Dairy Farm Water Footprint

Effect of method, data, and spatial scale.

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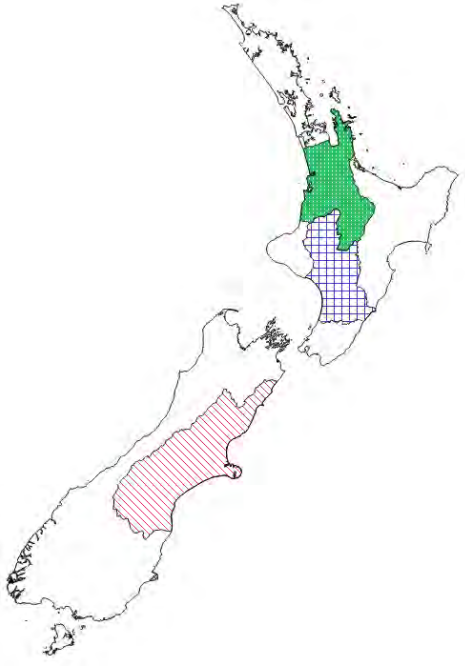
Today…

- Background
- Aims
- Methods – two
- Data – level of detail
- Spatial scale
- Environmental flow requirements

Background

- PhD on water use on dairy farms
  - Detailed data collection
    - Brought on by regional limits
  - Published detailed water use patterns on farms in the Waikato, Manawatu, and Canterbury regions



Dairy Water footprint

- M. Zonderland-Thomassen and S. Ledgard (2012) on dairy farms in the Canterbury and Waikato regions
- New detailed on farm water data – direct water footprint in Canterbury, Manawatu and Waikato of farm and feed

We wanted to investigate

- The direct water footprint of dairy farming
- The effect of two different methods
  - Blue scarcity and Availability minus demand
- The effect of the detail of data
  - Global vs. Local data
- The effect of spatial scale
  - Catchment scale vs. regional scale

Water footprint

- Three parts to a water footprint

- $Characterised\ water\ footprint = volumetric\ water\ footprint \times characterisation\ factor$

- Characterisation factor = AMD and blue scarcity

Methods – Blue scarcity

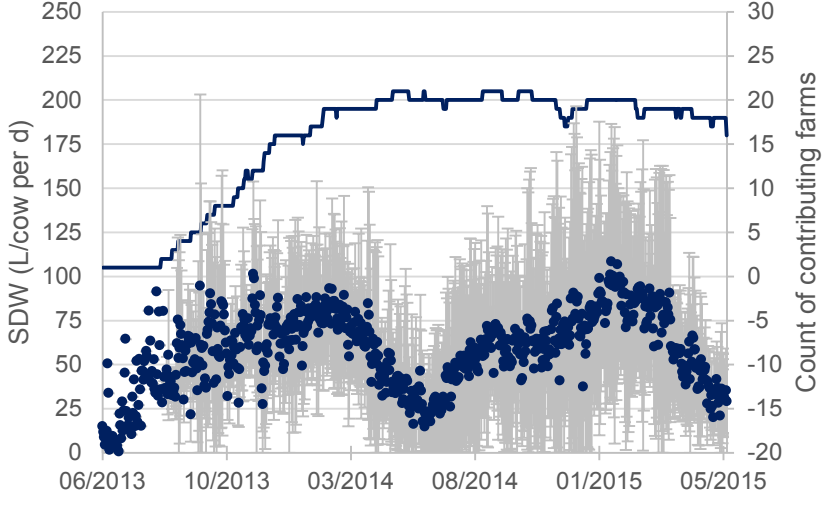
- Blue scarcity - Water footprint network (WFN)
  - Based on the water consumed to the water available (runoff minus demand)
  - $WS_{blue} = \frac{\sum WF_{blue}}{WA_{blue}} = \frac{\sum WF_{blue}}{R_{nat} - EFR}$

Methods – Availability minus demand (AMD)

- Developed by the WULCA group AWARE method (Available WAter REmaining)
- $AMD_i = \frac{(Availability - HWC - EFR)}{Area}$
- Normalised by the world average

Global vs. local data

- Direct water use data
- Stock drinking = 70 L/day while milking and 45 L/day while dry



