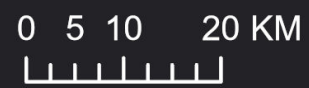
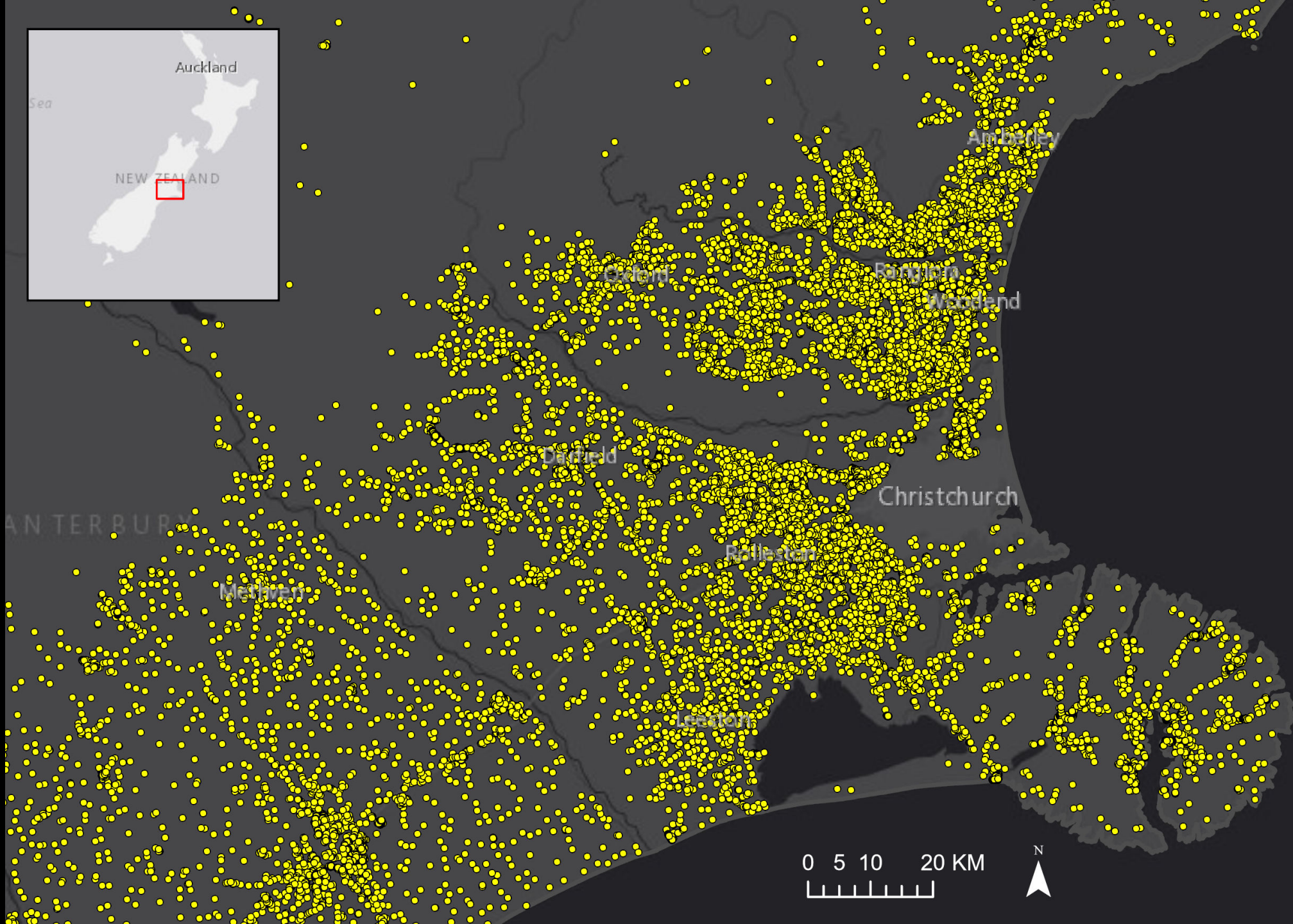
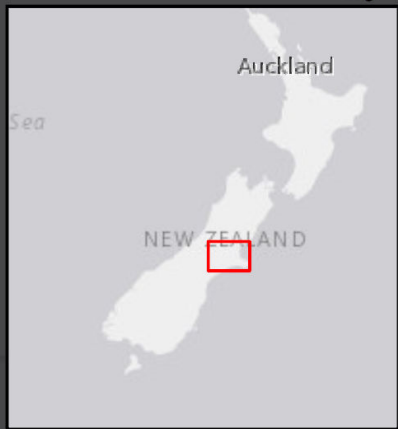


On-site wastewater systems – risks and insights into their function

Bronwyn Humphries, Rachel Qiu, Gemma Langley, Dr Andrew Pearson and Dr Louise Weaver











