BEFORE THE HEARING PANEL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of Proposed Plan Change 26 to the Operative Waipā District Plan

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SUPPLMENTARY STATEMENT OF EVIDENCE OF MICHAEL GEORGE CHAPMAN

Dated 2 May 2023

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INTRODUCTION

1. This supplementary statement of evidence responds to the Commissioners' request for an example of the difference between 40% and 50% site coverage in terms of the stormwater effects.

FLOODPLAIN INFILLING

2. This memo is in response to Commissioner Mark Nigel-Brown's enquiry as to relative impacts of infill for 40% building coverage versus 50% coverage.
3. The current WDC flood modelling for the stormwater overlay does not consider impacts of site coverage (building footprints) on flood storage and impacts of maximum probably development.

4. A representative sample ponding area in Cambridge was chosen to estimate impacts of infilling (refer to figure 1).

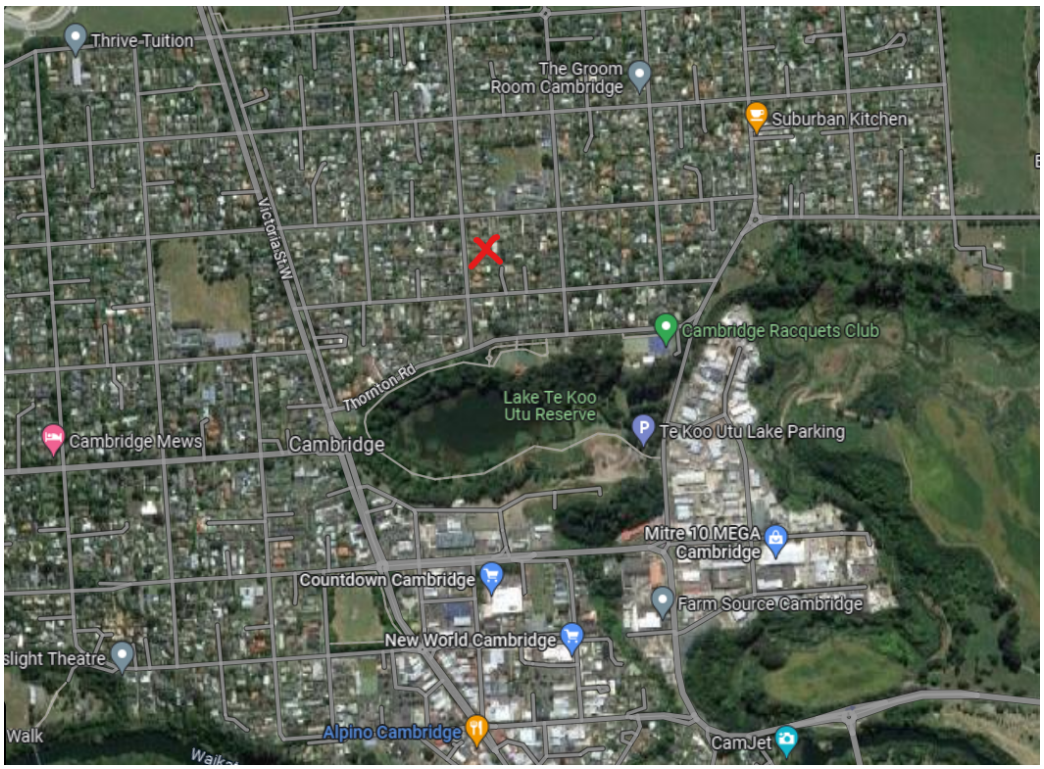


Figure 1 – Approximate location (red cross) of ponding area.

5. Flood modelling results (used for the stormwater overlay) were exported directly from Waipa Council's flood model and clipped to the area of interest (Figure 2). The maximum flood level in the existing scenario is 68.0m RL (Moturiki).