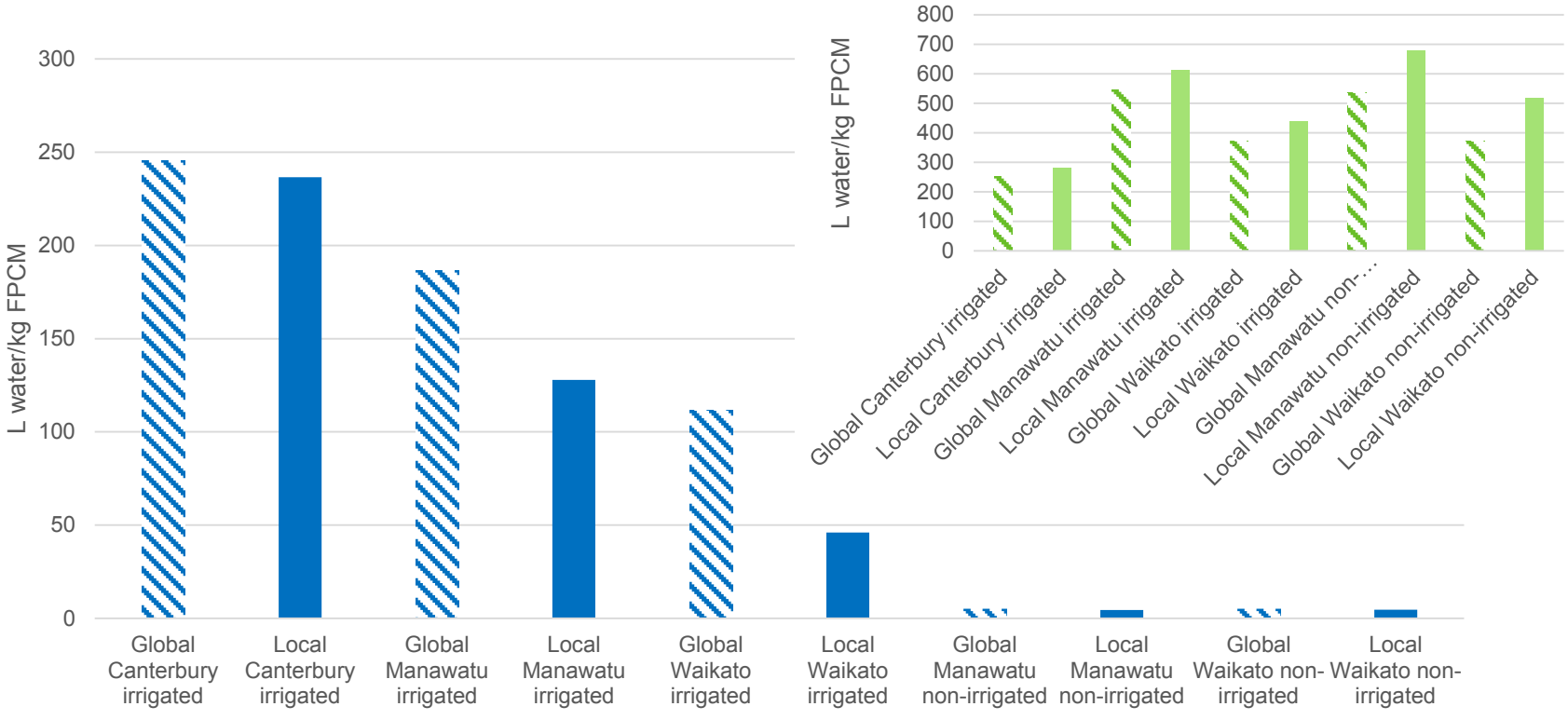
Climate data

- Global = average monthly data from CLIMWAT for CROPWAT at Hamilton airport, Palmerston North airport, Christchurch airport
- Local = NIWA Virtual Climate Station Network data – from the site most representative of the farms

ETgreen and ETblue

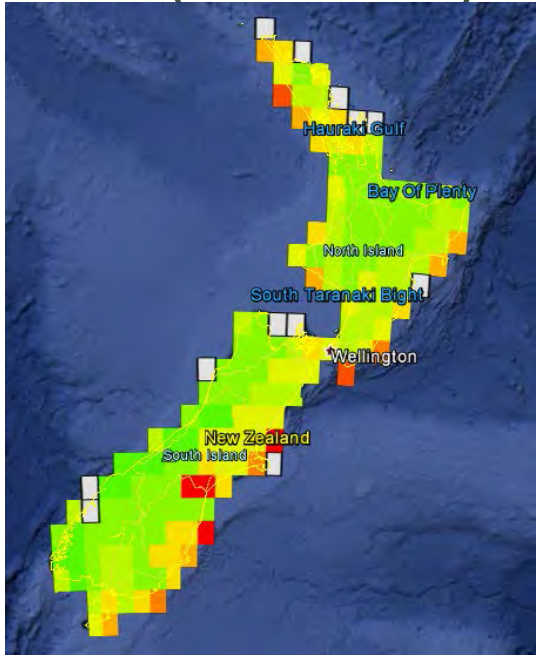
- ET = Evapotranspiration
- The water used from rain = green
- The water use from irrigation = blue
- Global data - Monthly ET calculated using the USDA Soil Conservation method (Smith, 1992)
- Local data – Soil water balance model, with local profile available water from S-Map

