determine where people are genuinely at risk, Wellington Water has taken advantage of their consultants' panel to draw on the expertise of both Stantec and WSP Opus to create a methodology for fire hazard assessment for every property in the region. This incorporates both hydraulic model outputs and the nationally consistent OpenStreetMap roads dataset into a simple online tool to determine the most likely access route for firefighters to any building, and the likely available fire flow from hydrants they can actually use.

A second aspect of ongoing frustration to water network modellers is that the fire code is based around simultaneous use of multiple hydrants to obtain the required flow. Modelling software can give you accurate predictions of how much water is available at a single hydrant, but flow from multiple hydrants requires manual setup and analysis – not practical for every building in a city. A statistics-based analysis has been developed to determine the combined output of a group of hydrants from the single-hydrant flows which are readily available from an InfoWorks model. This analysis provides an estimate of the total available hydrant flow for any given set of hydrants.

With knowledge of which hydrants can be used and how much water is available from these hydrants, Wellington Water is now able to estimate the level of fire coverage for every property in the region.

This paper will explain how Fire and Emergency NZ (FENZ) manage risk when fighting fires, how this relates to the current CoP, and how modelling and GIS tools have been developed to better inform FENZ when fighting fires.

KEYWORDS

Fire-Fighting, Water Networks, Modelling, GIS, Public Safety, Risk, Infrastructure Planning

PRESENTER PROFILE

Keith Pedley is the National Operations Advisor Fleet & Equipment at Fire Emergency New Zealand

Ben Davies is a Water Networks Specialist with Stantec, Wellington.

Iman Aghamohammadi is the Senior Water Modeller at Wellington Water

Dan Johnson is the Water Group Manager - Water Asset Management & Engineering at WSP Opus

1 INTRODUCTION

Fighting fires is a tough job. It takes a special type of person to want to run into a fire instead of away from it, and the fact that fire fighters are happy to do it frees the rest of us up to live our lives safe in the knowledge that someone is there to save us.

However, even firefighters don't like running into fires without water. A consistent and sufficient supply from the water network is a critical part of firefighting efforts, and the ability of water networks to deliver the water required for firefighting is now a key performance criterion for most water networks.

Fire and Emergency New Zealand (FENZ, previously New Zealand Fire Service) have developed the New Zealand Fire Service Firefighting Water Supplies Code of Practice (SNZ PAS 4509:2008), which is the go-to document for determining fire flow requirements for buildings in New Zealand. However, there are 3 challenges when applying the CoP to determine available fire flow in the network.

1. The focus of the CoP is on individual buildings, with the outcomes dependent on looking at the circumstances of the building itself. This does not translate well to fire flow capacity assessments across an entire water supply network.
2. Additionally, the CoP specifies the number of hydrants which should be within a certain distance of the building to ensure access to water during a fire incident. Interpreted literally this may mean you can use any hydrant within a certain radius, but in reality firefighters can only use hydrants with a direct line of access to the entrance of a building.
3. The final problem is that although water modelling software is able to accurately determine the available flow from any one hydrant for high-risk buildings (such as industrial or storage facilities), a number of hydrants will be required to supply the required flow. Opening one hydrant will affect the flow available from the next hydrant, and there is no way to automatically model the combined flow from a set of hydrants in the modelling software.

We therefore need a tool which can use readily available district-wide data sets to do the following:

a. Automatically determine the worst-case fire classification for each building

b. Automatically determine which hydrants are available for use at each building

c. Automatically determine the combined available flow from these hydrants.

This paper sets out a methodology to achieve the three requirements above, which have been incorporated into an easy-to-use webtool. The paper also sets out some of the pitfalls which were encountered and how they have been overcome along the way.

2 THE PROBLEM – A FIREFIGHTER'S PERSPECTIVE

The call has come in and the first responding appliance is on its way, and already the officer in charge (OIC) is thinking about several things. What size is the building, number of persons reported, access and positioning of appliances, further resources required, type of structure, fuel loads in the building, any other hazards. On arrival, the whole plan can change in an instant.

A call can go from an alarm activation or smoke in area to a K99 (structure fully involved in fire) within seven minutes depending on fuel loads and building materials used. Key to a rapid and successful conclusion to an incident of this nature is a good water supply that is easily accessible. Volume and pressure is also key.

Large fires can use several appliances, all capable of pumping up to 3,600 L/pm, so knowing where hydrants are located, water main pressure and expected water output from a hydrant, is key information the OIC will be considering.

Delays in getting a good water supply to an incident can make the difference to whether the building is saved or burns to the ground, and can also affect whether neighbouring buildings can be protected and damage limited.

How much water is available is a key factor in the tactics that the OIC may choose to adopt when completing a 360 of the fire ground on arrival. The tactics may very well determine the outcome, so good information on the availability of water is a critical piece of the firefighting puzzle.

At present, the knowledge around where good water can be found depends largely on personal experience of the OIC and firefighters on the ground. With the exception of actual fires, this knowledge comes from the results of hydrant flow testing, but for a number of reasons the hydrant testing process is becoming harder, and reliance on individual experience is therefore becoming a critical risk.

3 THE CHALLENGE – NETWORK MANAGERS PERSPECTIVE

3.1 ABOUT WELLINGTON WATER

Wellington Water is a Council Controlled Organisation (CCO) jointly owned by the Wellington, Hutt, Upper Hutt, and Porirua City Councils and the Greater Wellington Regional Council (GWRC).

We have service level agreements in place with all of our client councils. Our agreement with GWRC is to manage its bulk water supply network on their behalf, and the agreement with each of the city councils is to manage the reticulation networks on their behalf.

3.2 OUR OUTCOMES AND SERVICE GOALS

There are 3 outcomes and 12 service goals which define what we provide to our customers.