Quality

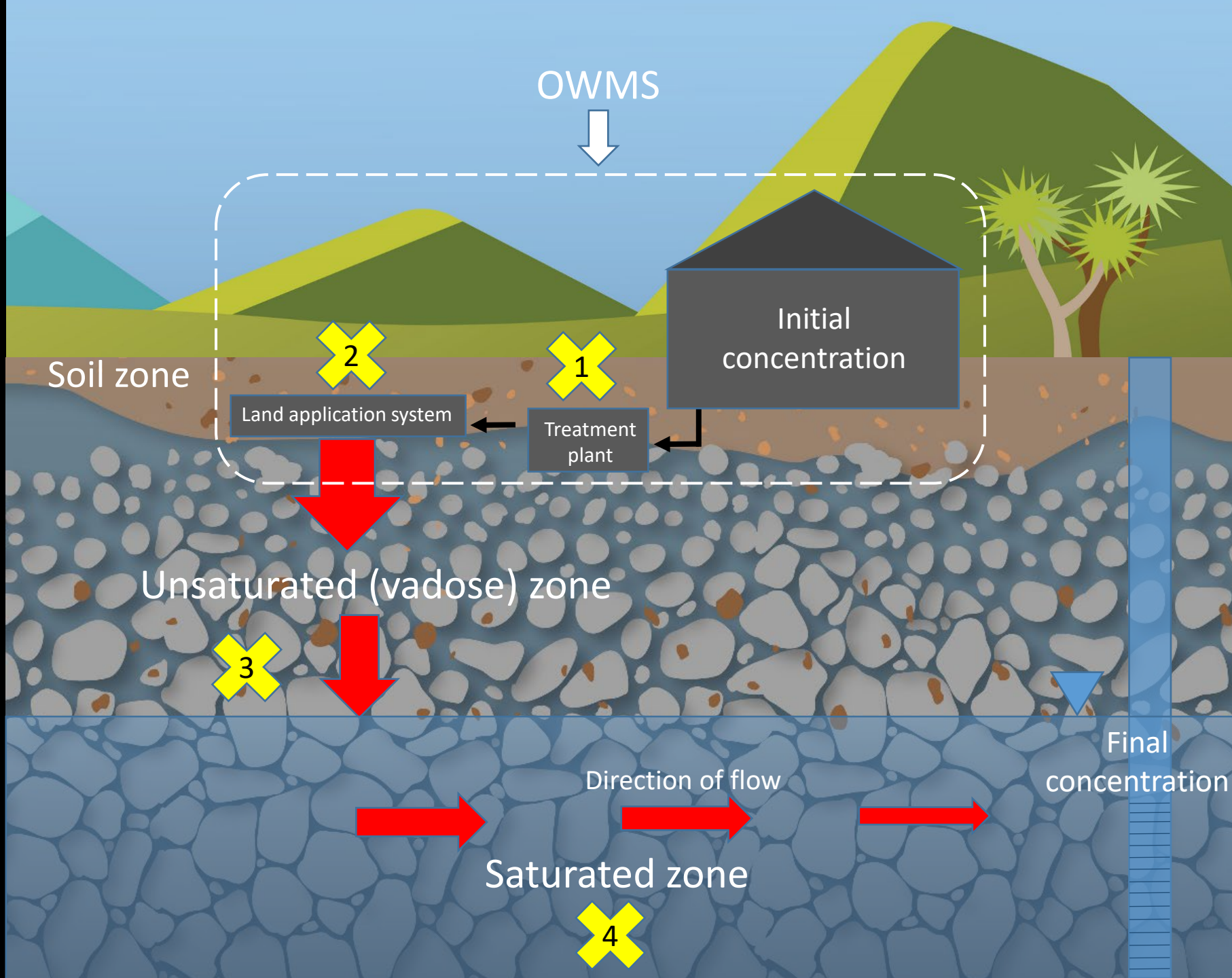
Quality

Volume

Quality

Volume

Density

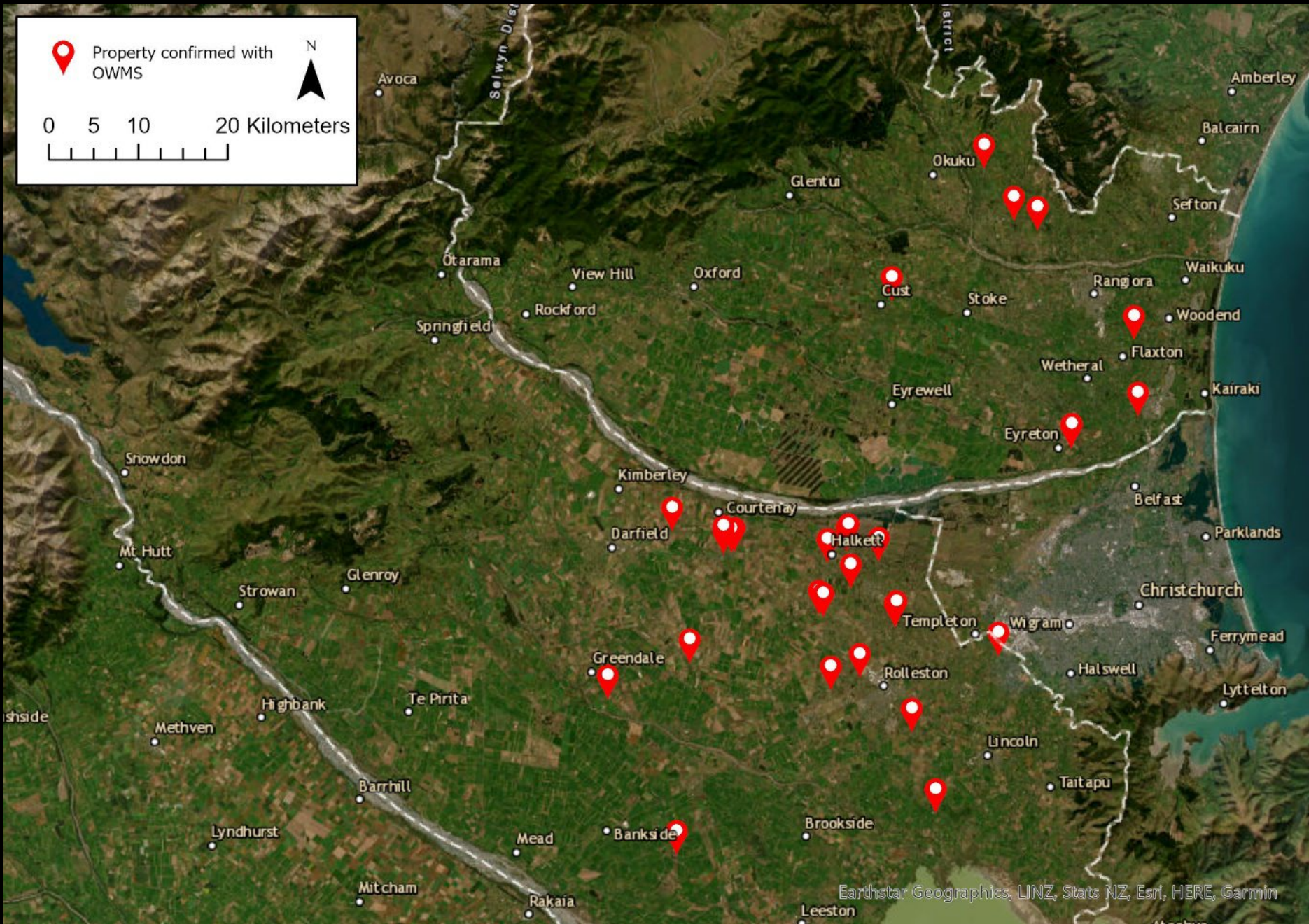




TĀNE

WAHINE





Property confirmed with OWMS

0 5 10 20 Kilometers

N

Earthstar Geographics, LINZ, Stats NZ, Esri, HERE, Garmin

BOD₅ (mg/L)

TSS (mg/L)

Ammoniacal nitrogen (mg/L)

Total nitrogen (mg/L)

Total phosphorus (mg/L)

