

Upper Hutt City Council  
Hearing - Wednesday 26 April 2023  
Intensification Planning Instrument

Hydraulic neutrality and 'qualifying matters'  
are for public safety  
which is never out of scope!

Stephen Pattinson

Submitter 65

Part 1 "Qualifying Matter Areas"

My thanks to the s42A report author's recommendation that this late submission be accepted.

This submission S65 was submitted on the closing date 30 September 2022 at 5:40pm.

## OUTLINE

1. Recent NZ floods and cyclone call for accurate flood maps
2. Beca Pinehaven Stream Flood Mapping Audit (2015) misleads the public
3. Jacobs did not fix “major issue” in Pinehaven flood model
4. How the “major issue” shows up:
  - i) 1976 eye-witness ‘ground-truthing’
  - ii) 4 Case Studies
5. Large errors in GWRC flood map for 27 Elmslie Road, Pinehaven
6. Why are there so many anomalies in the Pinehaven flood maps?
7. Pinehaven 1-in-25 year flood on 8 December 2019
8. Consequences of unreliable base model:
  - i) No hydraulic neutrality for GTC development; no flood protection for Pinehaven
  - ii) Properties shown in a flood zone that actually aren’t
  - iii) Unnecessary expenditure replacing Pinehaven Road culvert, ~\$5M
  - iv) Over-engineered Pinehaven Streamworks, \$20 - \$35M (?)
9. Potential future disaster of human making if Pinehaven flood model is not rectified
10. What needs to happen now?

**NZ floods and Cyclone Gabrielle - "death toll rises to four ... including a child"**



**1. Calls for accurate flood modelling to avoid tragic disasters like these in future**



Report

## Pinehaven Stream - Flood Mapping Audit

Prepared for Greater Wellington Regional Council

Prepared by Beca Ltd (Beca)

13 July 2015



## 2. Beca Audit (13 July 2015) misleads the public

- Not three audits, only this one by Beca. The first review was internal (GWRC). The DHI review was “*not an independent audit of the Pinehaven Stream flood maps*” (DHI email, 8 Mar 2018).
- Beca audit doesn’t disclose the cause of a ‘major issue’ in the flood maps but simply dismisses it.
- The ‘major issue’ was a failure to find a massive increase in stormwater runoff from proposed Guildford development on Pinehaven hills due to base model (forest) and development model (roads, roofs and driveways) being the same!
- The Auditor states repeatedly that MWH were not able to explain this, but MWH did explain to the Auditor that the pre- and post-development models had the same hydrology of only 2mm/hr infiltration [like a supermarket carpark] [OIA]
- The Pinehaven base model is not ‘fit for purpose’ but fatally flawed (failure of hydraulic neutrality test).

Date 23 June 2016  
 Attention Alistair Allan  
 From Peter Kinley  
 Subject Pinehaven Developments Scenarios 1 and 2  
 Copies to Ben Fountain  
 Michael Hall

**1. Background**

Greater Wellington Regional Council (GWRC) and Upper Hutt City Council (UHCC) that Jacobs provide updated model results for the future development scenarios for land in the catchment flood model and investigate two development scenarios for land in the catchment. The request to update model results for the future development scenarios from the review undertaken by Beca in 2015. The development scenarios are contained in a report prepared by Boffa Miskell for a private landowner.

The base model, which has been used to update the results of the scenario and to investigate two development scenarios, is the model from the Pinehaven Stream Flood Hazard Assessment: Volumes 1 (Maps and Hazard Maps), SKM, 25 May 2010.

The purposes of the modelling are to:

- Resolve the "Future Development Scenario" modelling in Section 4.2 of the report Pinehaven Stream – Future Development Scenarios, July 2015.
- Investigate the impacts of a development scenario of 1,665 new residential dwellings with an average imperviousness, in the upper reaches of the Pinehaven catchment, under Development Scenario 1 (DS1)
- Investigate the impacts of development across a reduced area of the upper reaches of the catchment. This is referred to as Development Scenario 2 (DS2). The density and imperviousness characteristics of those areas are assumed to remain the same as the worst case development scenario described above. Figure 1 below shows the locations of the subcatchments used for the modelling. Figure 1 below shows the locations of the subcatchments used for the modelling. Areas assumed to be excluded from development, in yellow.

The modelling of scenarios and generation of the hydrographs was undertaken by Jacobs. The supplied hydrographs were not altered except to divide the flow into subcatchments (H, J and O) between inflow points in these subcatchments; this was done to ensure consistency with the methodology used in the modelling undertaken to support the report on Stream Flood Hazard Assessment (SKM, 2010). Figure 1 below shows the locations and names of the subcatchments used for the modelling.

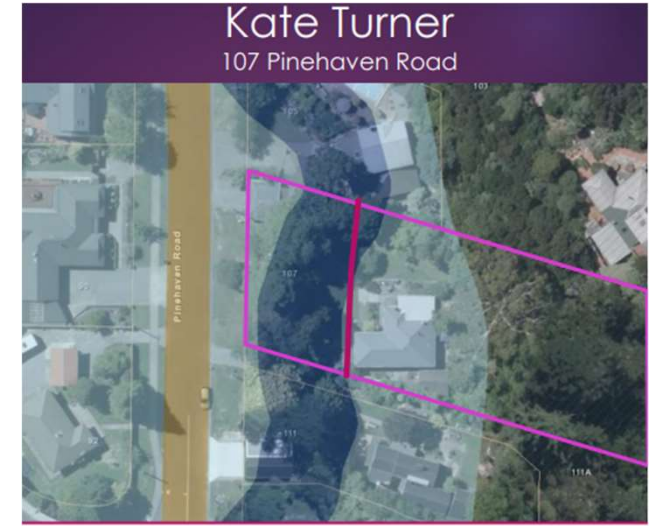
The hydraulic network model used is the model developed for the Pinehaven Stream Flood Hazard Assessment (SKM, 2010). The storm event applied to the hydraulic model was for the two hour duration, 100 year ARI rainfall.