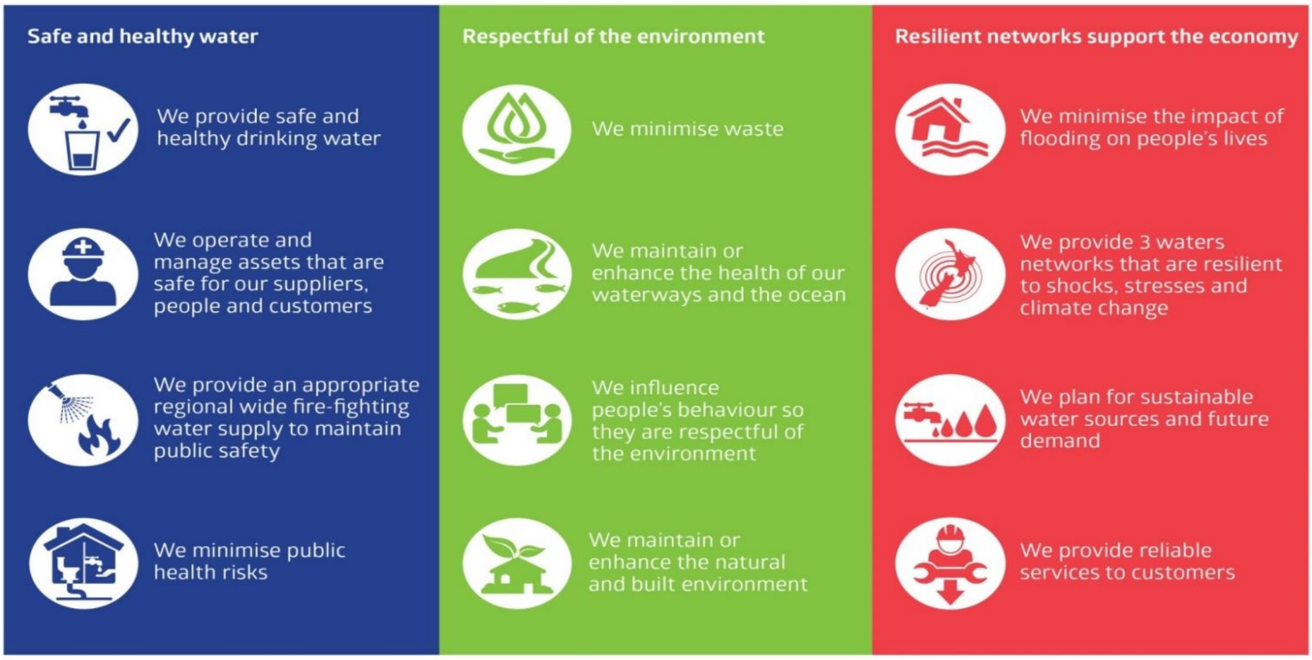

Figure 1: Wellington Water 12 Service Goals

One of the 12 service goals is specifically designed to maintain public safety through appropriate region wide fire-fighting water supply capacity in the network - "We provide an appropriate region-wide fire-fighting water supply to maintain public safety".

We are committed to monitoring and reporting on the following two Key Results Areas associated with our fire-fighting water supply service goal:

- Sufficient water is supplied to meet urban firefighting needs under normal conditions
- We identify and implement water supply improvements to assist Fire and Emergency New Zealand

3.3 HOW WE DO THIS AND WHAT IS THE HYDRAULIC MODELLING ROLE

To make sure there is appropriate fire flow capacity in the reticulation system, Wellington Water has developed a hydrant performance testing programme which includes condition assessments of all fire hydrants and physical flow and pressure tests of key fire hydrants. Hydrant testing is used to determine network capacity and identify areas of concern. A capital programme of works is then developed to improve fire-fighting water supply capacity in the network and information is shared with the Fire and Emergency New Zealand (FENZ) on the extent of testing and any known issues.

In the absence of water supply hydraulic models, key fire hydrants were selected based on network extremities, local high points and proximity to key customers. A calibrated hydraulic model is a perfect tool to accurately provide areas of concern where low pressure or low hydrant flow is expected in the network which may not necessarily be on the network extremities or high points.

In addition, fire flow scenarios in a calibrated hydraulic model can reveal how much firefighting capacity is available in the network at any given time. This can be compared with what is required based on the CoP (SNZ PAS 4509:2008) to identify the list of possible non-compliant hydrants and earmark them for further investigations. Hydraulic models can also be used to inform what upgrades are required to improve the fire flow capacity in the network.

3.4 NEW ZEALAND FIREFIGHTING WATER SUPPLY CODE OF PRACTICE (SNZ PAS 4509:2008)

New Zealand Firefighting Water Supply Code of Practice provides comprehensive guidance to assess fire hazard classification and it specifies the water flow requirements to match that hazard.

The CoP sets out what constitutes a sufficient minimum supply pressure (10m residual pressure) and volume for firefighting in structures in urban fire districts. It provides techniques to define a sufficient firefighting water supply that may vary according to circumstances.

The water supply requirements to address the fire hazard is established by identifying Fire Hazard Category (FHC) for each individual building and selecting an appropriate Fire Water Classification (FW rating) provided in the CoP.

For any premises, this establishes the minimum firefighting water supply that is required for the fire hazard. The CoP recommends that water supply systems are designed to provide 60% of annual peak demand in addition to the fire flow. Fire flows are usually derived from table below provided in the Fire Code.

	Reticulated water supply			**Non-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**	**Minimum water storage within a distance of 90 m** (see Note 8)	
				Time (firefighting) (min)	**Volume** (m^3)
FW1	450 L/min (7.5 L/s) (See Note 3)	–	1	15	7
FW2	750 L/min (12.5 L/s)	750 L/min (12.5 L/s)	2	30	45
FW3	1500 L/min (25 L/s)	1500 L/min (25 L/s)	3	60	180
FW4	3000 L/min (50 L/s)	3000 L/min (50 L/s)	4	90	540
FW5	4500 L/min (75 L/s)	4500 L/min (75 L/s)	6	120	1080
FW6	6000 L/min (100 L/s)	6000 L/min (100 L/s)	8	180	2160

Table 1: Fire water classifications

3.5 WHAT ARE THE CHALLENGES?

3.5.1 FIRE CODE REQUIREMENTS VS HYDRAULIC MODEL RESULTS

The CoP focuses on hazards at a building level. It requires assessment of available fire flow from a number of hydrants (combined flow of up to 8 hydrants) within acceptable distance from the building (first hydrant/set of hydrants within 135m and the second set within 270m distance). Calculation of the required fire flow depends on the building Fire Hazard Category (FHC). This is defined based on many different parameters like building type and usage, building height, sprinklered or not, existence of hazardous substances and so on. Fire cell size in each building also needs to be considered in conjunction with its Fire Hazard Category to determine FW classification and estimate required fire flow.

Hydraulic models are network focused. A calibrated network model can predict the available fire flow at 10m residual pressure. Models can automatically produce these results but only from one hydrant at a time. There are methods to undertake a multi hydrant assessment for a set of particular hydrants manually with pre-defined exceptional flow at each hydrant. However it will be for one set of hydrants at a time and it is a manual time-consuming procedure. There is no method to apply this at a property level as per the CoP requirements.