E. coli (CFU/100mL)

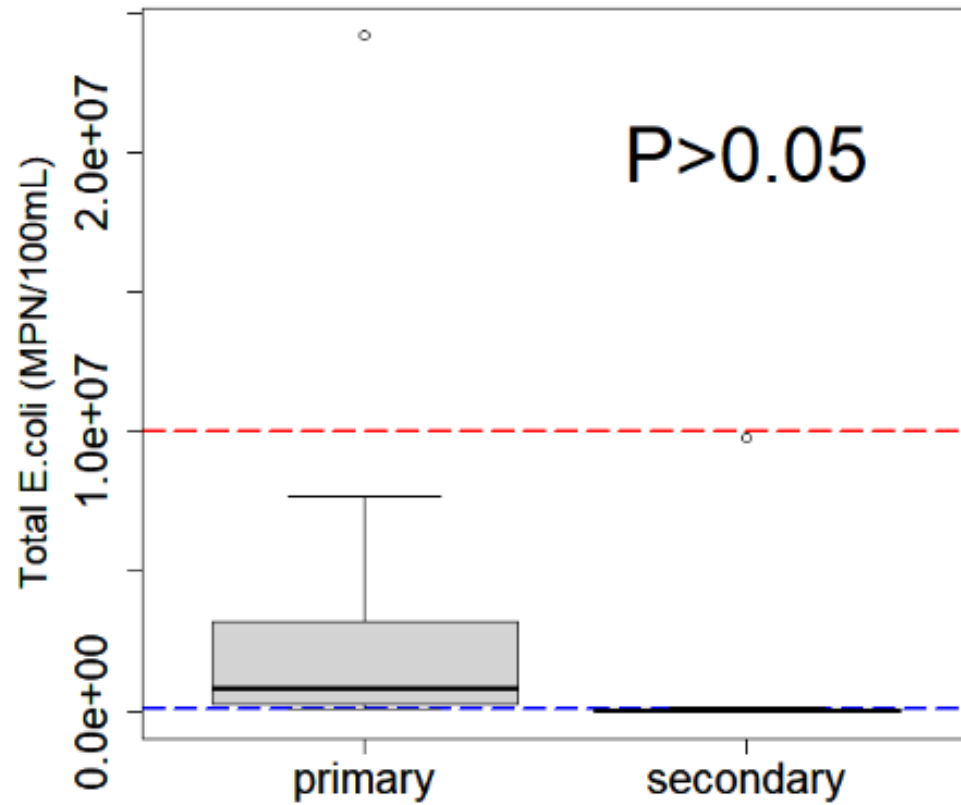
	Primary Treatment	Secondary Treatment
BOD ₅ (mg/L)	100 - 140	≤20
TSS (mg/L)	30 - 70	≤30
Ammoniacal nitrogen (mg/L)	<30	<5
Total nitrogen (mg/L)	<100	<40
Total phosphorus (mg/L)	<20	<10
<i>E. coli</i> (CFU/100mL)	10 ⁶ - 10 ¹⁰	<10 ⁴

Auckland Council GD06

ESR 2023

	Primary Treatment	Secondary Treatment	Primary Treatment n=16 (mean)	Secondary Treatment n =14 (mean)
BOD ₅ (mg/L)	100 - 140	≤20	25 – 630 (203)	4 – 270 (58)
TSS (mg/L)	30 - 70	≤30	33 – 4,500 (446)	8 – 160 (54)
Ammoniacal nitrogen (mg/L)	<30	<5	36 – 250 (99)	0.08 – 102 (22)
Total nitrogen (mg/L)	<100	<40	35 – 302 (106)	8 – 123 (52)
Total phosphorus (mg/L)	<20	<10	7 – 91 (17)	2 – 20 (12)
<i>E. coli</i> (CFU/100mL)	10 ⁶ - 10 ¹⁰	<10 ⁴	10 ⁴ – 10 ⁷ (10 ⁶)	10 ² – 10 ⁶ (10 ⁵)

E.coli

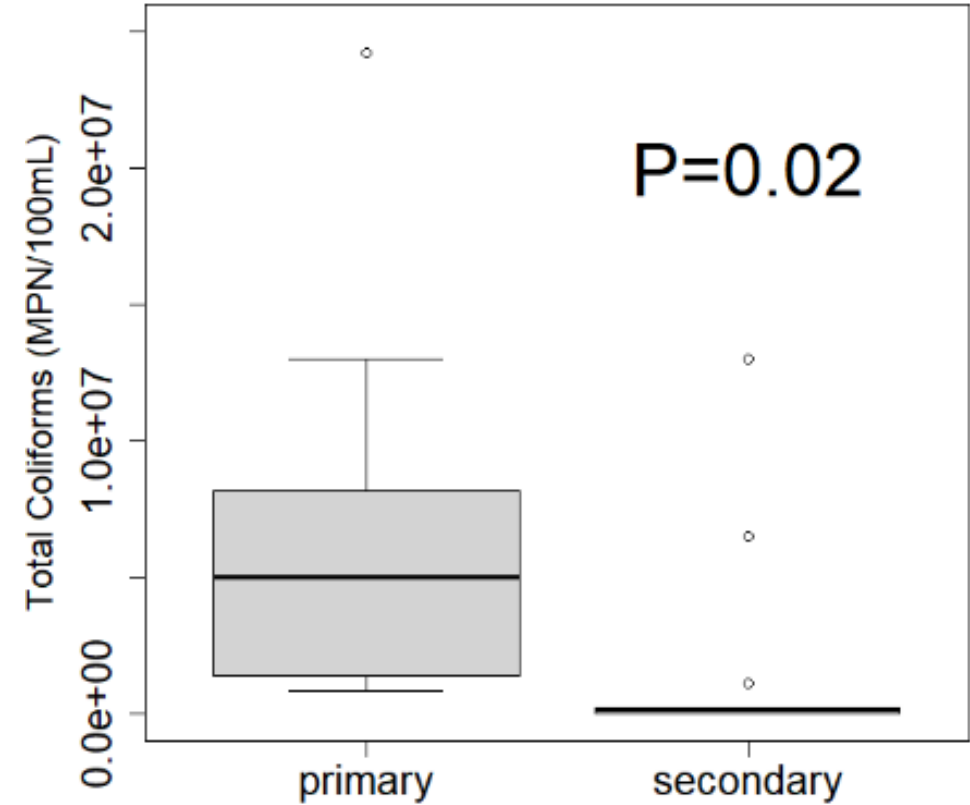


Range $10^4 - 10^7$

$10^2 - 10^6$

(MPN/100mL)