Volumetric blue water footprint



Global characterisation factor layers

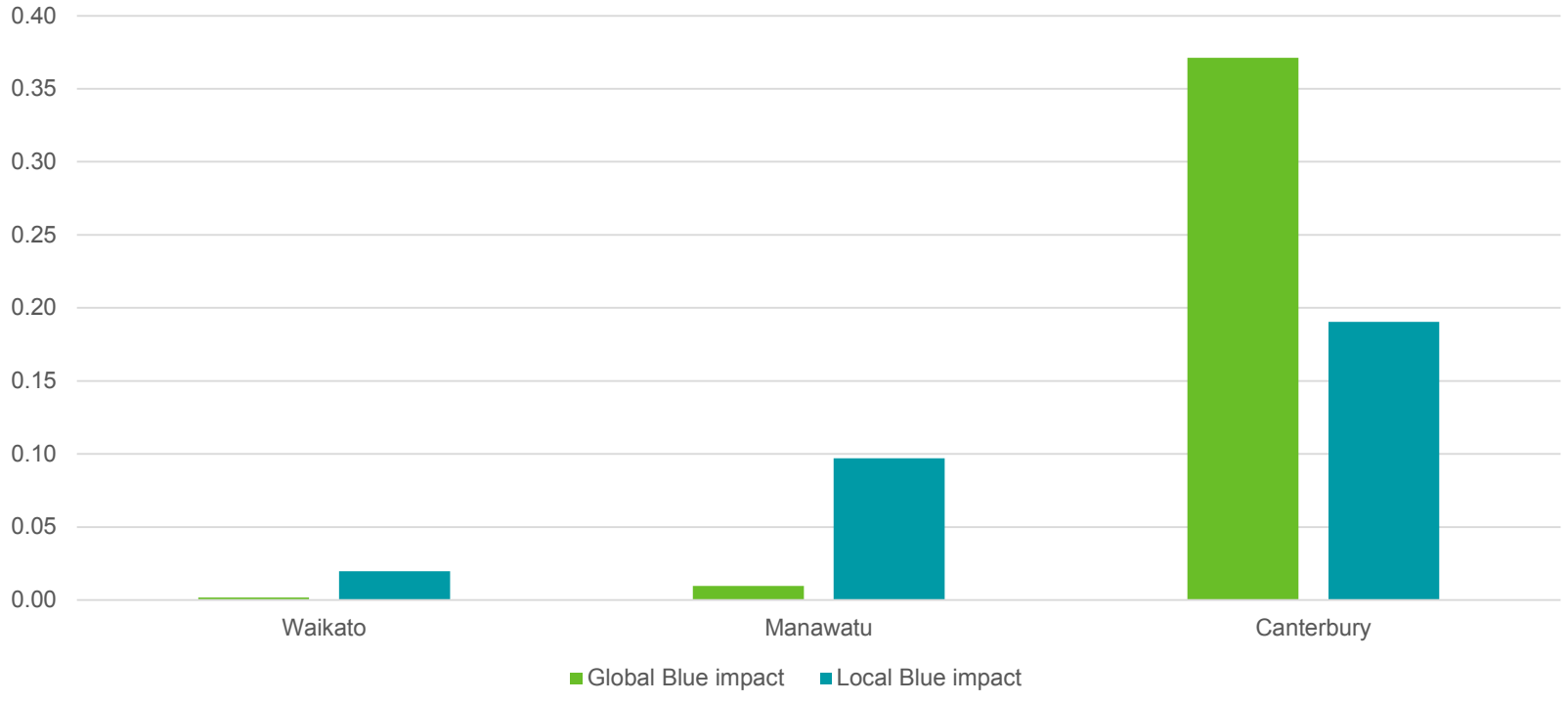
- AMD (WULCA) and blue scarcity (WFN)