There was an obvious need to bring the fire code requirements and the hydraulic modelling outputs together, or at least as far as practically possible. We needed to find systematic links between the fire code requirements and model outputs in order to be able to develop an all-inclusive methodology. As engineers, we embarked on developing a technique that can be explained mathematically. At the beginning the only available information was descriptive fire requirements based on the CoP in one hand and limited knowledge of available fire flow at individual hydrants from the model in the other hand. Our goal was to link these together in a systematic way so we deal and tackle them both simultaneously.

We encountered few challenges while interpreting the CoP for hydraulic modelling purpose. These are set out in the following sections.

3.5.2 CHALLENGE ENCOUNTERED – MULTIPLE HYDRANTS

Dealing with buildings which require fire flow from multiple hydrants proved to be a challenging analysis. When we run a fire flow assessment in a hydraulic model, there are two ways in which to approach the simulation:

1. We can set up a simulation with realistic hydrant losses, to tell us the realistic flow from each hydrant. However, this provides no information on the combined capacity of multiple hydrants.

2. We can set up a simulation with zero hydrant losses, to estimate the network capacity which in theory could be available with unrestricted outflow, for example if the pipeline was severed. Theoretically, if you open enough hydrants at this location then this is the amount of flow you should be able to get out of the network. However, in reality the hydrants are usually spaced out across a wide area, so this theoretical flow is not realistic.

Figure 2 shows the outputs of a modelling fire flow assessment, showing the available network capacity (method 2 from above) at four hydrants near a building which has been classified as FW4.

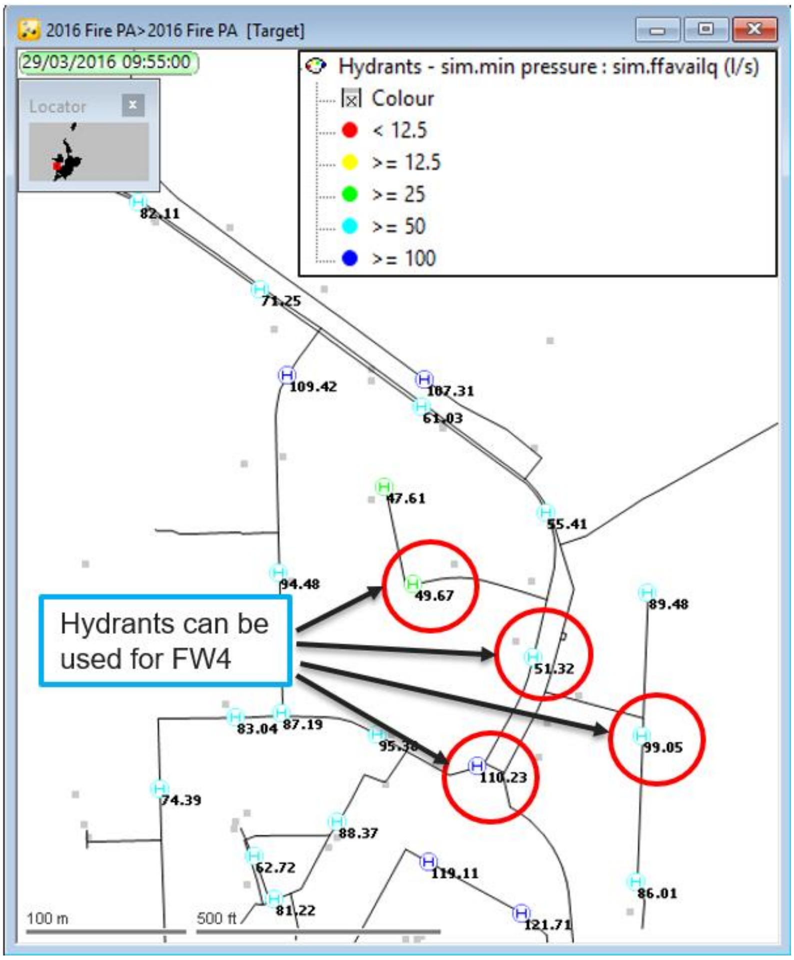

Figure 2: Example of multiple hydrants for use in firefighting

As demonstrated in the Figure 2, the model results show there are 49 L/s, 51 L/s and even 110 L/s available fire flow at hydrants but the actual maximum design hydrant flow for safety reasons (as specified in the CoP) is 35 L/s.

Another point is that flow at one hydrant will affect available flow at the next hydrant, meaning those flows indicated will not be achievable simultaneously. So how can we assess the combined available flow based on individual hydrant flows?

Another challenge is when hydrants are at different elevations. In that case, 10m residual pressure at one hydrant is at different Hydraulic Grade Line (HGL) than 10m at the next hydrant. Although the Fire Code requires water delivered at 10m residual pressure, this is in reality not likely to be possible if hydrants are at different elevations.

3.5.3 CHALLENGE ENCOUNTERED – LINEAR PIPE DISTANCE

Fire flow requirements for residential properties are more achievable with lower FW ratings (usually FW2). In those cases, the CoP requires the minimum of 25 L/s supplied from maximum of two hydrants. The distance criteria dictates 12.5 L/s fire flow is required within the 135m distance and another 12.5 L/s can be supplied within 270m distance from the building. An example of the CoP distance requirement is shown in Figure 3.

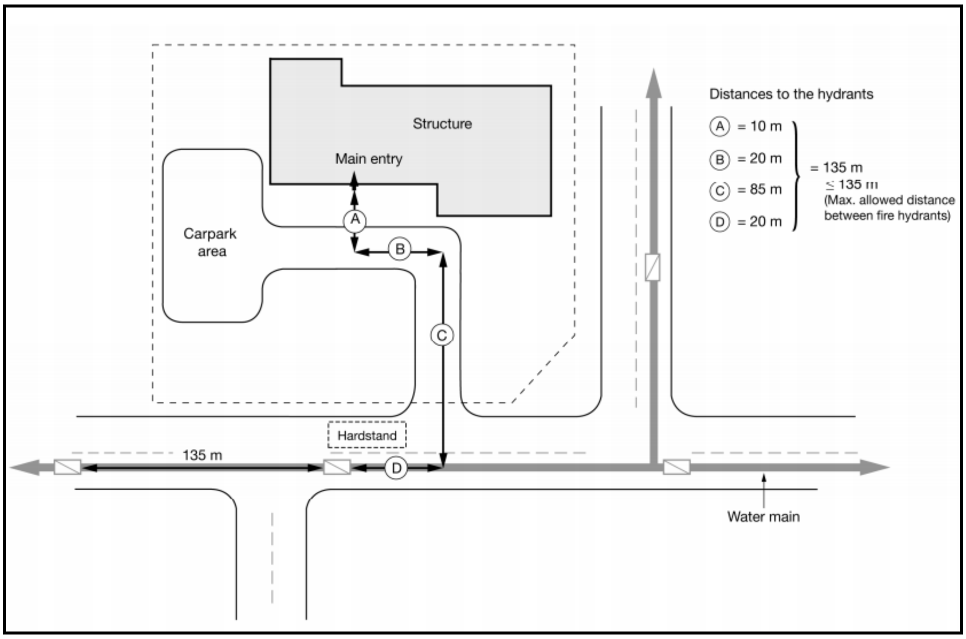

Figure 3: The Fire Code requirements for the location and distance of fire hydrants