**Jacobs didn't fix 'major issue'**

### 3. Jacobs (2016) didn't fix 'major issue' in flood model

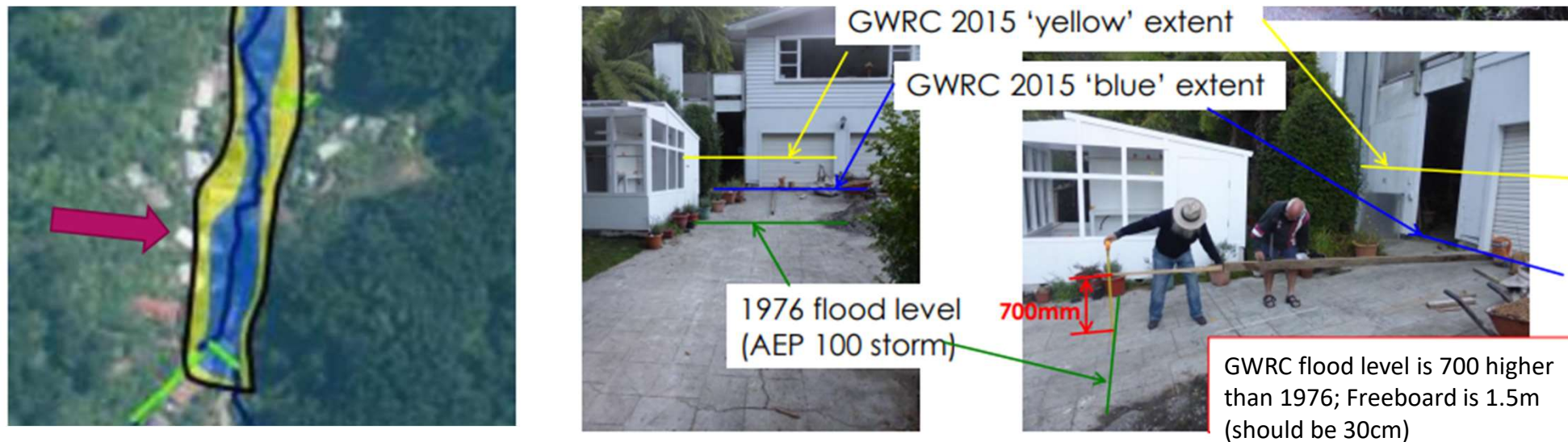
- The rainfall-runoff model is where major issue is & GWRC did the rainfall-runoff model not Jacobs: *"The hydrological modelling ...was undertaken by GWRC and provided to Jacobs."* (Jacobs, 23-6-16)
- *"we conclude that Jacobs ( 2016 ) have not resolved this issue and... because they were using hydrographs supplied to them by GWRC, in effect they never actually addressed that issue at all."* (RJ Hall & Assoc., 5 Nov 2019).
- Commissioner accepted Auditor's advice Jacobs had fixed the issue, but Auditor advised GWRC: *"I have not reviewed the [Jacobs] modelling or raw results of the additional model runs ... It would be prudent for GWRC to walk over the sites ... to confirm that the results are sensible and appropriate."* OIA – Beca Memo 1-3-2017

#### 4. How the major error in the flood model shows up: 1976 flood - eye-witness 'ground-truthing'



- The December 1976 flood was massive: *“it is estimated ... a 500 to 3,000 year return period”* (G. Horrell, 10-8-2018)
- GWRC’s 100-year flood extent goes 60m beyond the 1976 flood (red line) at 44 Whitemans Rd
- The 1976 flood did not breach the road gutters in Fendalton Road at John & Angela Campbell’s property
- The 1976 flood did not enter Kate Turner’s house (reached red line) on her sloping property at 107 Pinehaven Rd

## 1976 flood - eye-witness 'ground-truthing' - continued



- GWRC Pinehaven flood map (2015)
- The 1976 flood came up the driveway at 138 Pinehaven Rd to the green line (see above) – (Kevin Keown, resident)
- GWRC's flood map predicts 100-year flood will rise 700mm higher (blue line) than the 1976 flood (green line)
- GWRC's freeboard is 1.5m (yellow line) above the predicted water level (blue line); it's supposed to be 30cm !

## 4. How the major error in the flood model shows up:



### Case Studies (Dec 2014)

Case Study 1: 27 Elmslie Rd  
~ 15\*m<sup>3</sup>/s vs ~4.5\*m<sup>3</sup>/s

Case Study 2: Dunns Street  
~ 77\*m<sup>3</sup>/s vs ~25\*m<sup>3</sup>/s

Case Study 3: Pinehaven Reserve  
~ 50\*m<sup>3</sup>/s vs ~16\*m<sup>3</sup>/s

Top of  
Case Study 4: Pinehaven Road  
~ 19\*m<sup>3</sup>/s vs ~5\*m<sup>3</sup>/s

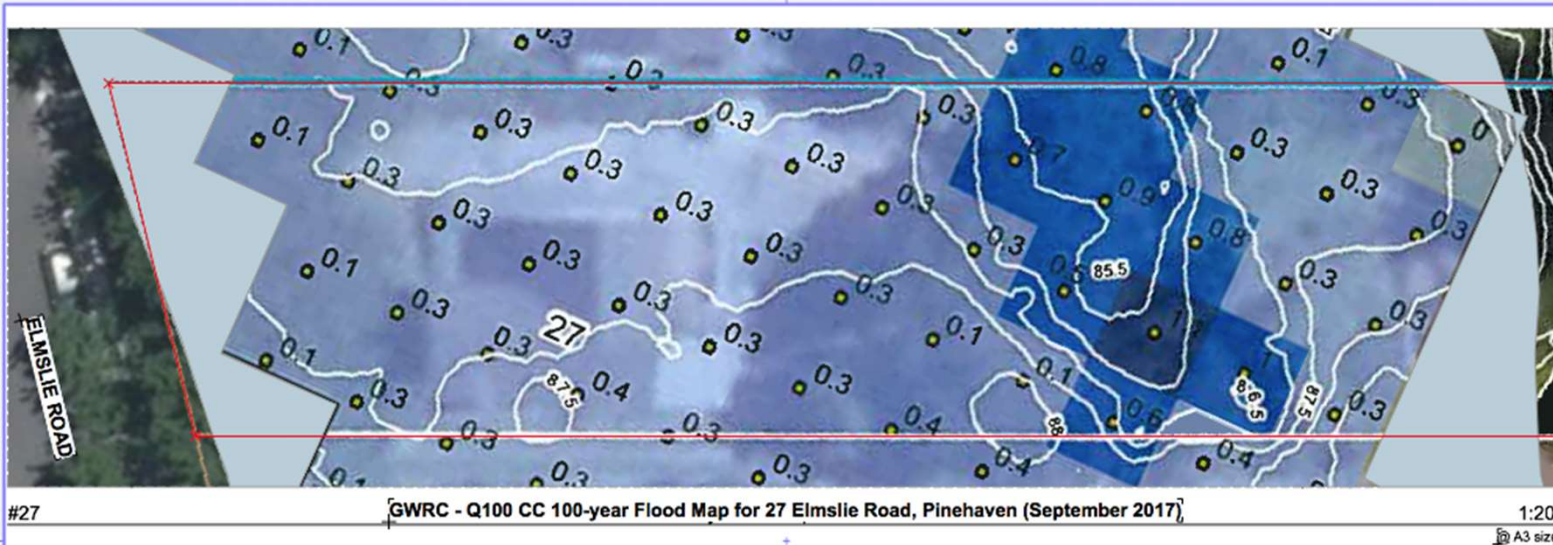
\* After removing 30cm freeboard

## Four case studies

- Cross-sections were surveyed at each of these 4 locations (Co-Design Architects Ltd)
- GWRC's predicted 100-year flood levels were added to the cross-sections
- 30cm of freeboard was deducted from the water level in the cross-sections
- The cross-sectional area of water was multiplied by an assumed flow velocity of 1m/s to give an estimation of the volume of flow at each location
- **At all 4 locations the volume of flow is at least 3 times more than GWRC's published data for 100-yr flow at these locations**