Local characterisation factors

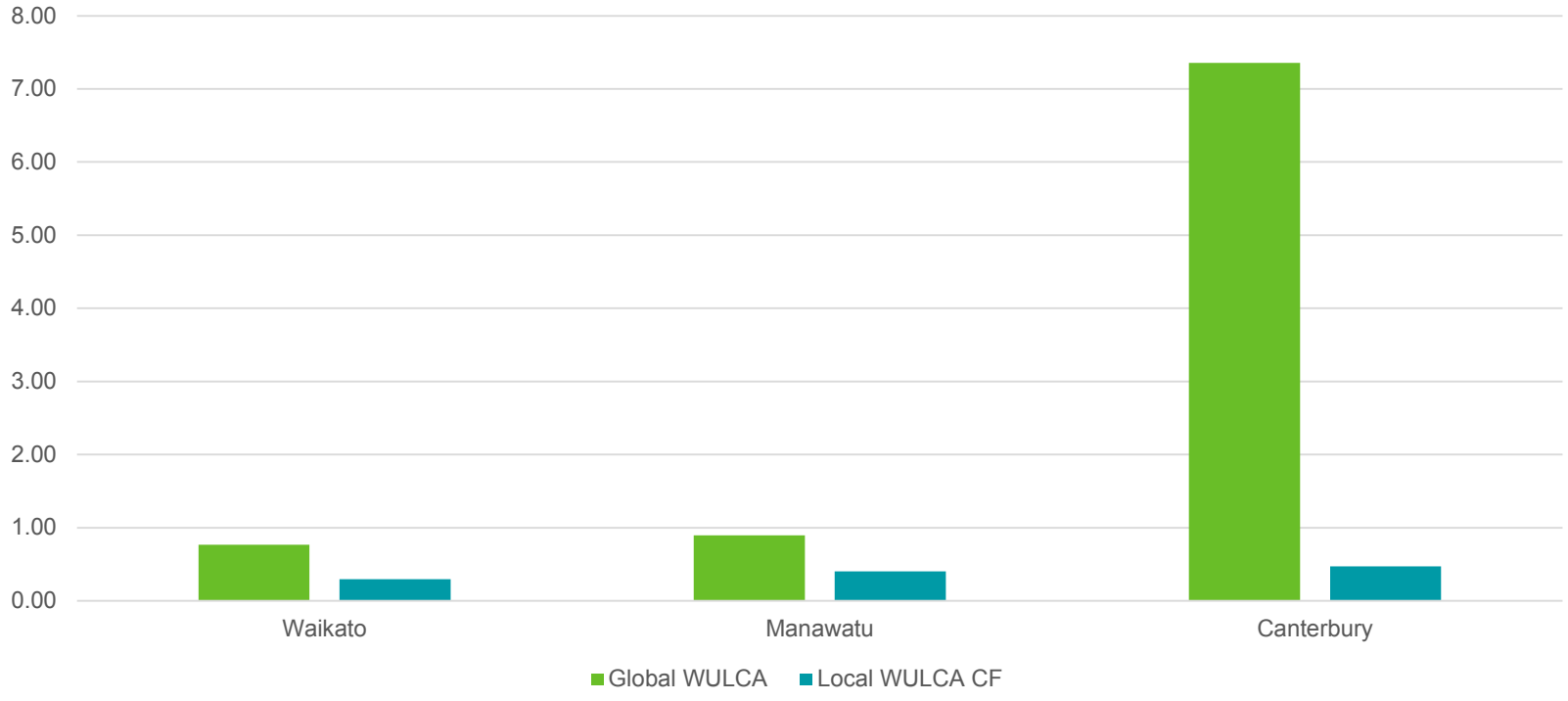
- Calculate with similar local data
  - NIWA water availability layers
  - Consented volumes from region councils with actual use fractions and consumption applied