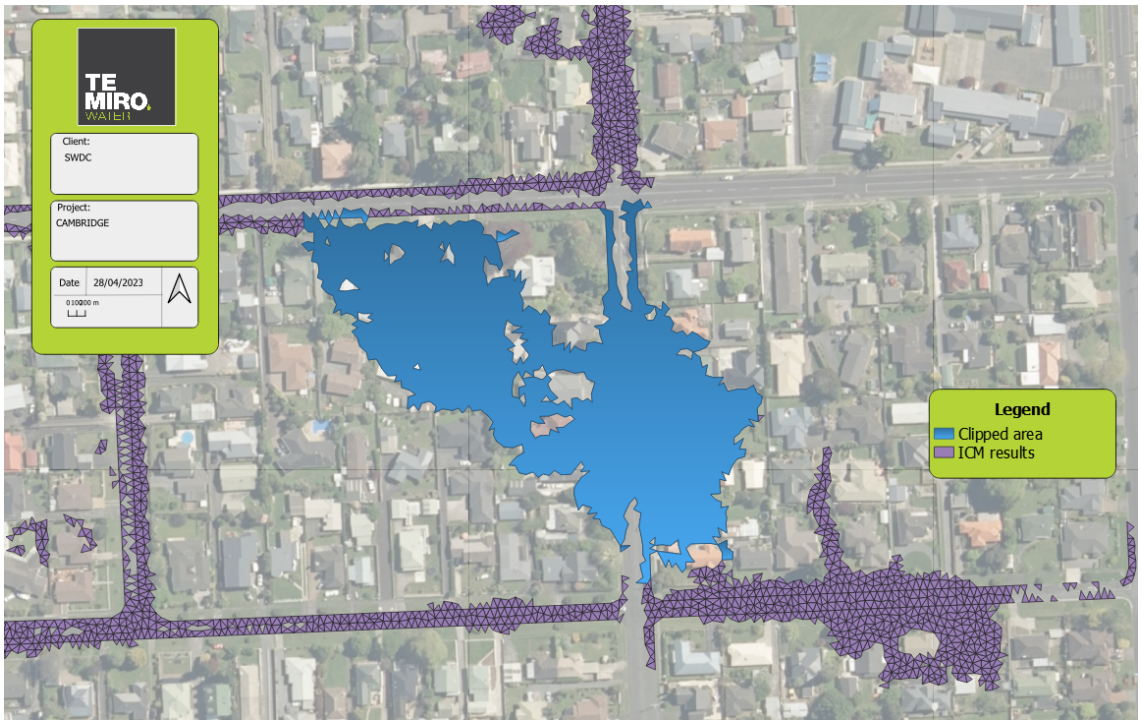


Figure 2. ICM results and clipped area

6. 2019 LIDAR, with heights in terms of Moturiki 1953 vertical datum, was used to capture the area (sqm) per 0.1m contour interval see Figure 3:

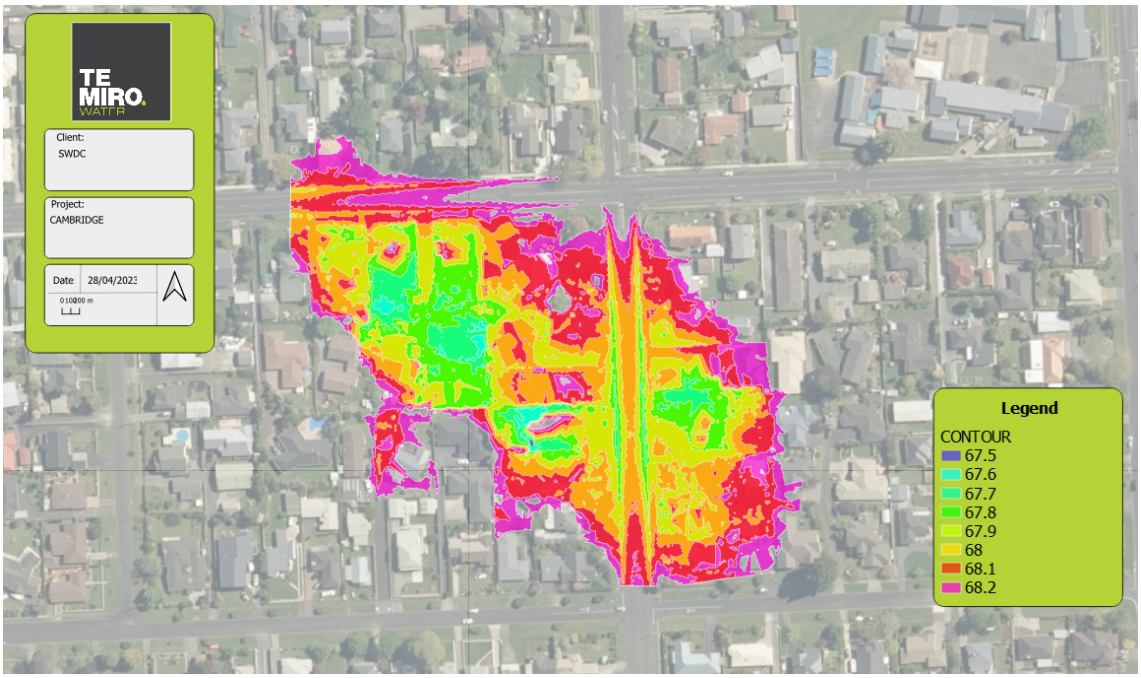


Figure 3. LIDAR contours areas

7. An elevation/volume table was created using 0.1m slices of ground. The results are provided in Table 1:

Table 1

Elevation	Area (m2)	Volume (m^3)	Cumulative Volume (m^3)
67.5	4.8	0.2	0.2
67.6	200.7	10.3	10.5
67.7	1392.1	79.6	90.2
67.8	4195.5	279.4	369.5
67.9	8816.5	650.6	1020.1
68.0	14142.0	1147.9	2168.1
68.1	19977.5	1706.0	3874.0
68.2	24180.2	2207.9	6081.9

8. The maximum flood level in the existing case is 68mRL, therefore the total ponding volume at that level is 2168 m^3 (see yellow row in Table 1).