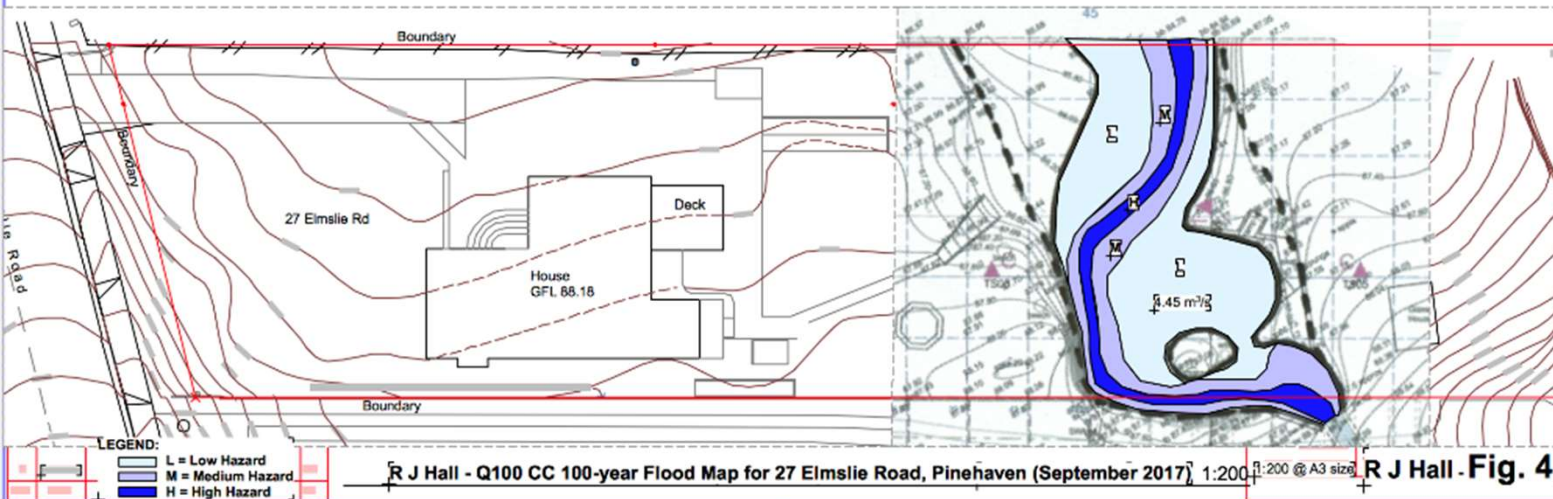
## 5. Large errors in Council flood map for 27 Elmslie Road, Pinehaven



GWRC 100-yr flood map, 27 Elmslie Road, Pinehaven:

~ 15m<sup>3</sup>/s without freeboard

~ 33m<sup>3</sup>/s with freeboard, i.e. more than the peak flow for whole catchment in 1976 flood estimated at 30m<sup>3</sup>/s - see R.G. Bishop 1977 and G. Horrell, 10-8-2018)



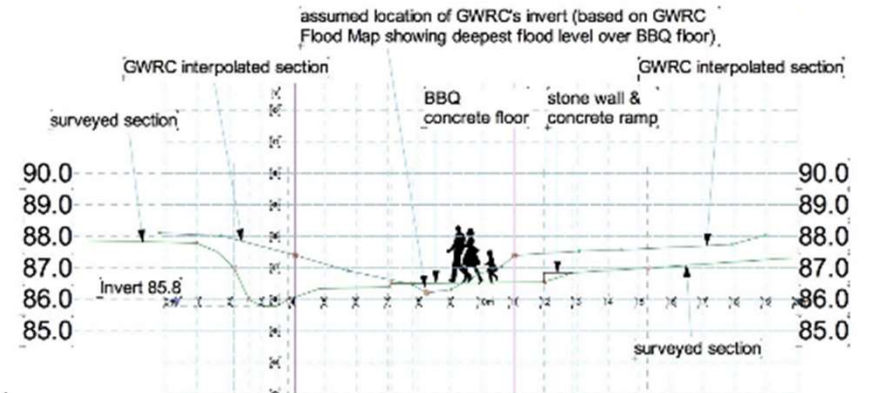
RJ Hall & Assoc. 100-yr flood map - 27 Elmslie Rd. Calculated 100-year flow at 27 Elmslie Rd, 4.45m<sup>3</sup>/s (RJ Hall & Assoc.)

GWRC published data for 100-yr flow at 27 Elmslie Rd is similar, 4.8m<sup>3</sup>/s

## 5. Large errors in Council flood map for 27 Elmslie Road, Pinehaven



Horizontal error in location of stream = 8m  
Vertical error in ground height = 0.5m to 1.8m



### Channel Section Y-Y (based on Topo. Survey) compared with GWRC Interpolated Section at Chainage 640

Scale 1:200 @ A4 size

0 1 2 3 4 5 m



### Channel Section M-M (based on Topo. Survey) compared with GWRC Interpolated Section at Chainage 650

Scale 1:200 @ A4 size

0 1 2 3 4 5 m

## Auditor misrepresents 100-yr flooding at 27 Elmslie Road

- Auditor's diagram (below) dismisses Case Studies 1 – 4, yet it is clearly not applicable to Case Study 2 (Dunns St)
- Nor is it applicable to Case Study 1 (27 Elmslie Road) but original data for 27 Elmslie Road has been altered to suit Auditor's diagram below to dismiss Case Study 1
- Diagram below confuses flood level with overland flow – a serious mistake (see next slide regarding Case Study 4)

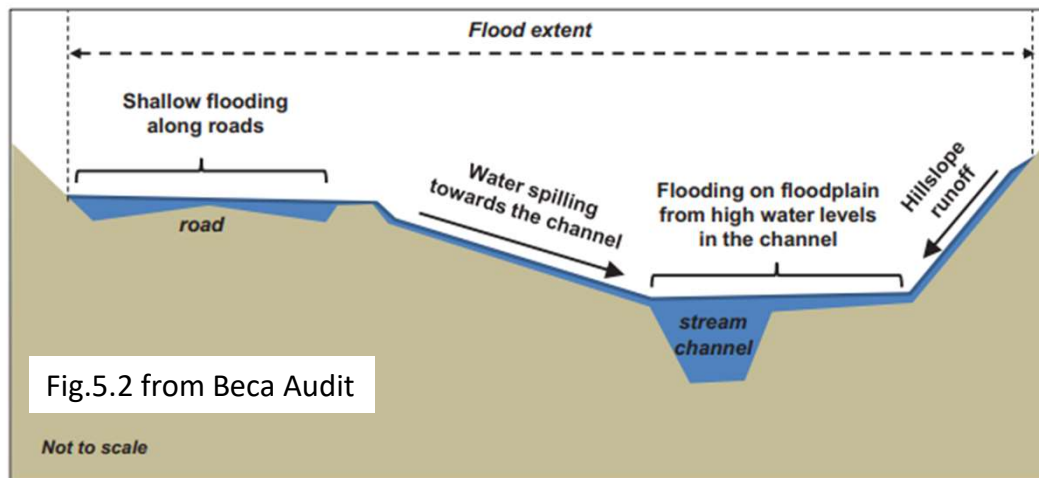
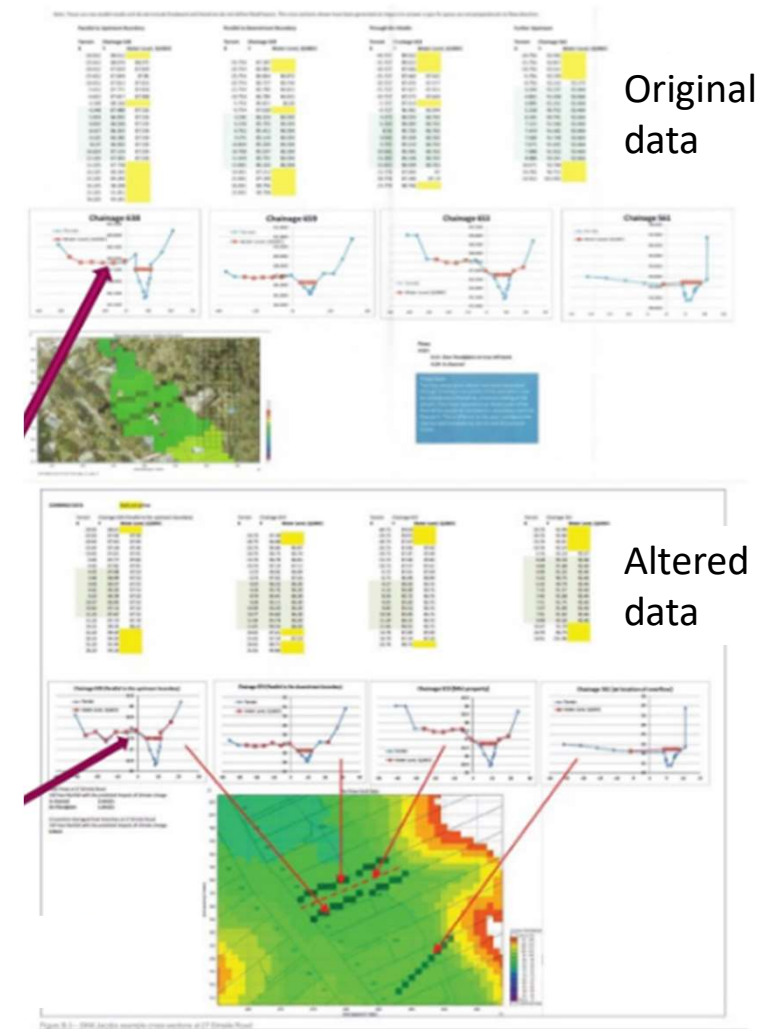