Blue scarcity CF - Regional



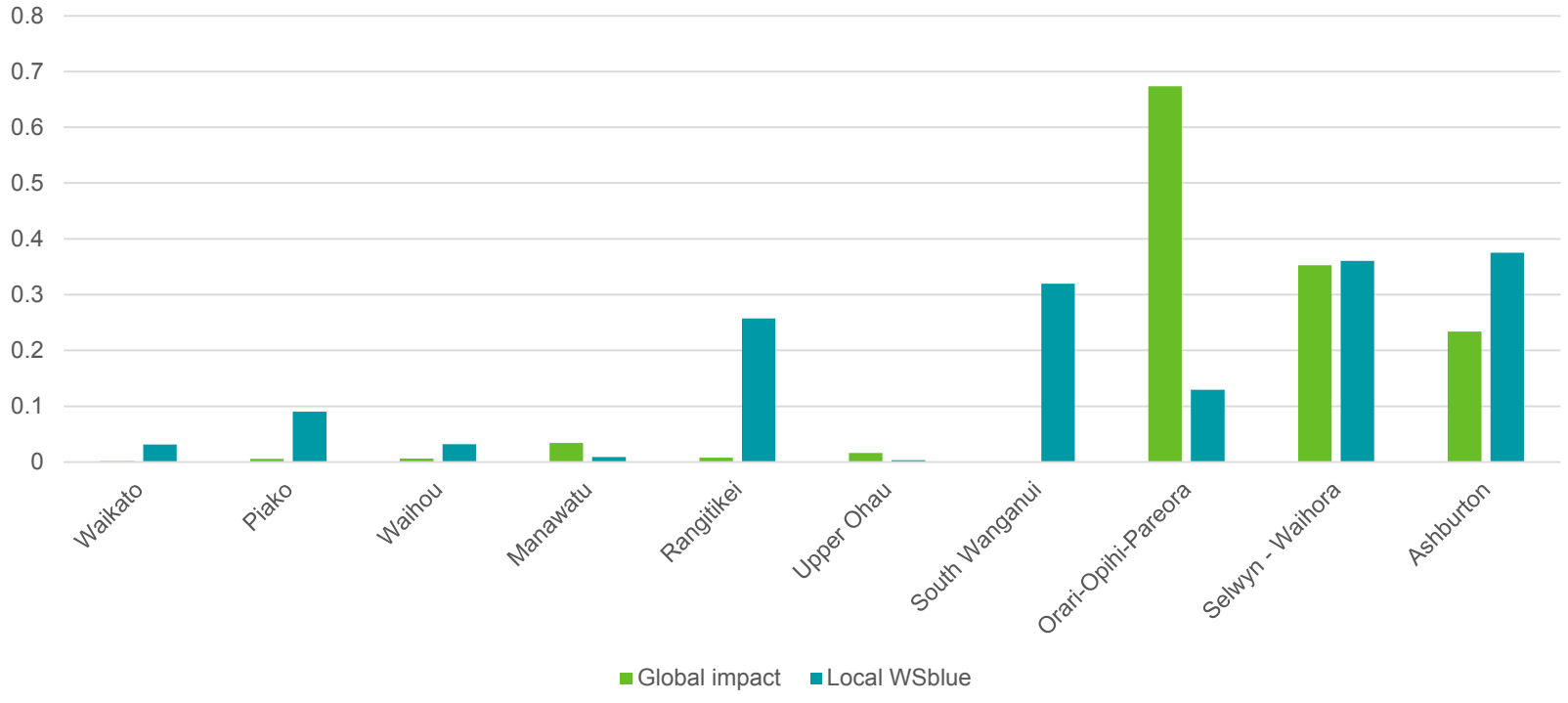
Local coefficient of variation = 0.83

Availability minus demand CF - Regional



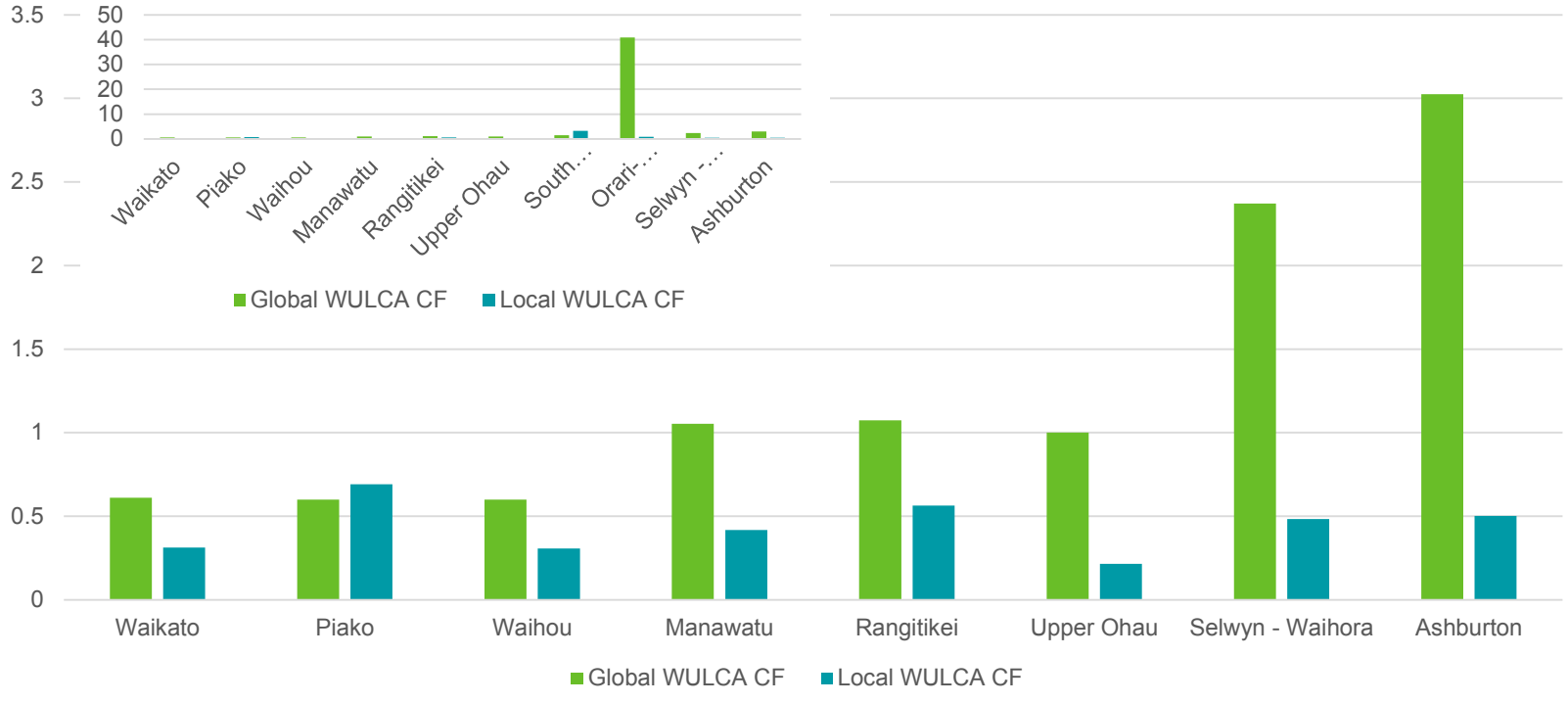
Local coefficient of variation = 0.23

Blue scarcity characterisation factors - catchment