Total Coliforms



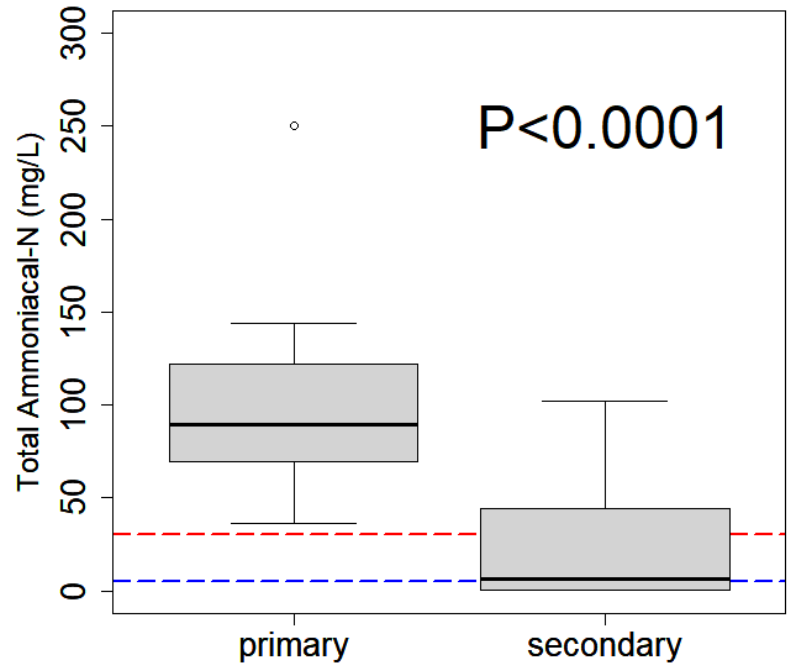
$10^3 - 10^7$

$10^3 - 10^7$

----- Primary typical value
----- Secondary typical value

Source: Auckland Council (GD06)

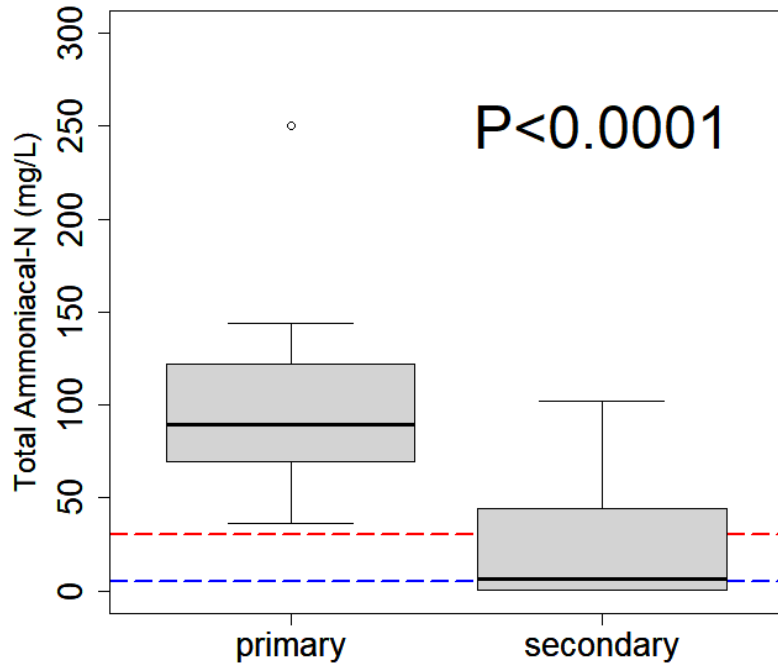
Total Ammoniacal-N



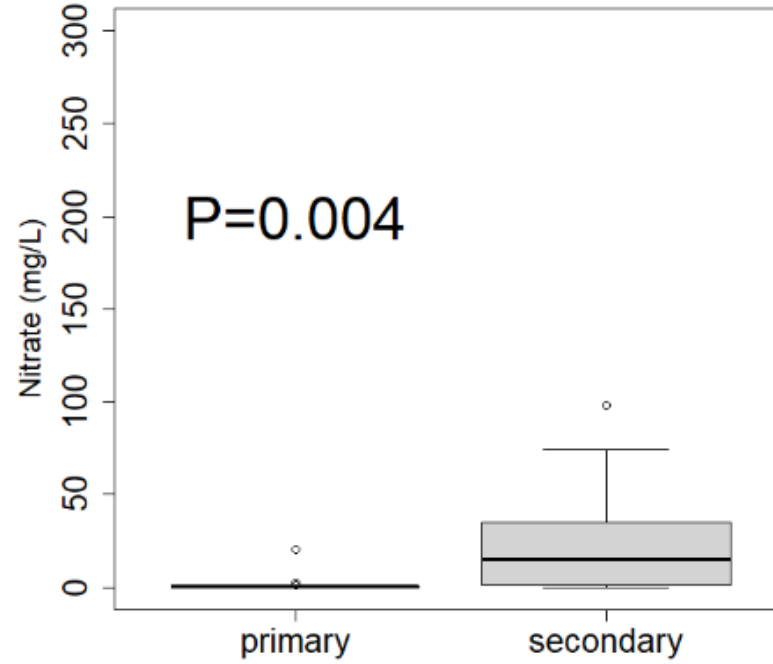
----- Primary typical value
----- Secondary typical value

Source: Auckland Council (GD06)