Figure 5.2 Flood extent elements

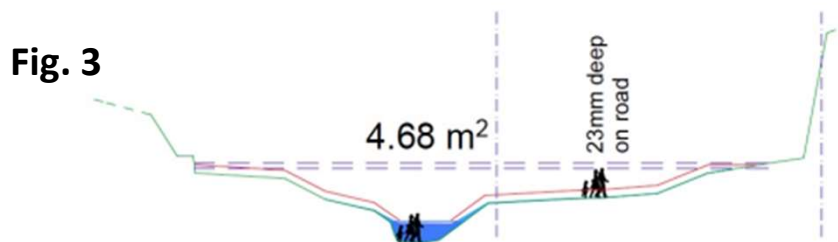
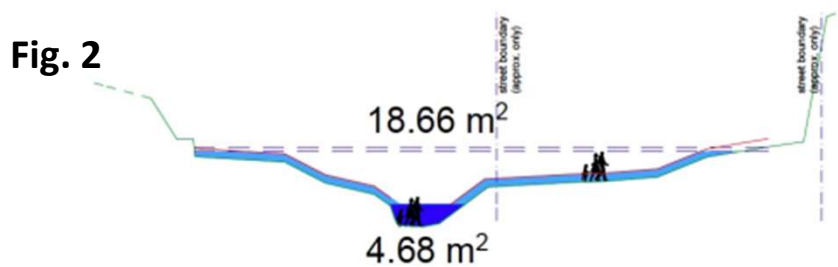
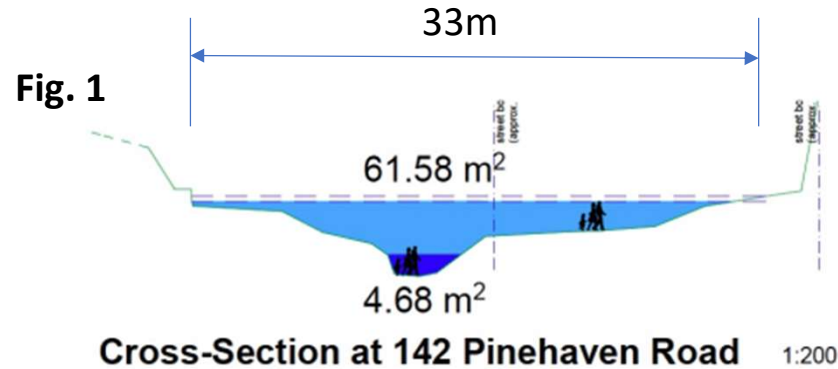


## Case Study 4 – Top of Pinehaven Road: The danger of representing overland flow as flood level

1. In their unconvincing explanation as to why future development modelling did not create any extra flooding in Pinehaven, SKM (2010 Vol 1 p30) state: *“The steep topography of the catchment appears to constrain the overflows in the upper catchment”.*

But what is really happening is that by combining overland flow (Fig. 2) with  $4.68\text{m}^3/\text{s}$  flood flow (Fig. 3) in their flood map (far right), the massive extra runoff from large-scale future development is masked.

2. Overland Flow - the Legend in SKM’s Vol. 2 (2010) flood maps describe light blue shading (in flood map far right) as “0 – 500mm”. This must be overland flow. According to SKM, it could be up to 500mm deep, creating a 33m wide floor extent (far right) of about  $19\text{m}^3/\text{s}$ , about 4 times more than there should be (and this is without including 30cm of freeboard)!
3. As in Figs. 1 & 2, 300mm (30cm) of freeboard has been removed in Fig. 3 to show the extent of 100-year flood flow at this location in the catchment calculated by SKM to be  $4.68\text{m}^3/\text{s}$ . Fig. 1 shows the extent of  $4.68\text{m}^3/\text{s}$  of flow as described to the writer by the GWRC Pinehaven flood Project Manager, viz. that there is 23mm of water on the road (cul-de-sac) feathering out to 0mm on the far (right) side of the road, and 40mm depth at the edge of the channel and the rest of the flood water in the channel.



Pinehaven Rd Aerial 1:1000

Assuming a flow velocity of 1m/s, GWRC's flood map at 142 Pinehaven Rd is showing about **~19 m<sup>3</sup>/s** (after deducting freeboard), which is 3 times GWRC's calculated flow of approximately 4.7 m<sup>3</sup>/s.

## 6. Why are there so many anomalies in Pinehaven flood maps?

- SKM (2010, Vol. 1, p7 & p21) report that there was no rainfall data for Pinehaven catchment due to a “malfunction” of the Pinehaven raingauge when they did the Pinehaven flood hazard assessment. This is incorrect. [OIA) GWRC removed the Pinehaven raingauge from the catchment from 2008 -2010 while the flood study was being done;
- GWRC’s Pinehaven flood model is based on just one storm 23 July 2009 for which:
  - there is no rainfall data (due to GWRC removing the Pinehaven raingauge)
  - there was only one piece of measured data for this storm, the depth of flow (1.6m) at the stream gauge (at Whitemans Rd), but SKM didn’t use it
  - instead, SKM used their field observations because they said they gave a better match to their flood model than the flow depth did at the stream gauge
  - in an OIA response GWRC would not release SKM’s field observations without payment (about \$10k), so the public have no ready access to SKM’s ‘field observations’ for the flood on 23 July 2009
  - no specific eye-witness observations were published except for 3 photos in Birch Grove (SKM 2010 Vol. 1, p41)
- The published record shows that GWRC gave consultants the results, and the consultants produced them
- *“Relying on a single flood event with an incorrect flow peak coupled with the lack of any Pinehavencatchment rainfall for callibration, followed by the lack of testing against actual data makes their[MWH] analysis invalid. Any further use such as inputs into a hydraulic model will result in large errors ...” G. Horrell, 27-11-2020*



■ **Figure 19 Current Existing vs. Future Case Compar the Q<sub>100</sub> with Climate Change.**

## Sponge or Rock?

According to Greater Wellington Regional Council, Upper Hutt City Council and Wellington Water Ltd, and their consultants, auditor and commissioners, catchments like the sponge and the rock have about the same water absorption properties!