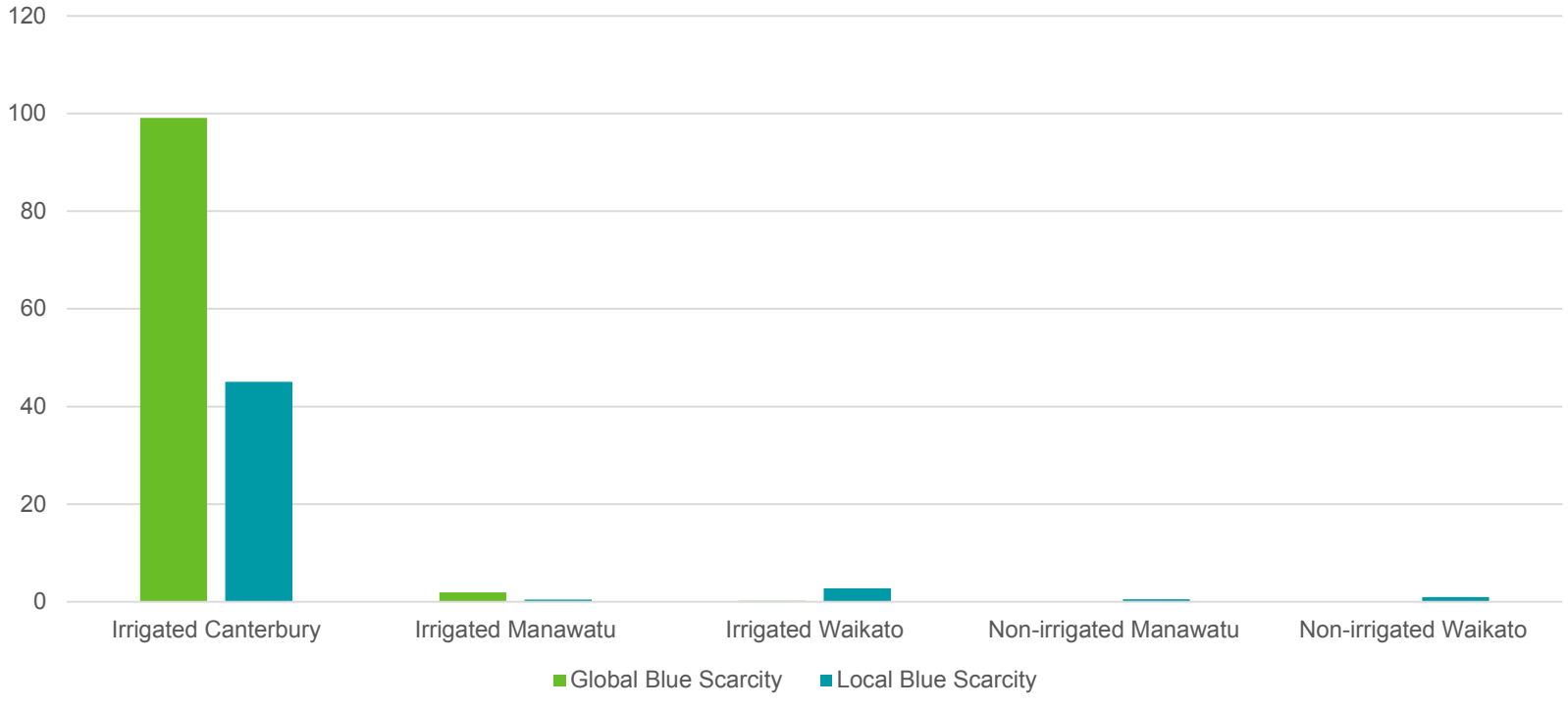
Local coefficient of variation = 0.95

Availability minus demand characterisation factor - catchment

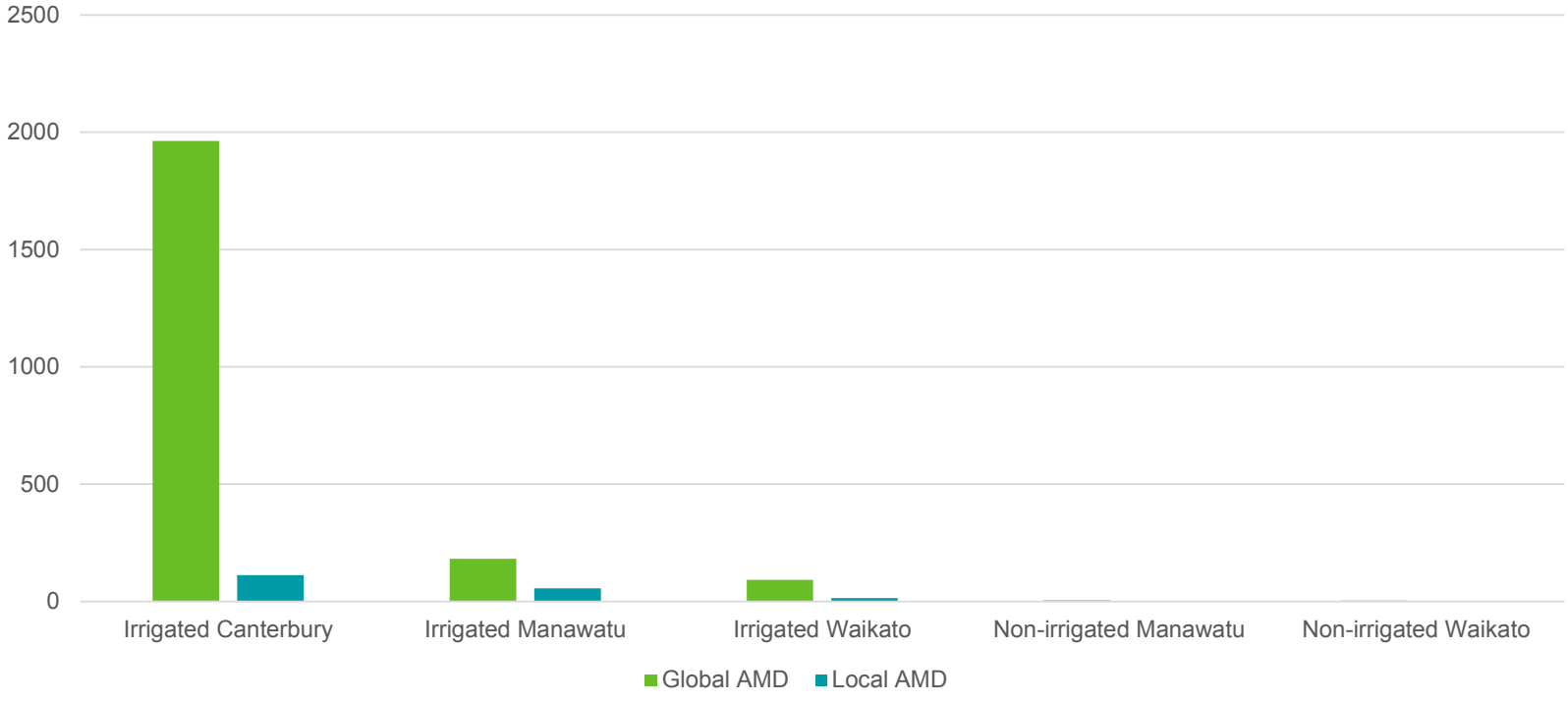


Local coefficient of variation = 1.19

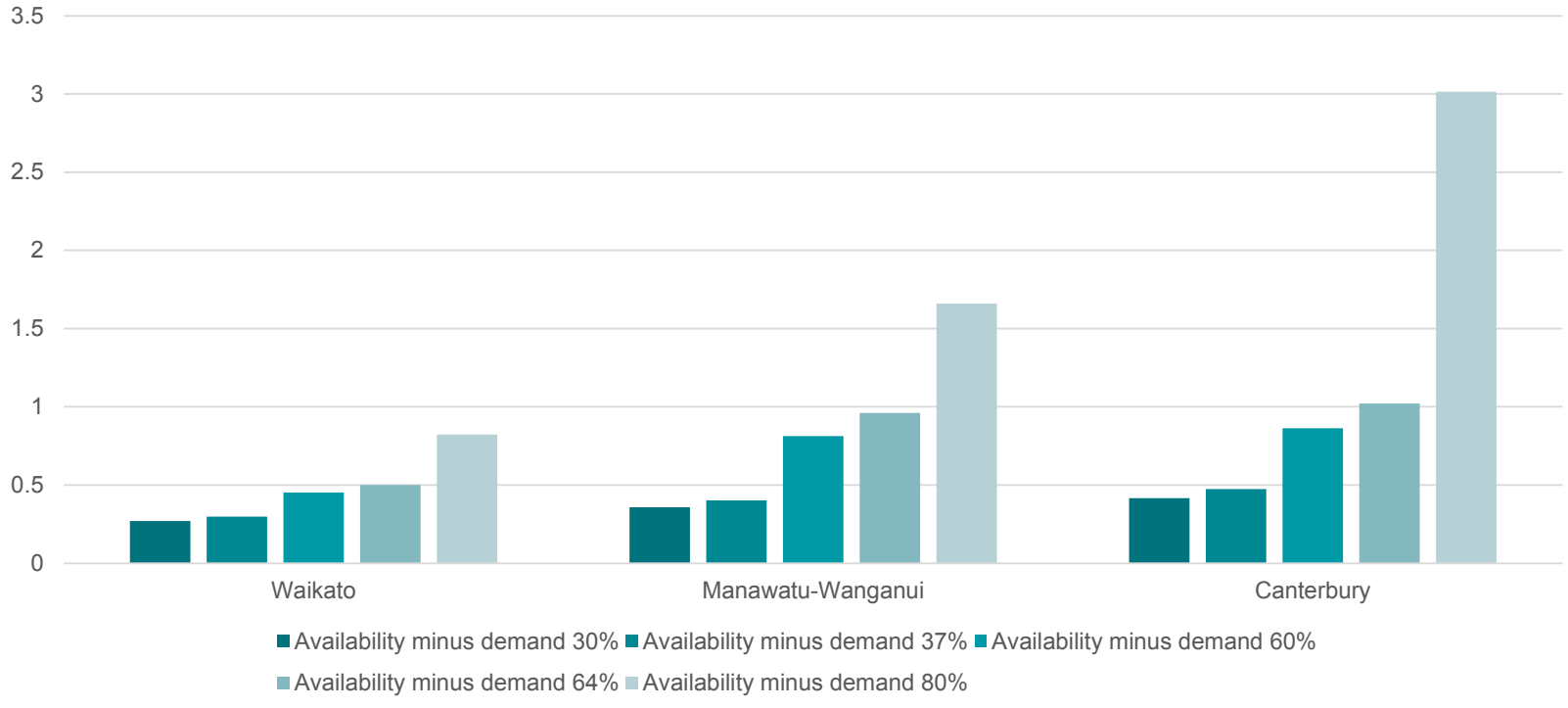
Characterised blue scarcity footprint



Characterised Availability minus demand footprint



Environmental flow requirements - AMD



Summary

- Methods – AMD and blue scarcity
- Data – level of detail changes water footprint
  - Volumetric water footprint
  - Characterisation factors
- Spatial scale effects
- Environmental flow requirements

Take home messages

- The data that you use determines your footprint – substantially lower footprints with local data in this case
- The AMD method differentiates more at catchment scale than blue scarcity
- From this analysis NZ is better using the detailed data to calculate your water footprint

Questions?