Total Ammoniacal-N



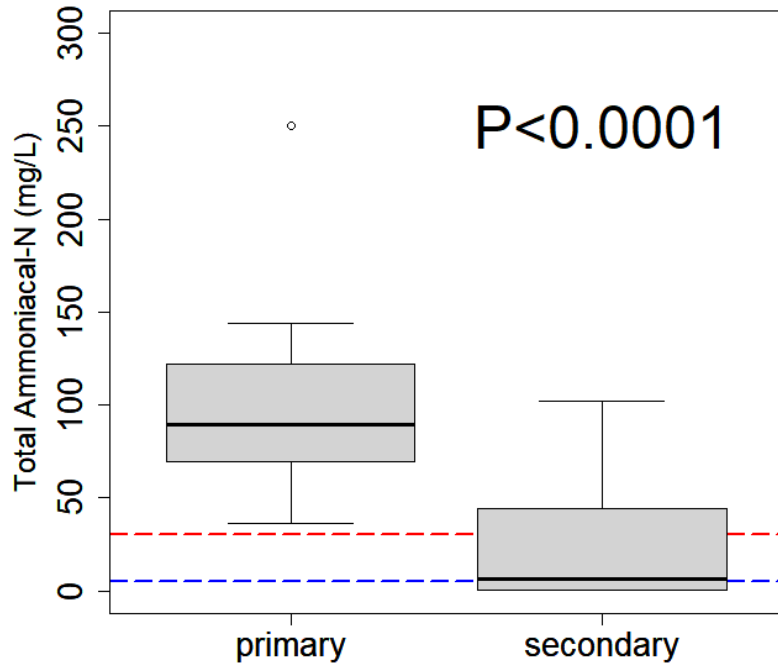
Nitrate-N



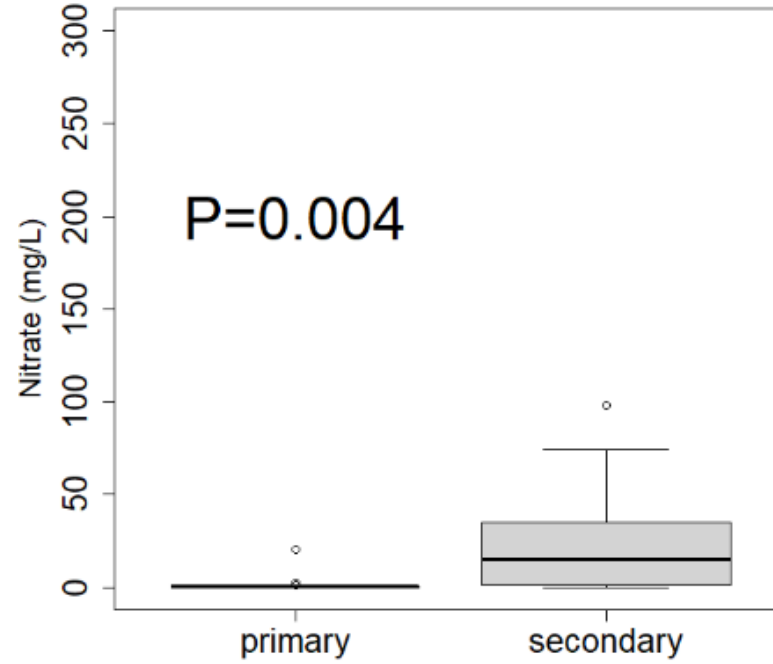
----- Primary typical value
----- Secondary typical value

Source: Auckland Council (GD06)

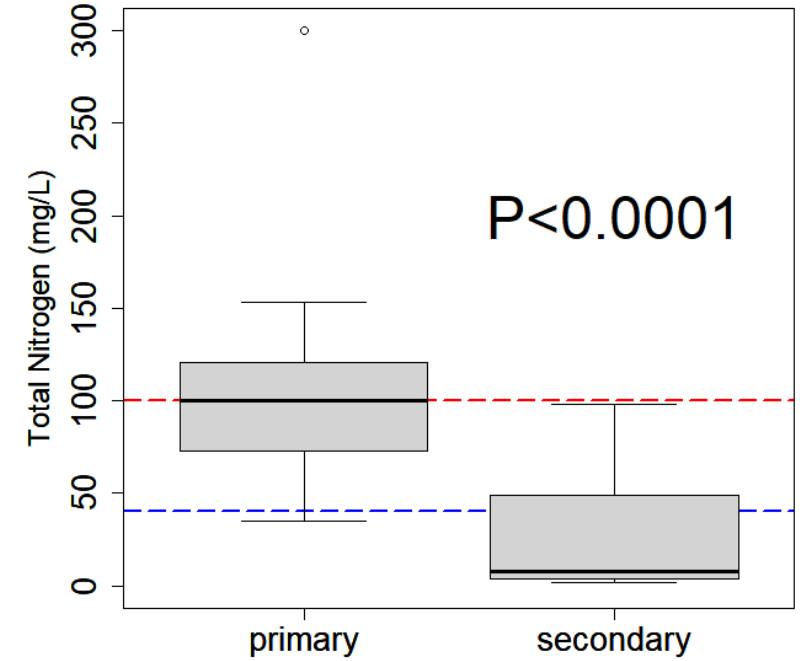
Total Ammoniacal-N



Nitrate-N



Total Nitrogen



----- Primary typical value
----- Secondary typical value

Source: Auckland Council (GD06)



ResearchGate

On-site Wastewater Management System
(OWMS) Effluent Quality Survey (2023)