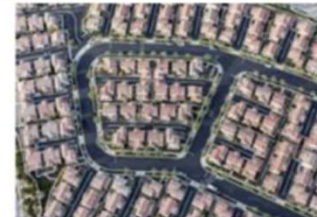


### How do we know?

According to the Councils, if 1,665 new houses (like the rock) are built on Guildford Timber Company land in the catchment of Pinehaven Stream on Pinehaven hills it will make no difference to stormwater runoff or flooding than when the hills are covered like they are now with forest and bush (like the sponge). This is grossly incorrect. It has dire consequences for our community if Councils' flood model is not fixed!



How the existing hills should be modelled; lots of new housing replacing trees would show lots of extra runoff that developer must manage on site.



Council modelled existing hills as if like this, so extra runoff from new housing goes undetected and is allowed to flood community downstream.

### How Did the Councils Grossly Exaggerate the Pinehaven Flood Maps?

Greater Wellington Regional Council (in partnership with Upper Hutt City Council) has used inaccurate assumptions that exaggerate the Pinehaven flood maps:

**1. GWRC's model assumes that the Pinehaven hills, instead of being covered with forest, are bare and hard. Therefore, in Council's model, nearly all rainfall runs off the hills ...**



Instead of modelling the forest like this ...

Council modelled the forest as if it's like this!

Council's flood model assumes that during storms nearly all rainfall runs off the hills, causing massive flooding in Pinehaven and Silverstream. This isn't so. On-site tests have shown that the forest soaks up huge volumes of rainfall, significantly reducing runoff and flooding. Take the forest away, like Council did in their model, and flooding increases dramatically.

*[MWH's Hydstra hydrological model of the Pinehaven catchment assumes 5mm Initial Loss and 2mm/hr Continuing Loss. By back-calculating, R J Hall & Associates Ltd found that this is equivalent to a CN (rainfall loss) value of CN96 in HEC-HMS, similar to an asphalt carpark. The forest has infiltration rates ranging from 500 to 900 mm/hr, determined by field tests.]*

**2. All the rainfall coming down off the hills in Council's model floods overland because Council's model assumes all channels upstream from Pinehaven Reserve are blocked up...**



Instead of modelling the streams like this ... Council modelled the streams totally clogged!

In Council's flood model, all stream channels in Pinehaven Rd Elmslie Rd, Forest Rd, Jocelyn Cres are clogged up; floodwater has nowhere to go except all over everybody's properties.

*[In the upper catchment SKM's hydraulic model assumes Manning's n = 0.2 channel roughness]*

**3. Council's model blocks culverts ... then assumes extra flood depth again for blockages!**



Council's flood model assumes all culverts up to 1.2m diameter are 100% blocked, sending floodwater out over roads and properties. This is one way of allowing for blockages in a storm.

But then Council increased the flood depth in their model a second time for blockages as another fudge factor.

**4. Council's model assumes the 2.1m dia. pipe installed after the 1976 flood isn't there.**



The photo (left) shows the 2.1m diameter pipes that were installed in Whitemans Road after the 1976 flood to improve drainage. By adding this large pipe alongside the existing 1.8m pipe, the capacity of the drainage down Whitemans Road was doubled. But Council's model assumes both large pipes are 50% blocked, which is the same as assuming the newer one is 100% blocked. This effectively removes the new big pipes, making Council's model of the drainage system in Whitemans Road like it was before 1976.

**5. Council's model assumes the Hulls Creek detention dam isn't there.**



After the 1976 flood a detention dam was built to hold water from Heretaunga back so that during a big storm the water level in Hulls Creek would be low, allowing the Pinehaven Stream to empty out into Hulls Creek, reducing flooding in Silverstream. Council's model assumes a high water level in Hulls Creek (as if the detention dam isn't there), increasing flooding in Silverstream.

The combination of these wrong or inaccurate assumptions results in grossly exaggerated flood maps of the situation in Pinehaven and Silverstream as it is now (before any Guildford development on the hills). An inflated baseline model defeats 'stormwater neutrality' rules, resulting in two very negative outcomes for Pinehaven and Silverstream: 1) there will be much bigger floods in future if a large-scale Guildford development is built on the hills; and 2) ratepayers pay for dealing with Guildford's floodwater which Guildford should be dealing with on site. This is all because of Council's flawed model; the baseline model must be fixed!

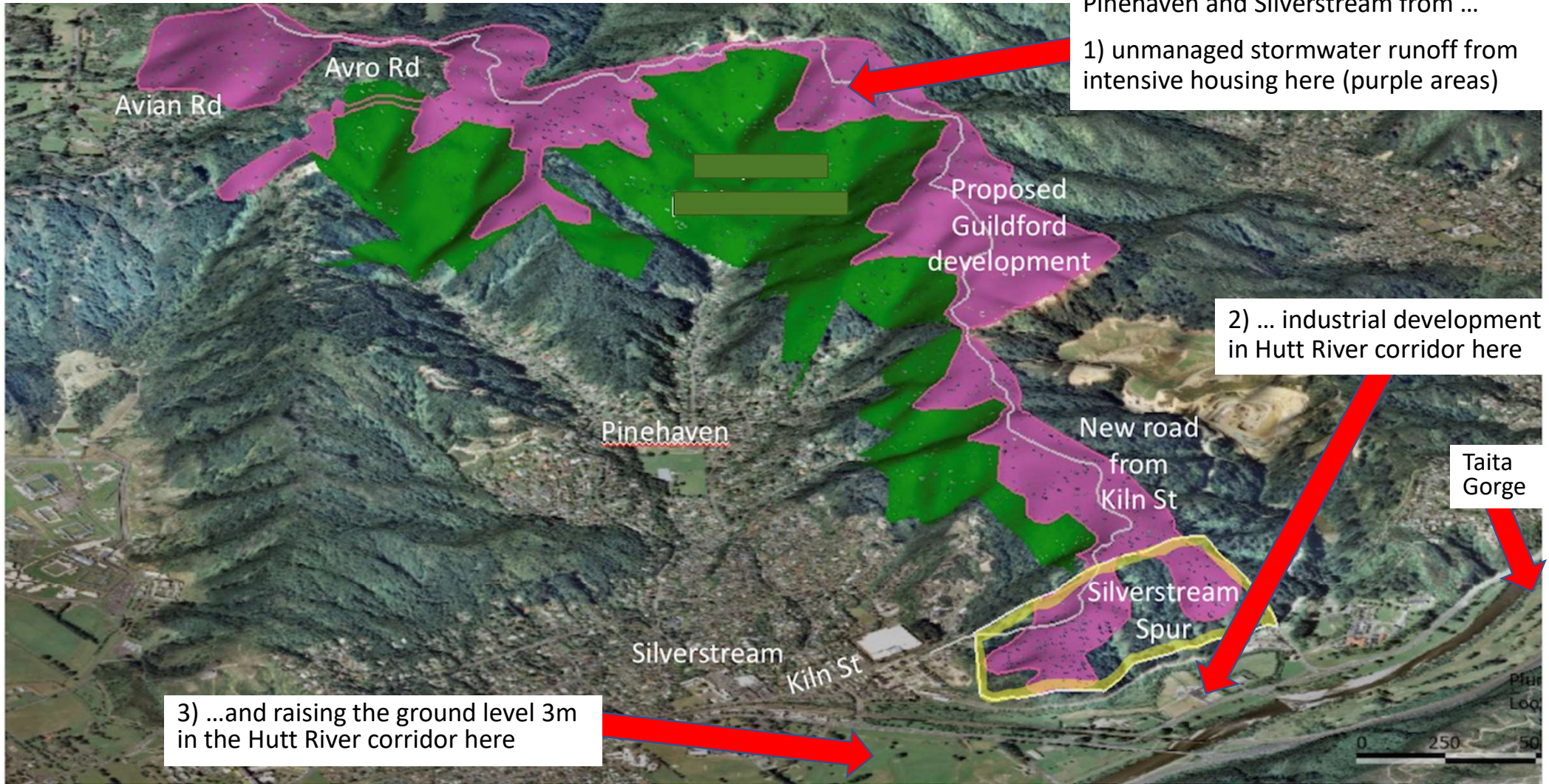
## How might all this development affect flooding in Pinehaven and Silverstream?