The challenge is that the hydraulic model does not contain much information on property level and building perimeter to accurately determine the maximum distance to the building's main entry as required by the CoP. This challenge is illustrated in Figure 4.

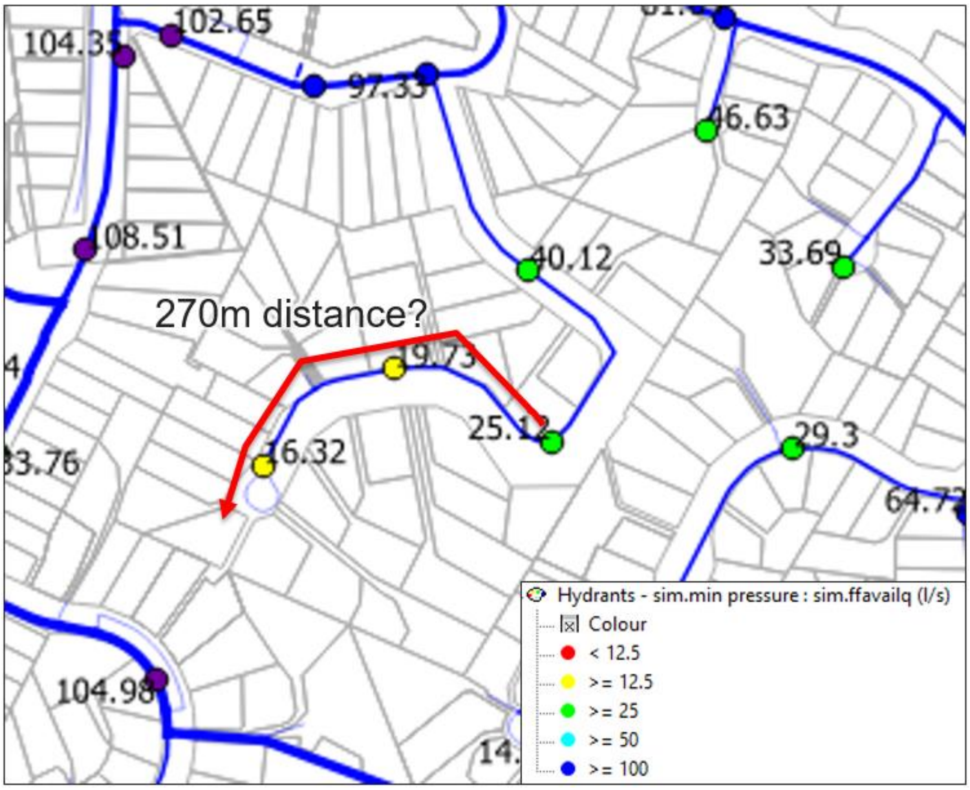

Figure 4: Linear distance requirements

3.5.4 CHALLENGE ENCOUNTERED – RADIAL DISTANCE

This is a challenge that has been encountered in the previous code and still illustrates the challenges when using a model for Fire Flow analysis and aligning it with the requirements of the CoP. If the radial distance is used to select suitable hydrants and it is done automatically then there is a chance that the system picks the wrong hydrant. Because the hydrant is within the required radial distance it doesn't always mean it can be used by fire fighters. In the example below (Figure 5) the nearest hydrants do not have enough flow, but there is still a hydrant within 135m radial distance with enough flow. However, it is impossible for fire fighters to use the hydrant down the road for a burning house on top of a hill in another street.