2.5 people per household

2.5 people per household

200 L/person/day

2.5 people per household

200 L/person/day

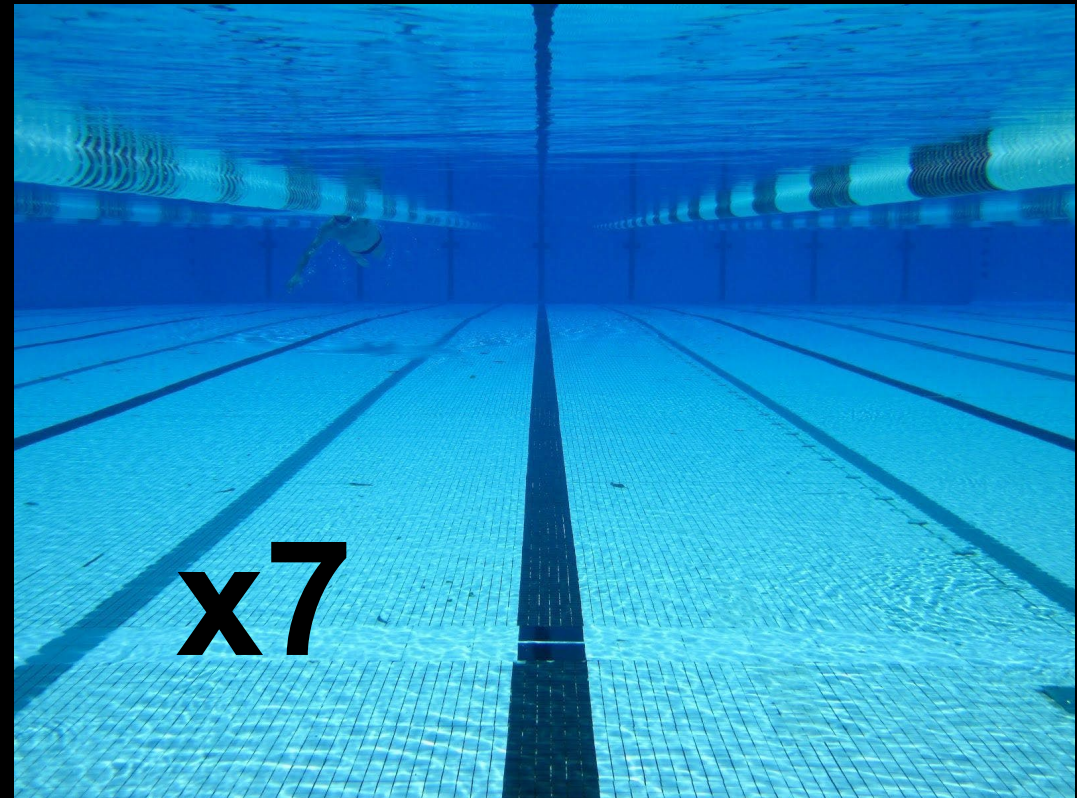
34,000 OWMS

2.5 people per household

200 L/person/day

34,000 OWMS

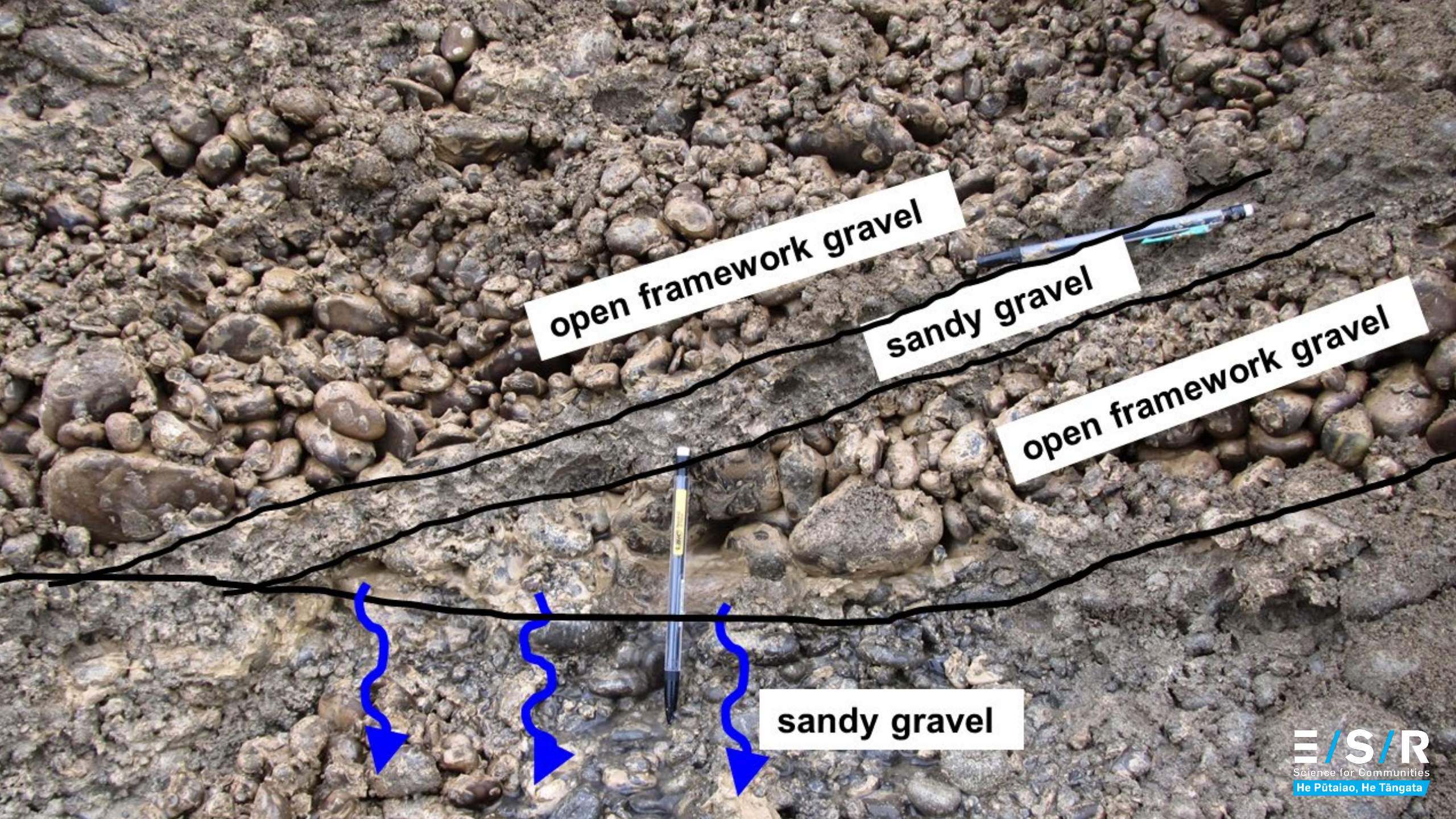
17 million L/day



10^{10} genome copies per mL



CDC



open framework gravel

sandy gravel

open framework gravel

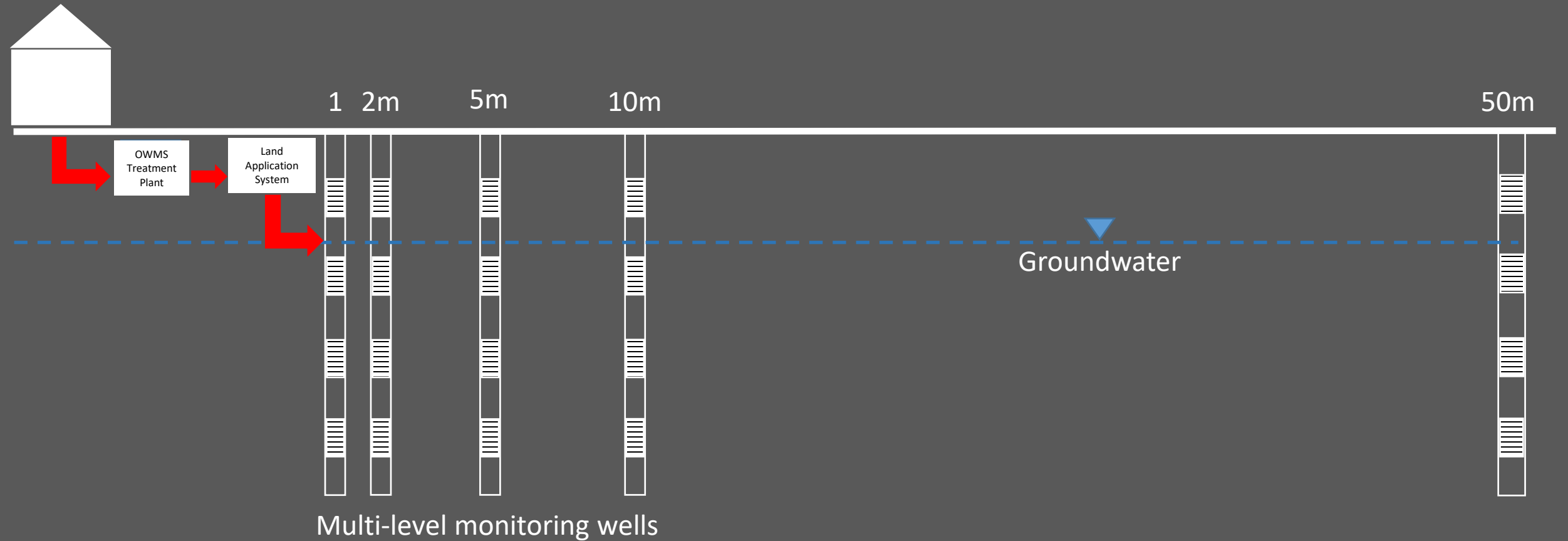
sandy gravel

Recommended maximum on-site wastewater densities to avoid groundwater contamination