What would be the impact on flooding in Pinehaven and Silverstream from ...

1) unmanaged stormwater runoff from intensive housing here (purple areas)

2) ... industrial development in Hutt River corridor here

3) ...and raising the ground level 3m in the Hutt River corridor here



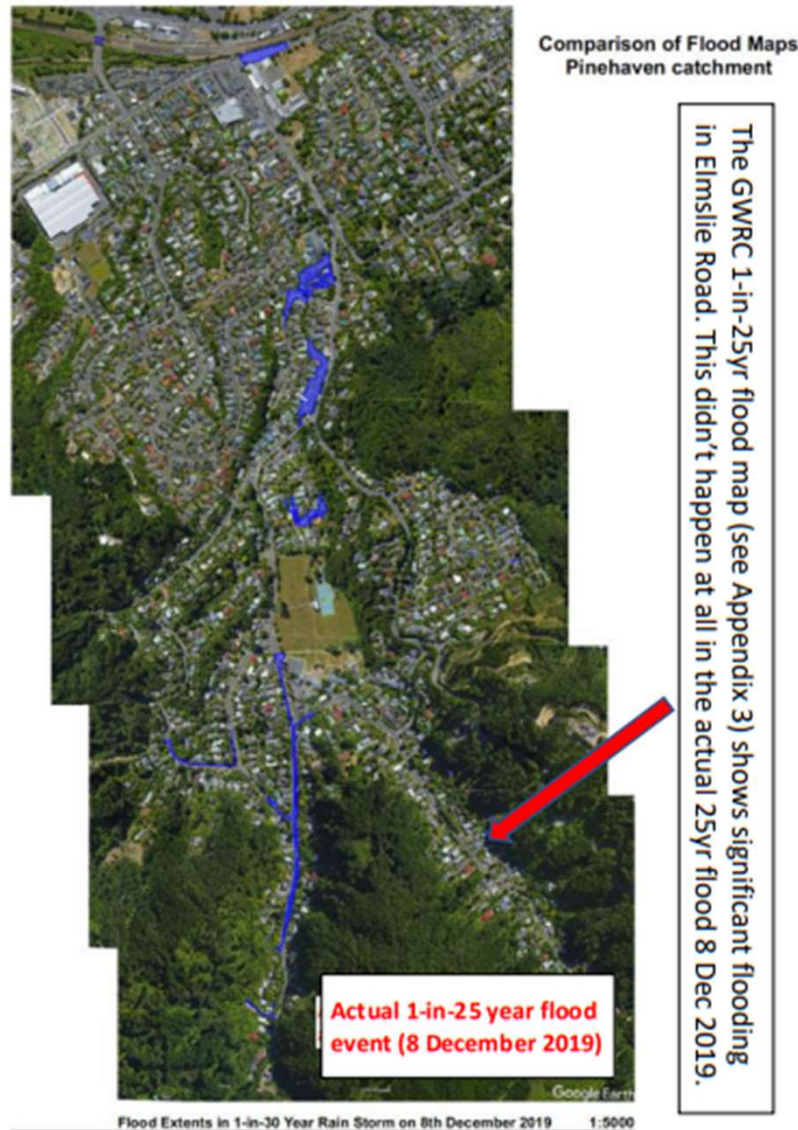


## 7. Pinehaven 1-in-25 year flood 8 December 2019



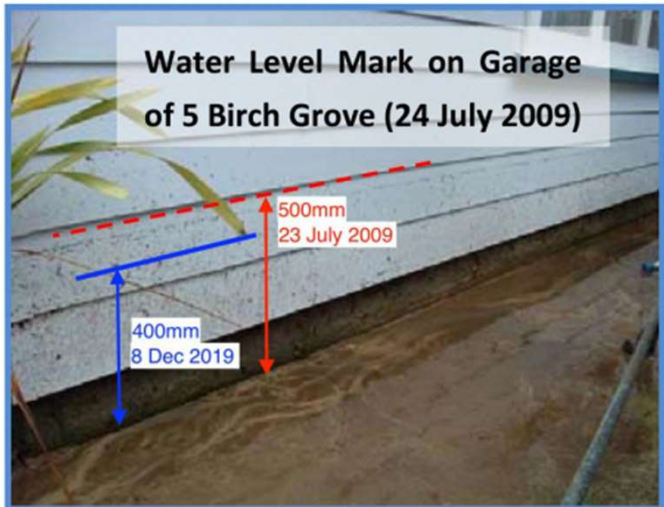
GWRC's 25-year flood map (above) looks nothing like actual 1-in-25 year flooding on 8 Dec 2019 (right)

Even GWRC's 10-year flood map (far right) far exceeds actual flood extents observed on 8 Dec 2019



The GWRC 1-in-25yr flood map (see Appendix 3) shows significant flooding in Elmslie Road. This didn't happen at all in the actual 25yr flood 8 Dec 2019.