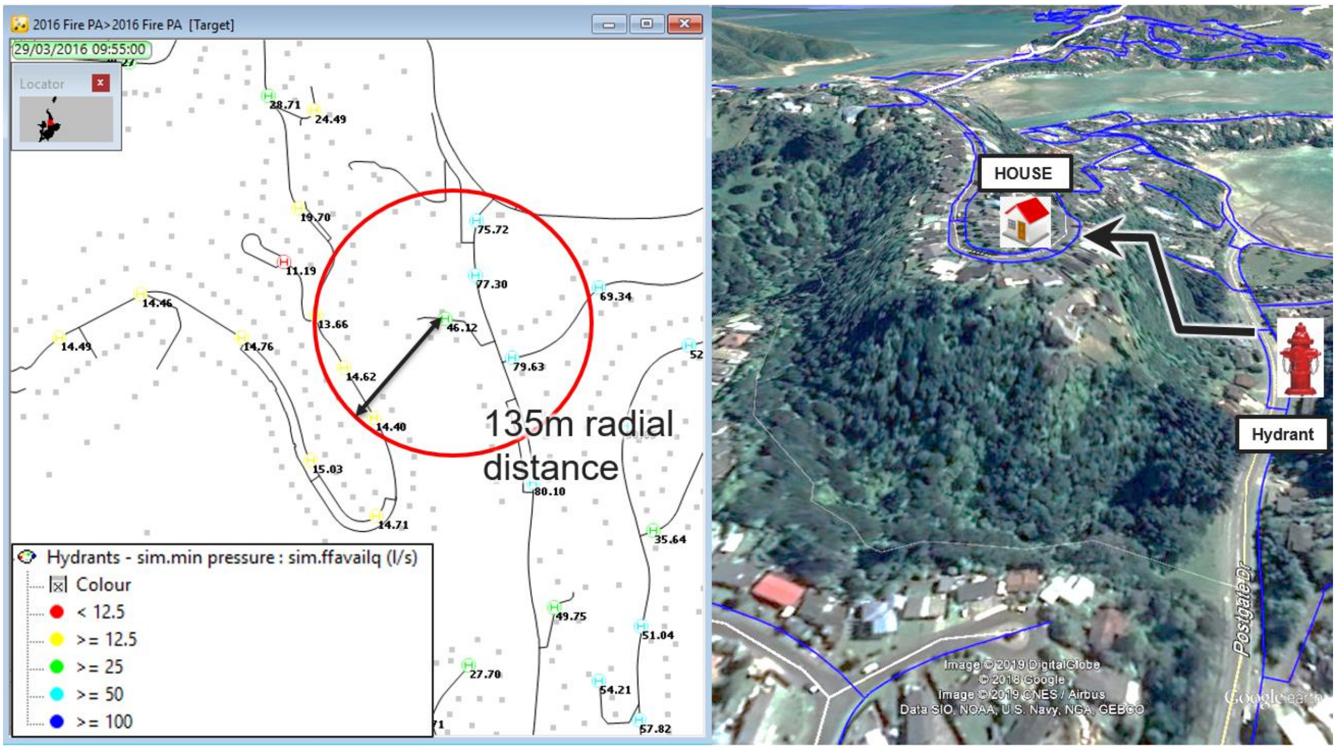

Figure 5: Radial Distance

3.6 USING THE FIRE CODE TO DETERMINE RISK ACROSS A NETWORK

Up to now, hydraulic modellers and water engineers have assigned a required fire flow (FW ratings) to properties based on the planning information (land use zone, district plans). Then they assess which hydrants can be used by eye or radial distance to fulfil the fire code distance requirements. Eventually, engineering judgement was used to estimate the combined hydrant flow based on individual hydrant flows.

Our goal was to improve this process by developing a system which undertakes 3 main tasks:

- Automatically determines the required (worst-case) fire flow for a property.
- Identifies which hydrants can be used to supply the required flow.
- Determines what the combined flow of those selected hydrants is.

Completion of the above would allow comparison of the available fire flow with the CoP requirements to determine areas of deficiency.

Wellington Water has worked closely with its consultants' panel (Stantec and WSP Opus) to create the methodology for fire hazard assessment for every property in the Wellington region. This incorporates both hydraulic model outputs and the nationally consistent OpenStreetMap roads dataset into a simple online tool to determine the most likely access route for firefighters to any building, and the likely combined available fire flow from hydrants they can actually use. This methodology is currently being reviewed by FENZ.

4 THE SOLUTION – DEFINING THE HAZARDS

WSP Opus have developed a way of determining the likely fire water classification of any building based on aspects such as the land use, building height and other publicly available data sets.

In addition, WSP Opus have also worked out an innovative approach to using a set of individual hydrant flows, taken from a hydraulic model and combine them to provide an indication of the likely combined flow from these hydrants where more than one hydrant can be used in accordance with the Fire Code.

WWL's objective was to generate a fire classification plan for the Wellington Region and a methodology for assessing fire flow compliance, to provide consistency, and to support the development of current and future infrastructure planning.

4.1 THE FIRE HAZARD

The Fire Code is intended to provide guidance on assessing individual fire hazards and the water flow requirements to match that hazard. To determine the Fire Water Classification (FW) for each individual building, the Fire Hazard Classification (FHC) needs to be derived, and this is the challenge. The FHC requires a substantial amount of information about each fire hazard to assess the required water flow, which is difficult to collect for all structures across large towns and cities.

In a broad sense, the classification process in the Fire Code is achieved in two steps;

1. Applying a fire hazard classification (FHC) rating based on the activity type and,

2. Defining a firefighting water classification (FW) based on the FHC rating and the largest fire-cell within the building.

The FHC ratings range from FHC1 to FHC4, where a medium commercial office would typically be rated FHC2 and a large storage warehouse rated FHC4. Residential buildings are classified as FW2 unless they are defined as multi-storey, in which case a rating of FHC1 would be applied. A multi-storey building was defined as; ≥ 4 levels for residential apartments (i.e. RA) and ≥ 3 levels for other residential building.

Two conditionals in the Fire Code that help distinguish between these four FHC ratings and used in the methodology are;

1. A building of crowd activities of <100 people is FHC1 and of >100 people is FHC2

2. A building of working/business/storage activities with bulk storage ≤ 3 m is FHC3 and >3 m is FHC4

A fire-cell is the area enclosed by structural elements engineered to prevent a fire spreading. Most modern buildings are constructed with fire-proof walls. Determining a fire-cell requires a complex assessment undertaken by a fire engineer. This time-consuming process is not reasonable for large-scale areas, so the assumption that a building's footprint area is equal to the fire-cell was adopted.

To turn any category (building activity) data from the Core Logic dataset (CL) into useful information and make it compatible to the Fire Code, several levels of processing was required. The CL dataset contained 114 different category types, all category types were allocated a FW classification, FHC rating or conditional where appropriate. Technical guidance was provided from in-house WSP Opus fire engineers and building specialists to verify the assumptions.

The conditionals were applied to categories that fell between either FHC1 and FHC2 or FHC3 and FHC4. These are the two conditionals previously mentioned in the Fire Code and are applied later in the flow process to determine a final FHC rating and ultimately a FW classification.

To better understand the best pathway to take and produce classifications using the available data, a flow process was developed, as shown in Figure 6.