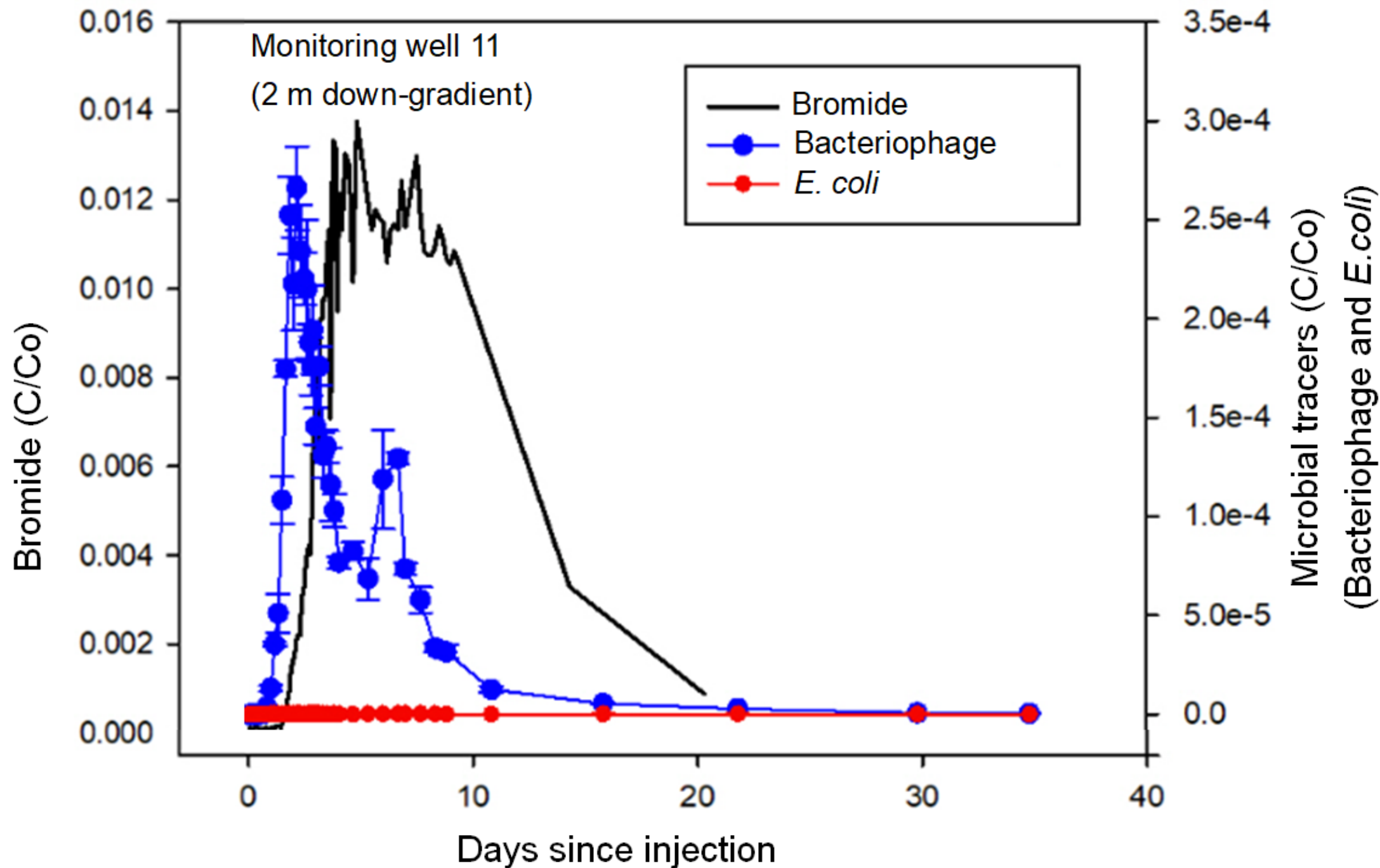
OWMS / hectare	Reference
0.15	US EPA 1977
1 – 2.5	Gardner et al. 1997
5	Reneau 1979
6	Morrissey et al. 2015



“Toilet – Tap”