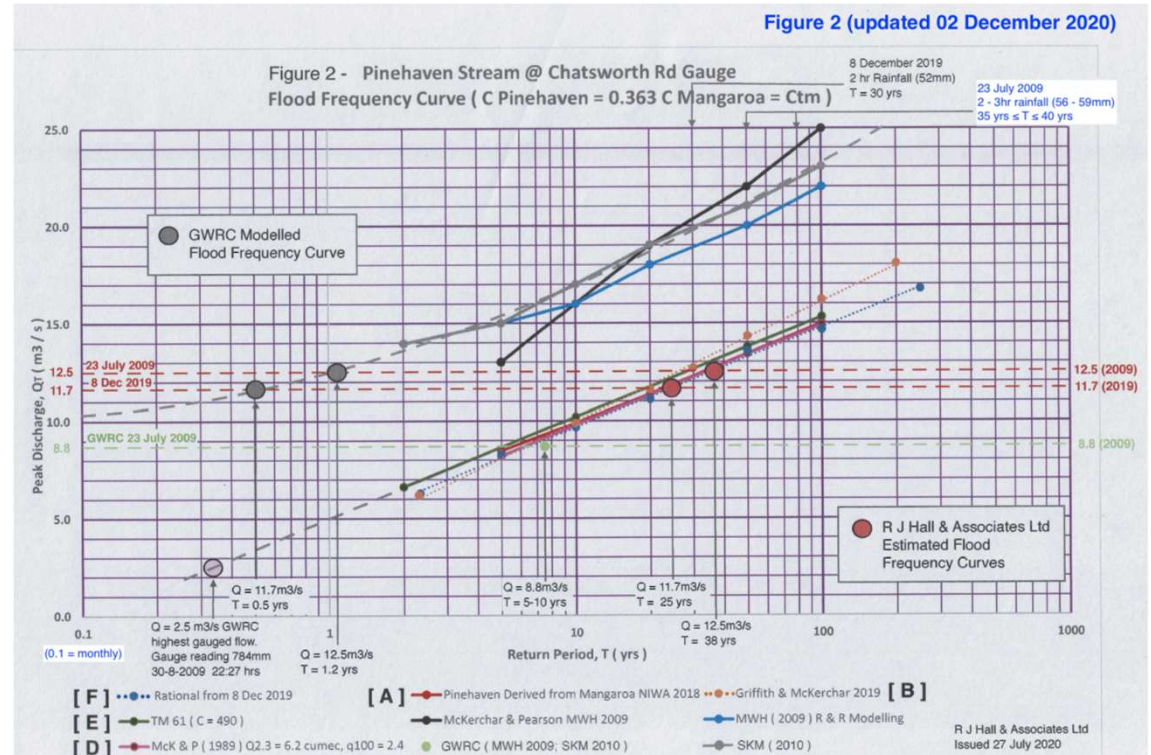




5 Birch Grove – 23 July 2009 flood was bigger than 8 December 2019 flood



12 Birch Grove – 23 July 2009 flood was bigger than 8 December 2019 flood.



- “This [RJ Hall graph above] is a thorough reality check ...” (G. Horrell, 31-7-2020)
- 8 Dec 2019 was in the order of a 1 in 25 year flood event (RJ Hall, 23-6-2020)
- 23 July 2009 was a 1-in-40 year flood event (RJ Hall, 27-7-2020, updated 3-8-2020)

## 8. Consequences of unreliable base flood model

- i) **No hydraulic neutrality** for GTC development; no flood protection for Pinehaven
  - IPI HBA for 'Southern Growth Area' (GTC development) is 1,960 to 2,857 lots (up from HBA 2017 estimate of 1,000 lots)
  - Showing properties in flood zone that aren't, devaluing property, increasing insurance and restricting development opportunities
  - No hydraulic neutrality means a **future disaster and risk to human safety** worse than 1976 flood (see later slide for photos of 1976 flood)
  
- ii) **Unnecessary expenditure** on replacing Pinehaven Road culvert ~\$5M (originally estimated by GWRC at about \$1M)
  - Existing culvert coped well with 25-yr peak flood flow on 8 Dec 2019
  - Condition of existing culvert was good for another 30 years (A.K. Ross)
  
- iii) **Over-engineered Pinehaven Streamworks** (capacity in excess of 100-year flood) costing about \$20 - \$35M (?)
  
- iv) Loss of connection with all historical flood flow data due to destruction of perfectly well functioning Pinehaven Stream gauge site (Whitemans Rd)

## Unnecessary expenditure on replacing Pinehaven Road culvert ~\$5M

### PINEHAVEN ROAD CULVERT

The Pinehaven Road culvert did not overtop during peak flow in this 1-in-25 yr flood event

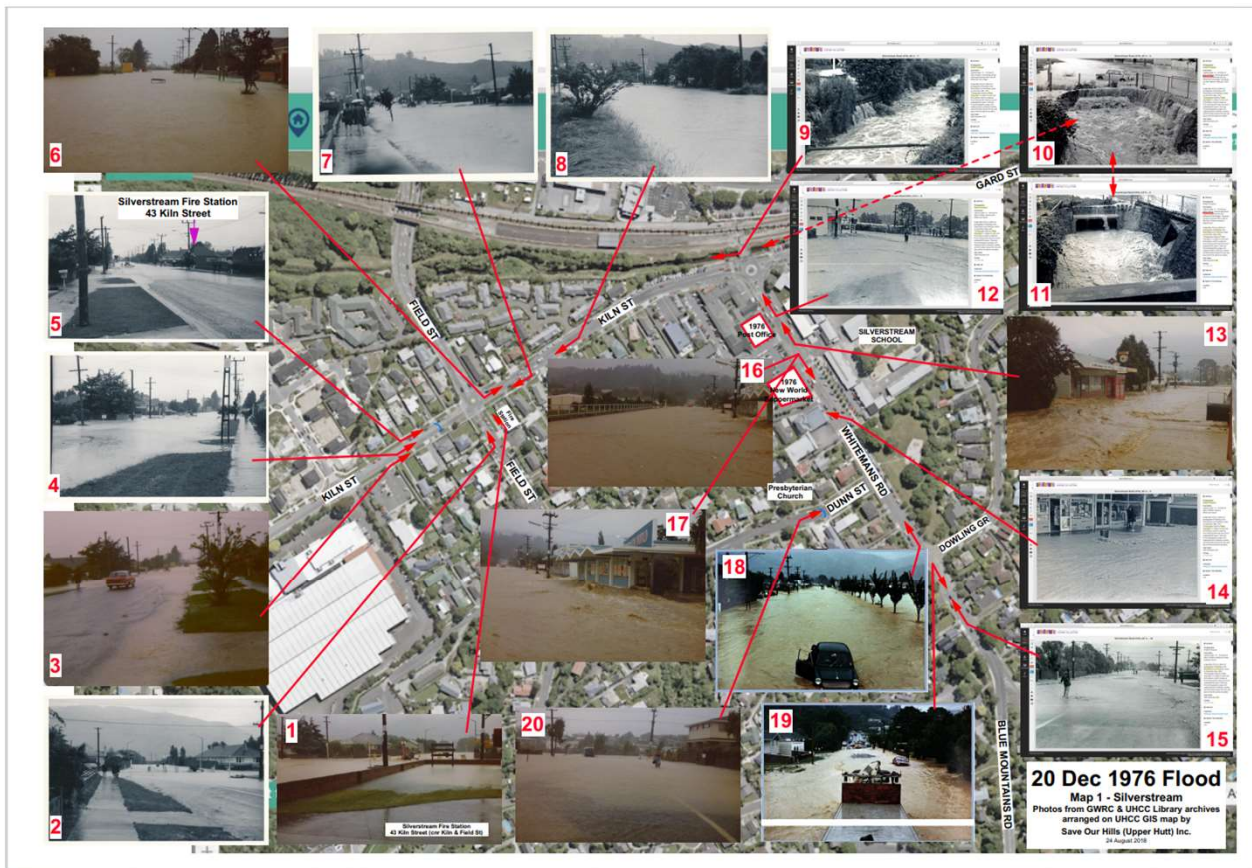


8 December 2019 6:36am Screenshot from movie (44 seconds) of 1-in-25yr flood at peak flow at upstream intake of the Pinehaven Road culvert at the intersection of Pinehaven and Blue Mountains Roads. The movie and this screenshot from it show that the Pinehaven Road culvert coped perfectly well with the 1-in-25yr peak flow without overtopping.



## 9. Potential future disaster of human making if flood model not rectified

The result of about 2,500 GTC development lots in 'Southern Growth Area' on Pinehaven hills coupled with no hydraulic neutrality would be a disaster for worse than this huge storm in Pinehaven and Silverstream 20 Dec 1976.