9. We undertook 2 scenarios:
    a. Site coverage = 40% so the ponding area is covered by buildings (infilled assuming solid foundations).
    b. Site coverage = 50% of the ponding area is covered by buildings (infilled assuming solid foundations).

10. The existing buildings will result in displacement of floodwater and increase in water levels. To assess the effect of infilling we increase the cumulative volume to account for the volume the buildings are occupying – in other words 'the displacement volume'.

MODEL OUTCOMES

11. Once we estimate the volume displaced by buildings, we add that volume to Table 1 to find the new flood elevation for both scenarios (a + b):

    a. For the 40% building coverage → volume displaced increased by 40% as:

Current volume = 2168*1.4 = **3035m^3**
New flood elevation = **68.05m RL (50mm increase)**

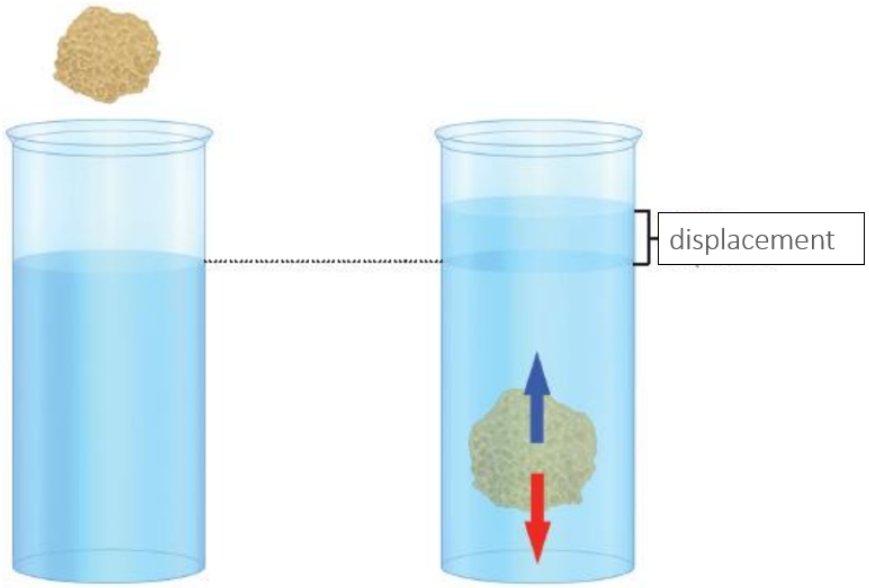
(displacement = water + buildings)

b. 50% of the area was covered by buildings. → Volume increased by 100%

Volume =2168*1.5 = **3252m3**

New flood elevation = **68.06m (60mm increase)**

A 10mm increase going from 40% to 50% site coverage,



12. Figure 4 shows the flood extent (blue) for the existing land use and then adding 40% or 50% site coverage which extend the floodplain outwards (pink/black outline).

Figure 4. Flood extents

13. A review of the existing site coverage (Figure 5) inside the 100yr flood extent (house roof areas) suggests that – in this example - 25% of the ponding area is covered by buildings.

Total ponding area (m^2)	Total site coverage (m^2)	% of site coverage
14,141	3,559	25%

Figure 5. Building outlines (site coverage).

14. Table 2 and Figure 6 show the number of households potentially affected by an increase in flood level caused by an increase in building coverage from 40% to 50%.

Table 2

Scenario	Number of buildings touched by the flood extent
Existing scenario	28
40% of the area was covered by buildings.	33
50% of the area was covered by buildings	33

15. I note that Table 2 assumes that each site is occupied by a single building having a site coverage of 40 or 50%. If the number of dwellings was increased to three dwellings per site, there would be three times as many households affected by the flood extent.

Figure 6. Buildings affected by ponding.

CONCLUSIONS

16. The current WDC flood modelling does not account for impacts of infilling (another brick in the bathtub) ie, no voids or ability for floodwater to pond under the house.

17. A sample ponding area in Cambridge was chosen to undertake an estimate of infill impacts on flood levels.

Two site coverage scenarios were assessed:

a. 40% site coverage results in a 50mm increase in ponding depth.
b. 50% site coverage results in a 60mm increase in ponding depth.
c. A 20mm increase in ponding occurs moving from 40% to 50%.

18. The assessment highlights the impacts of incremental infill of floodplains. A relatively small increase in flood depth (20mm) occurs due to a 10% increase in site coverage.

19. Overtime these small increases could result in an adverse impacts if mitigation measures are not put in place such as:

    a. Avoiding infill in floodplains (avoid increasing risk).
    b. Providing equivalent flood storage volume elsewhere within the ponding area.
    c. Providing void spaces under the finished floor level that remain 'open' in perpetuity with safe ingress and egress of floodwater.
    d. Flood resilient and flood proofing methods to protect people and property.

Michael Chapman
Dated 2 May 2023