SUMMARY STATEMENT

1. My name is **Ben Liley**. I am an Atmospheric Scientist with NIWA, specialising in solar radiation, including its health effects (UV) and applications in energy efficiency and solar power.

2. I have prepared evidence on behalf of the **Christchurch City Council** (the **Council**) to understand the effect on sunlight access and incident solar energy of neighbouring buildings constructed according to the Medium Density Residential Standards (**MDRS**) or their modification according to Plan Change 14 (Housing and Business Choice) of the Christchurch District Plan (**PC14**). Today I will provide a summary of my assessments that informed that evidence.

Latitude and sun access

3. As a first step, I compared Christchurch with other cities affected by the MDRS (Auckland, Tauranga, Hamilton, and Wellington) in terms of latitude and sunshine. Three of the other cities including Auckland are around 6° north of Christchurch, so their peak solar elevation in summer or winter is higher by the same amount. This means that tall buildings that shade others to the south will do so much more in Christchurch than in Auckland for the same dimensions.

4. As cloudiness is a major factor affecting sun access, I reviewed the sunshine hours of the MDRS cities. Tauranga has the highest sunshine hours of the five, with Auckland and Christchurch comparable at 10% less.

5. Within a city, sunlight access is largely affected by topography, especially for Wellington, and to a lesser extent Auckland and Tauranga. Hamilton and Christchurch, excluding hill suburbs, have minimal topography to influence aspect or cloud formation. My analysis therefore applies equally to everywhere in Christchurch north of the hills.

Climatic differences

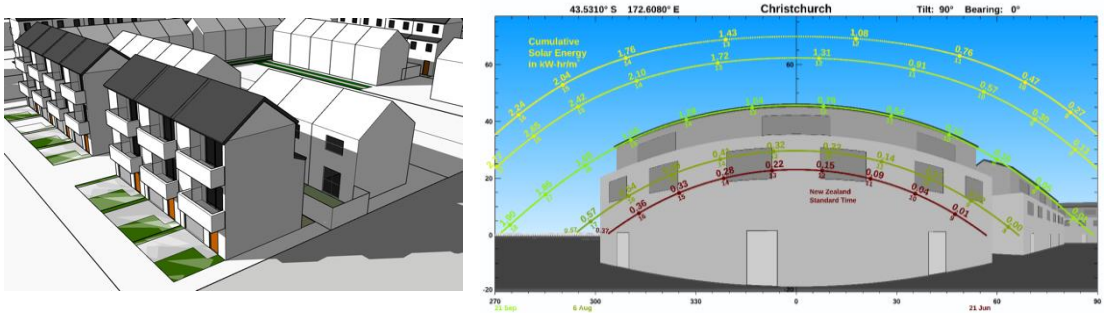
6. A further effect of latitude is that colder average temperatures will mean residents in Christchurch put greater value on solar warmth. In Christchurch annual heating degree days– a measure of the heating required for comfort – are more than twice those for Auckland or Tauranga.

7. A reasonable interpretation is that passive solar heating is about twice as valuable to residents in Christchurch than for northern cities.

Impact of MDRS on sunlight access in Auckland and Christchurch

8. My analysis for the Council was largely to test the work of David Hattam, who had used different building designs and relative positions with software that calculated cast shadows from sunlight.

9. I took a complementary approach by modifying a program, 'Solarview', served since 2008 on NIWA's web pages, that essentially looks out from the shade-affected surface to calculate the position of the sun and incident solar energy on a surface of any orientation anywhere in NZ.



Standard 3-storey design, and how it would appear from the shaded building behind at different seasons in Christchurch. The apparent distortion of straight rooflines to curves is because the view is a panoramic (cylindrical) projection of 180° width. Curves show the solar track at summer and winter solstices, autumn equinox, and intermediate dates in spring. Numbers under the curve are hour of the day, and above are cumulative solar energy for averaged cloud conditions.

10. Through use of the enhanced Solarview software I compared the impact of the MDRS and other development-enabling provisions under PC14 between Auckland and Christchurch. On the basis of my modelling described above, I conclude that the MDRS results in greater shading loss in Christchurch than in Auckland.

11. From my modelling of the buildings modified in accordance with PC14 including, the Sunlight Access QM, I conclude that PC14 will reduce the loss of both sunshine hours and solar energy in Christchurch so that they are comparable to the losses that will be experienced under the MDRS recession planes in Auckland.

Date: 31 October 2023

Ben Liley