## 10. What needs to happen now?

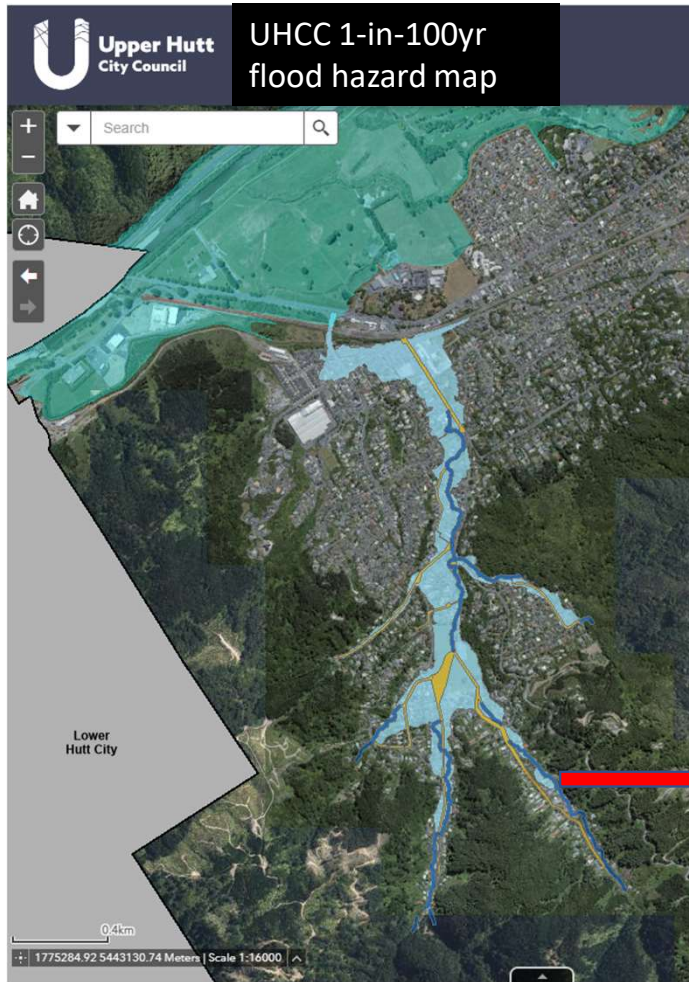
- *“the hydrology being used to inform the flood extent mapping, the effects of future urban development and the intended upgrades to be undertaken in the lower reaches of the catchment grossly overstates the runoff volumes to be expected from the catchment in its present state” (RJ Hall & Assoc., 2-12-2020)*
- *“The effect of overstating the pre-development storm runoff peak flows and volumes ... significantly diminish(es) and misrepresent(s) the actual scale of the changes that should be expected when development of [GTC] kind takes place. Any attempt to apply hydraulic neutrality procedures to this situation will clearly produce spurious results, **and hydraulic neutrality will not happen**” (RJ Hall, ibid.)*
- *“no reliance should be placed on the ... work by MWH, SKM, Beca and Jacobs ” (RJ Hall, 5-11-2019)*
- *“Pinehaven and Silverstream communities, instead of being protected by PC42 rules from increases in flooding due to future Guildford development, will actually be exposed to significant increases in flood risk to life and property from future developments such as those proposed in Guildford scenarios ...*
- *“We conclude Jacobs’ error can only be remedied by rejecting the hydrological and hydraulic modelling to date and doing it again using reasonable and representative runoff hydrographs for pre- and post-development situations.” (RJ Hall, 5-11-2019, peer reviewed G Macky 14-11-2019; G Horrell 31-7-2020)*

## **Update the flood modelling and mapping immediately ...**

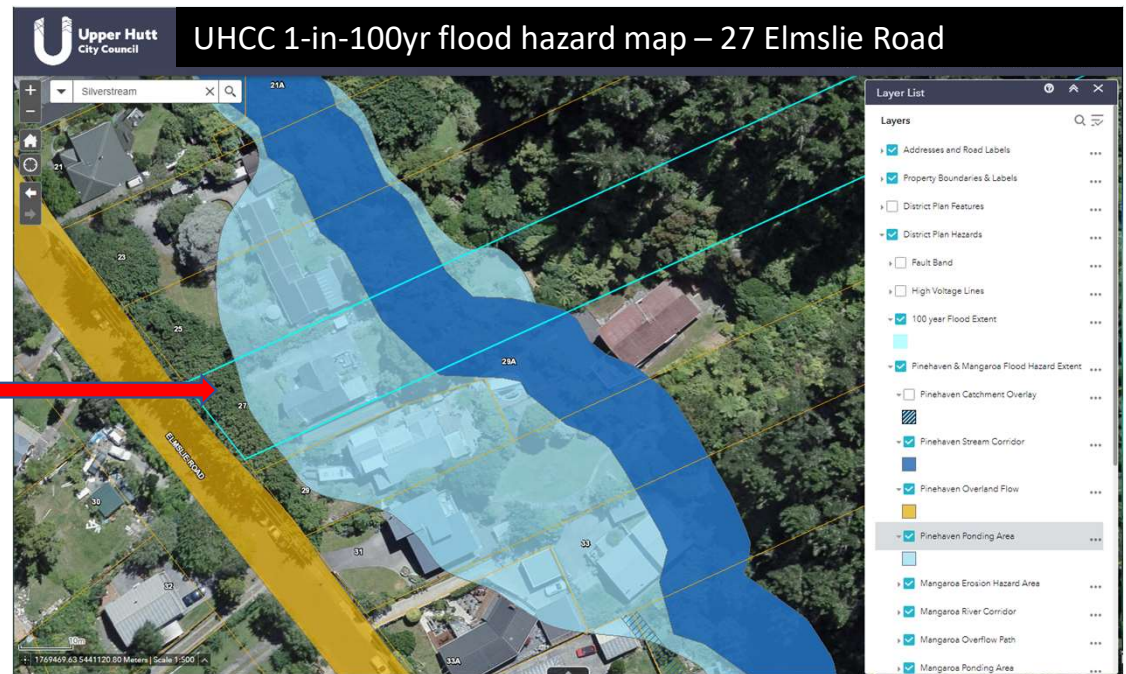
- GWRC's Pinehaven base flood model is now 15 years old
- The flood modelling is out of date regarding more recent rainfall and flood information
- The modelling uses a very crude 5m x 5m LiDAR grid resulting in large topographical errors
- Channel cross-sections are inaccurate, being interpolated between channel surveys up to 150m apart
- Very crude Manning's 'n' coefficient assumes upper catchment stream channels are totally filled in
- No account of the effect of buildings or fences on flood flow other than very crude floodplain coefficient
- GWRC removed the Pinehaven raingauge from the catchment while doing the flood model study
- Unthinkably, GWRC removed the stream gauge recorder causing the loss of 10 years of stream flow data

## **The flood model and maps urgently need updating with better inputs ...**

- *“Laser topographical mapping - called LiDAR – [gives] details down to the centimetre and could be used to help accurately plot flood risk”* (Climate Sigma, Belinda Storey, Many flood-damaged homes should not be rebuilt, says climate risk expert, Stuff News, 28-2-2023)
- The forested hills have a very high infiltration rate 500mm-900mm/hr (Council flood model uses 2mm/hr)
- Use more realistic channel and floodplain coefficient inputs that better reflect the existing situation
- Reinstate the stream gauge to collect more stream flow data for future flood model updates
- Do not use the same consultants responsible for the current flood model and flood mapping



Urgently **update** the flood model and maps for 27 Elmslie Road with better model inputs ...





## **I seek the following decisions:**

- Reject the current unreliable flood hazard maps as a 'qualifying matter area' for 27 Elmslie Road specifically;
- Ditto for Pinehaven and Silverstream generally;
- Re-assess the flood hazard zones for Pinehaven Stream using accurate input parameters that are truly representative of the catchment to provide:
  - a reliable base model for assessing hydraulic neutrality of future development
  - accurate and reliable flood hazard areas
  - accurate and reliable 'qualifying matter areas'

## **Reasons:**

- I support qualifying matter areas, but only for areas that are genuine qualifying matters;
- The current flood hazard maps for Pinehaven Stream are grossly inaccurate and cannot be relied on to show a genuine 'qualifying matter area';
- The current flood hazard maps falsely show properties, including 27 Elmslie Rd, in a flood zone when in fact they are not, and prevent what would otherwise be appropriate potential development under MDRS.