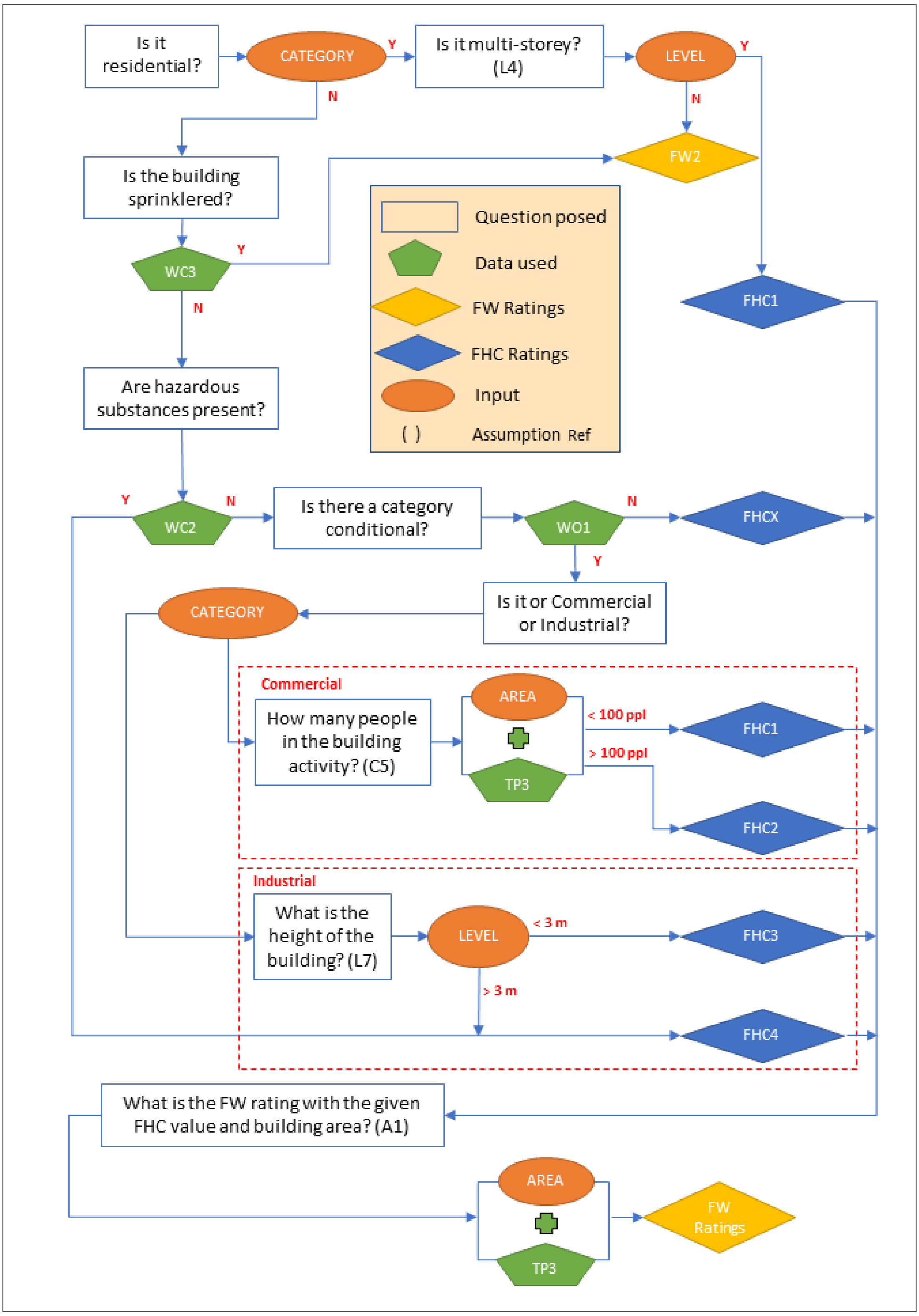

Figure 6: Simplified Methodology Flow Process

4.2 FIRE CLASSIFICATION MAP

Considering the data gaps and geometric inconsistencies, the resulting maps had reasonable coverage of the Wellington region. In total 3% of buildings in the Wellington region could not be assigned a classification value. These are shown by grey buildings on maps which are 'unknown'.

FENZ were consulted throughout the development of the methodology and had input to key assumptions to ensure the process and final outputs were valid and considered reliable. In addition, the FENZ risk map, which consists of risk scores that are data points on buildings and covers parts of the Wellington region. The scores are dependent on several subjective and objective factors. One subjective factor is the effect on the community of losing the building.

As these scores are not comparable to the FW classifications, it was decided to simply add the risk scores to a column on the parcel and building output maps. When more than one point existed on a parcel, the same logic was used, and the maximum score was adopted for the whole parcel.

Ways forward to address these 'unknown' points may involve obtaining building heights, area or activity types. The demerit system and error codes will aid the user in what confidence each building has been classified and which data fields are missing/inferred.

As expected, the majority classification ratings are FW2 (89%), which reflect the residential areas. Only 5% of buildings in the Wellington region are FW4 or above. How these buildings are spread will determine the effect of future planning of water networks and zoning.

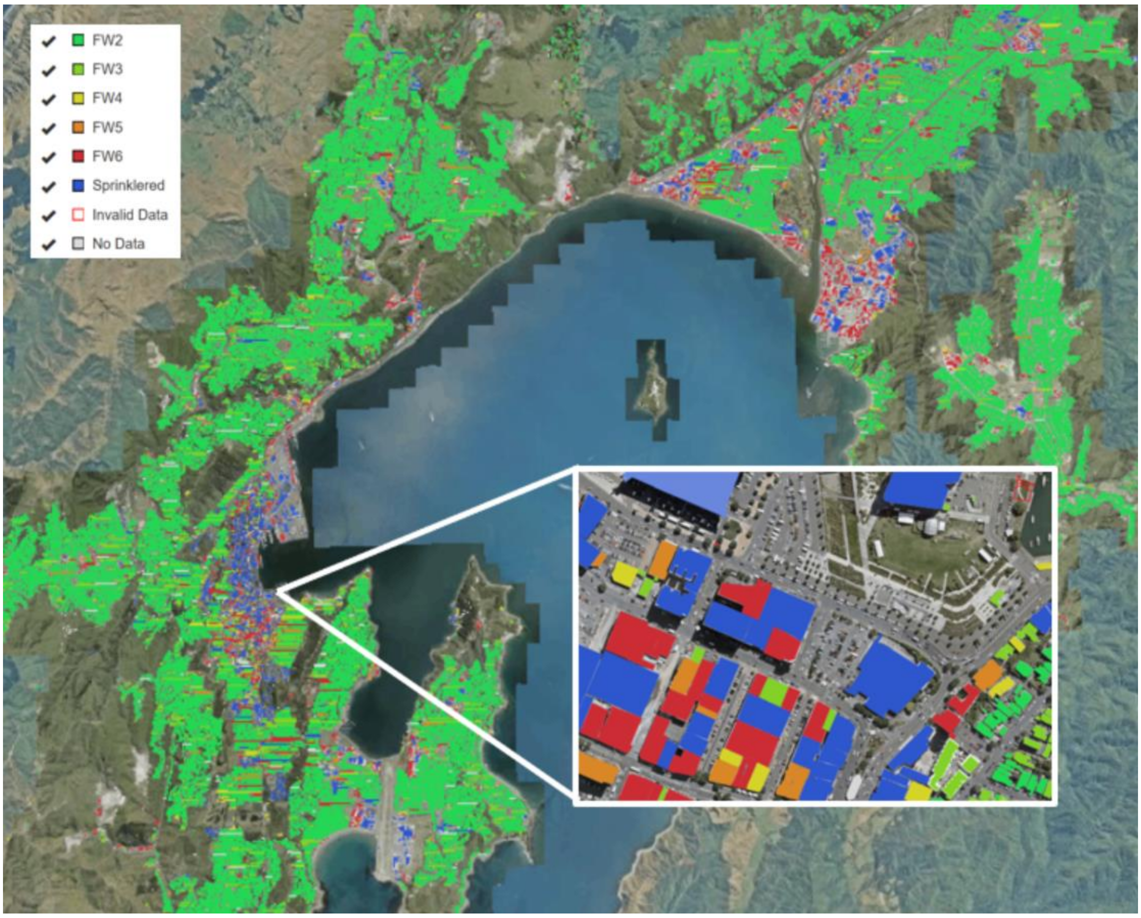

Figure 7: Wellington Region – Fire Classification Map Sample

4.3 FIRE FLOW ASSESSMENT

Once the FW rating or fire flow demand has been defined for each building, the next step to assess fire compliance, is to determine the available fire flow throughout the network.

WSP Opus have developed a practical approach to assessing fire flow compliance on a City-wide basis.

4.3.1 ASSESSMENT METHODOLOGY

WWL's calibrated hydraulic models are generally used where available to obtain the available hydrant flows. Two different methodologies are applied:

- For residential fire flows (FW2) the flow from a single hydrant is used to assess the likely flow from up to two hydrants
- For commercial and industrial fire flows (FW3 to FW7) the flow from a cluster of hydrants is used to estimate the likely flow from up to eight hydrants

For residential (FW2) hydrant flows, a GIS assessment is carried out to confirm if there is at least one hydrant within 135m (radial distance) of the building, if not, the building is immediately non-compliant.

An assessment is then carried out to obtain the flow from the two nearest hydrants (within 270m) using an automated GIS process. Where the average flow from the two hydrants or a single hydrant is equal to or greater than 25 L/s, it meets the FW2 criteria and the building is therefore compliant. In the event the flow from the two hydrants is between 20-25 L/s this is considered marginal, and a multi hydrant assessment maybe carried out. If the average flow is less than 20 L/s, the total flow from two hydrants running simultaneously is likely to be less than 25 L/s, so the building is classified as non-compliant.

For assessing non-residential (FW3 to FW7) available hydrant flow, a different approach from the FW2 assessment is required. For non-residential hydrant flows, at least 50% of the maximum number of fire hydrants to provide the fire flow within 135m of the building is required, if not the building is immediately non-compliant.

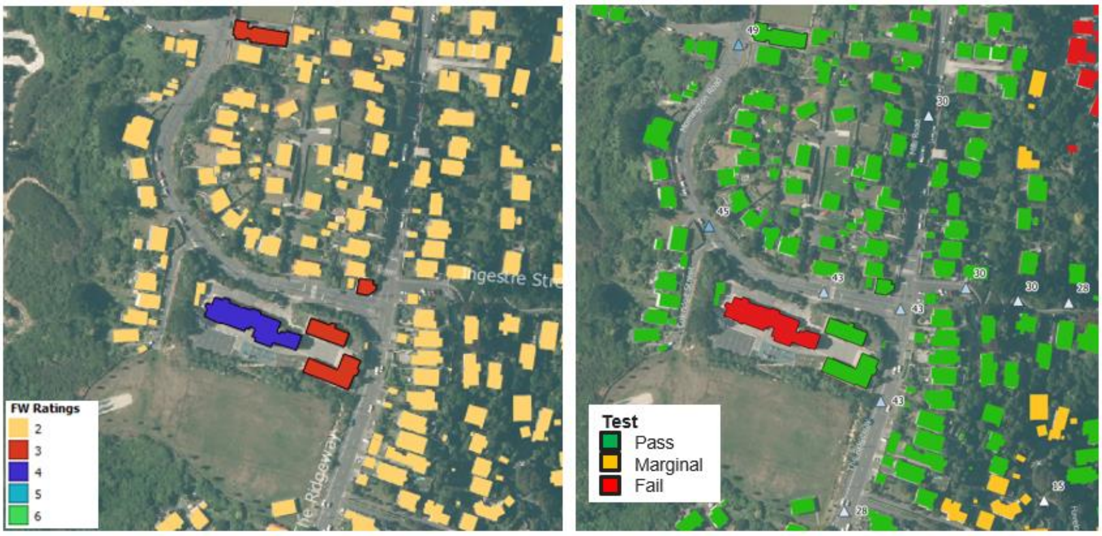

Figure 8: Fire Compliance Assessment

To simulate a point flow (multiple hydrant scenario), the hydrants are modelled as a single point to represent a cluster of hydrants, where one hydrant equals 25 L/s. For example, an FW6 requires 200 L/s from 8 hydrants. The model can assess the network available flow capacity to a single point with a 10m residual pressure. If the flow is greater than 25 L/s per hydrant, the system would be compliant with a cluster of hydrants adjacent to the hazard being considered. We have tested the modelled available flow from a single point against the modelled flow from up to eight hydrants around a hazard and found the results are generally within 5 %.

The flow from the maximum number of fire hydrants to provide the flow (within 270 m) are used. The hydrant flow is derived from the maximum number of hydrants allowed for each hazard. Where the flow is greater than or equal to 110% of the required flow the building is compliant, where it is between 90% and 110% of the required flow, it is considered marginal. If the flow is less than 90% of the required flow the building is non-compliant.

This modelling approach provides an innovative way to apply the Fire Code as it is stated, to determine the available fire flow at an individual building level across a water supply no matter the scale, without having to run hundreds or thousands of individual simulations.

5 THE SOLUTION – GETTING WATER TO THE HAZARDS

With the work WSP Opus did in defining the hazards, we now have the following pieces of the puzzle:

- We have knowledge of the potential fire requirements on a building level
- We have the ability to estimate the combined available flow from any set of hydrants from the modelled available flows of those hydrants.

Now we can move on to the final piece of the puzzle – finding the hydrants that firefighters can actually use to fight fires. Stantec attacked this as follows.

In setting up a firefighters' model, our plan was to determine the best routes for firefighters to follow from the hydrants with the water to the building with the fire. Our first assumption was that firefighters will be arriving in a truck, on the road, and most hydrants are located in the road, so roads themselves should form the basis of any route-planning analysis.

We use openstreetmap as our base roads dataset. A key aspect of this dataset is that it is fully connected, i.e. if you follow the line representing a road to an intersection, the line does not just stop – it is connected to another line and you can continue on your way.

This dataset includes all roads in New Zealand, along with walkways, cycleways, carparks, and footpaths. It became apparent pretty early on that we didn't want our firefighters following some types of roads – motorways for example would be troublesome to navigate with a large firehose in hand, so these were eliminated along with most walkways and pedestrian-only access routes. Although some walkways are accessible by firefighters, they largely run the long way around the back of properties and access to hydrants is limited.

With the data set sorted, we then told our firefighters (in the model) to access each building from the closest road. Although this seemed logical, we encountered difficulties. We found our firefighters were bashing through bush, hurdling fences and scaling cliffs to fight fires. Although suitably heroic, this is probably asking too much of real-life people, so we went back to the drawing board.

We then realized that the easiest access route to most buildings is through the front door, and the mailbox for a house is usually at or near the front door. From this, it followed that the street address for each building would probably indicate the easiest access route, even if the road was some distance away.

By using a fuzzy string matching function to match the street address for a building in the buildings database with nearby roads in the roads database, we were able to keep our

We have set the assessment up on a convenient webtool. As well as colour-coding buildings by whether they pass or fail the fire code criteria, clicking on a house will show the path to the hydrants used in the assessment along with the single-hydrant flows available from all hydrants. This makes it easy for any operator to see the full fire-coverage story for any building at the click of a button.

modelled firefighters out of trouble in most locations.

A sample output from the webtool is shown in Figure 9. Clicking on a house provides a description of the fire flow coverage compared to requirements, shows the hydrants that have been used to make this assessment, and shows the path that the tool assumes firefighters will take to reach the hydrants with firehoses.

Figure 9: Sample webtool screenshot

But it's not all roses – we have found some areas where these assumptions do not work.

In the first example, the street addresses for a number of properties are different from the street that the houses are accessed from - see Figure 10.

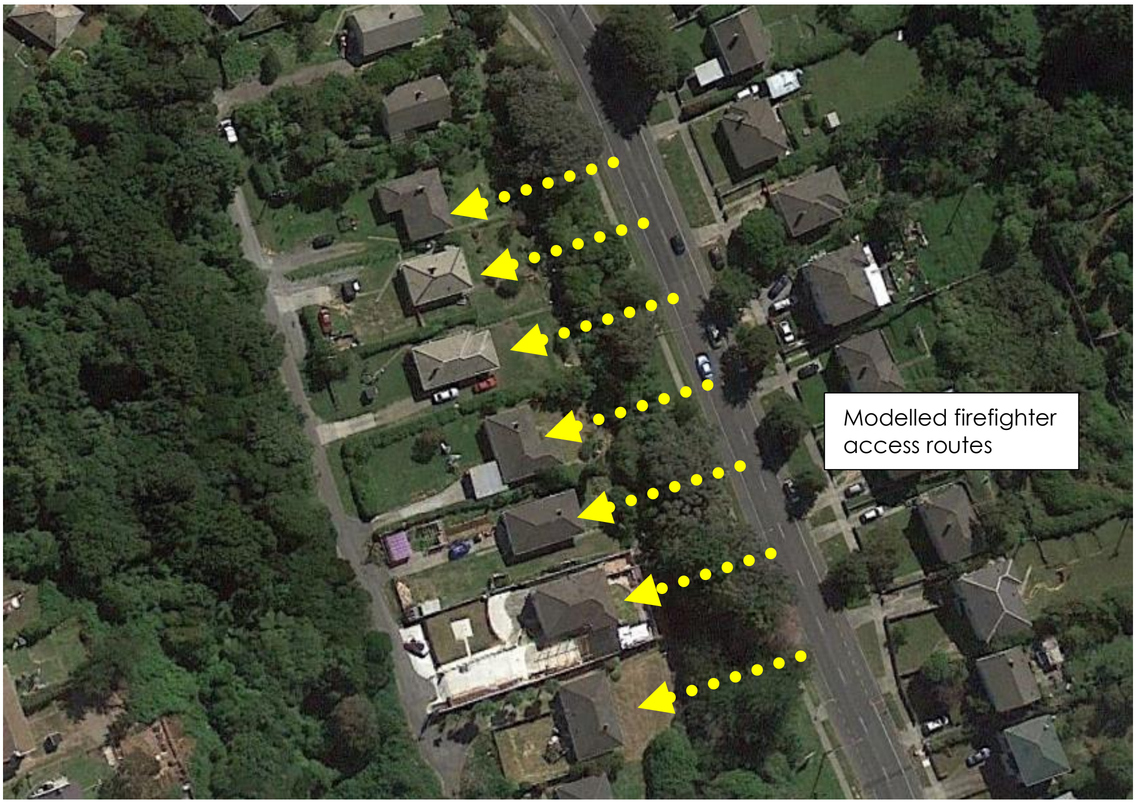

Figure 10: Houses with abnormal street addresses

It's not clear if the mailboxes are at the back of the properties away from the driveway, or if the mailboxes are beside the driveway but on the wrong road. Either way, our webtool unfortunately predicts that firefighters will need to run through the bushes to fight fires at these houses.

These examples show that although the new automated process is an improvement over previous methodologies, there is no automated substitute for local knowledge. Fire and Emergency NZ are therefore a key contributor to this tool, and there are already plans to improve the tool with risk-profile data sets which FENZ have gathered from their experience of real fires.

6 CONCLUSIONS

Over a period of time, it has become apparent that there is a serious disconnect between fire flow analysis in a water network hydraulic model and real-world fire risks. The causes of this have been identified, and new methodologies have been developed by combining skills across a number of parties to address each issue.

The power of the Wellington Water Consultancy Panel has been used to combine the outcomes of individual pieces of work into a convenient webtool which shows the ability of the water network to supply water for firefighting at any building in the Wellington region, so long as a good water network model has been developed for these zones.

This not only shows which areas water network improvements should focus on, but also demonstrates the wider uses of data and hydraulic modelling, for example to assist Fire and Emergency NZ in carrying out their vital work in keeping people safe.

ACKNOWLEDGEMENTS

We would like to acknowledge the offers of assistance, advice, input, and hard work of various parties involved in this joint effort, including the Wellington Water Network Engineering Team for their input and management of the fire classification plan project, and the project team at WSP Opus who developed the fire classification methodology. We would also like to acknowledge the work done by the Stantec GIS and data team, whose input made the path analysis possible and who went beyond the call of duty to develop the webtool which makes the visualisation of the process so easy to understand.

REFERENCES

New Zealand Fire Service Firefighting Water Supplies Code of Practice - SNZ PAS 4509:2008 (Standards Council, 2008)