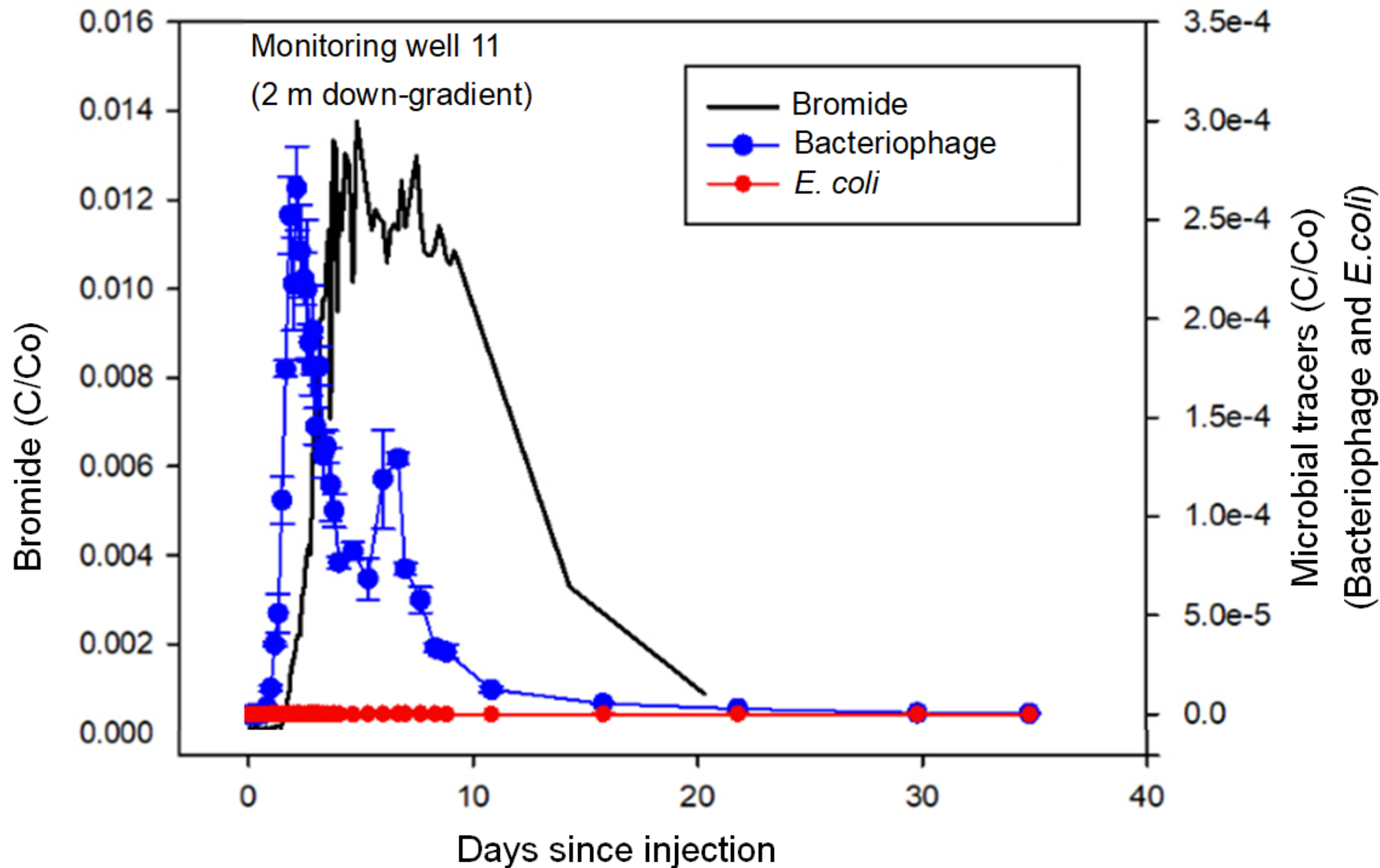


(not to scale)



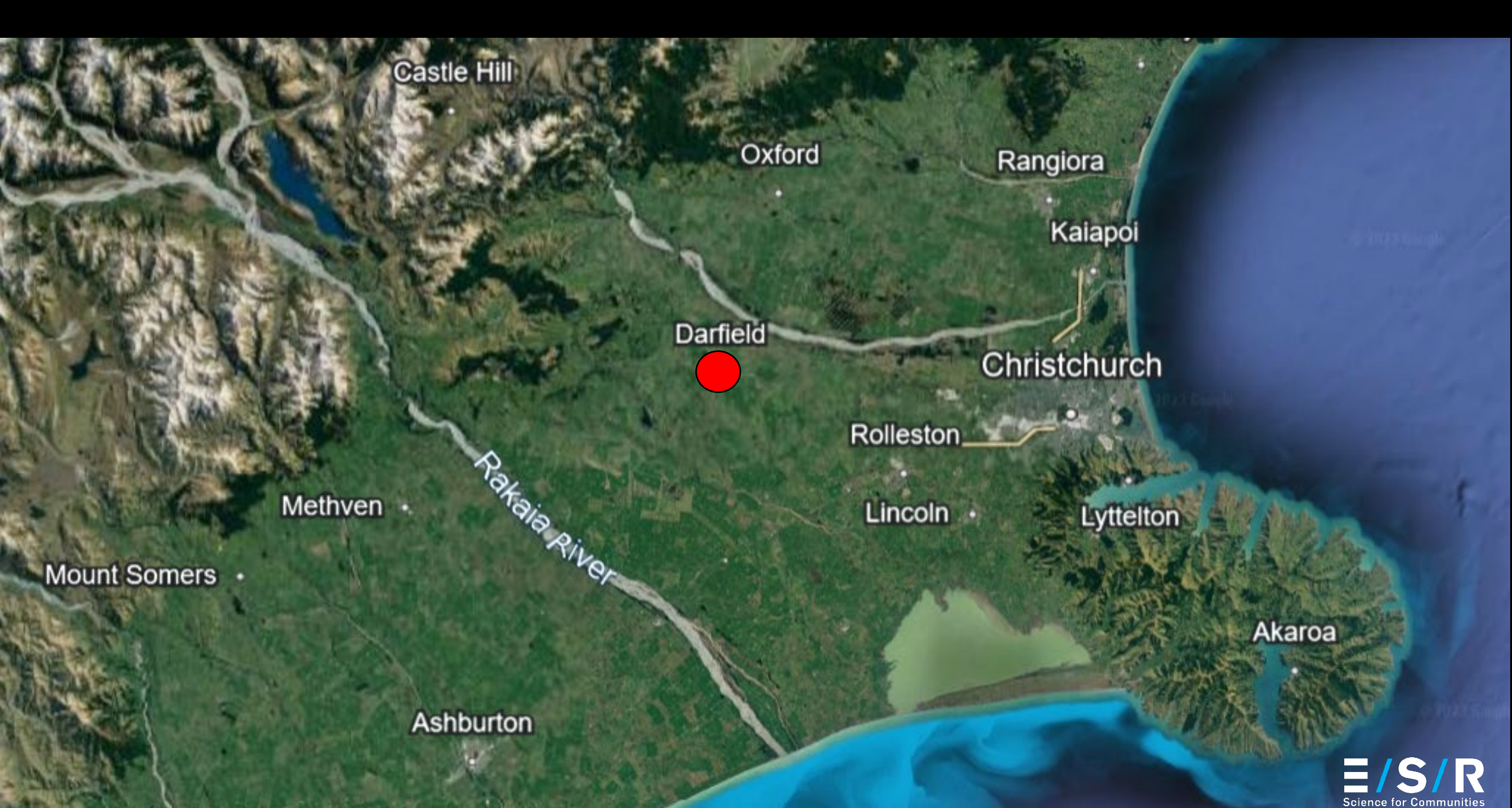


Monitoring well



Recommended maximum on-site wastewater densities to avoid groundwater contamination

OWMS / hectare	Reference
0.15	US EPA 1977
1 – 2.5	Gardner et al. 1997
5	Reneau 1979
6	Morrissey et al. 2015



Castle Hill

Oxford

Rangiora

Kaipoi

Darfield

Christchurch

Rolleston

Methven

Lincoln

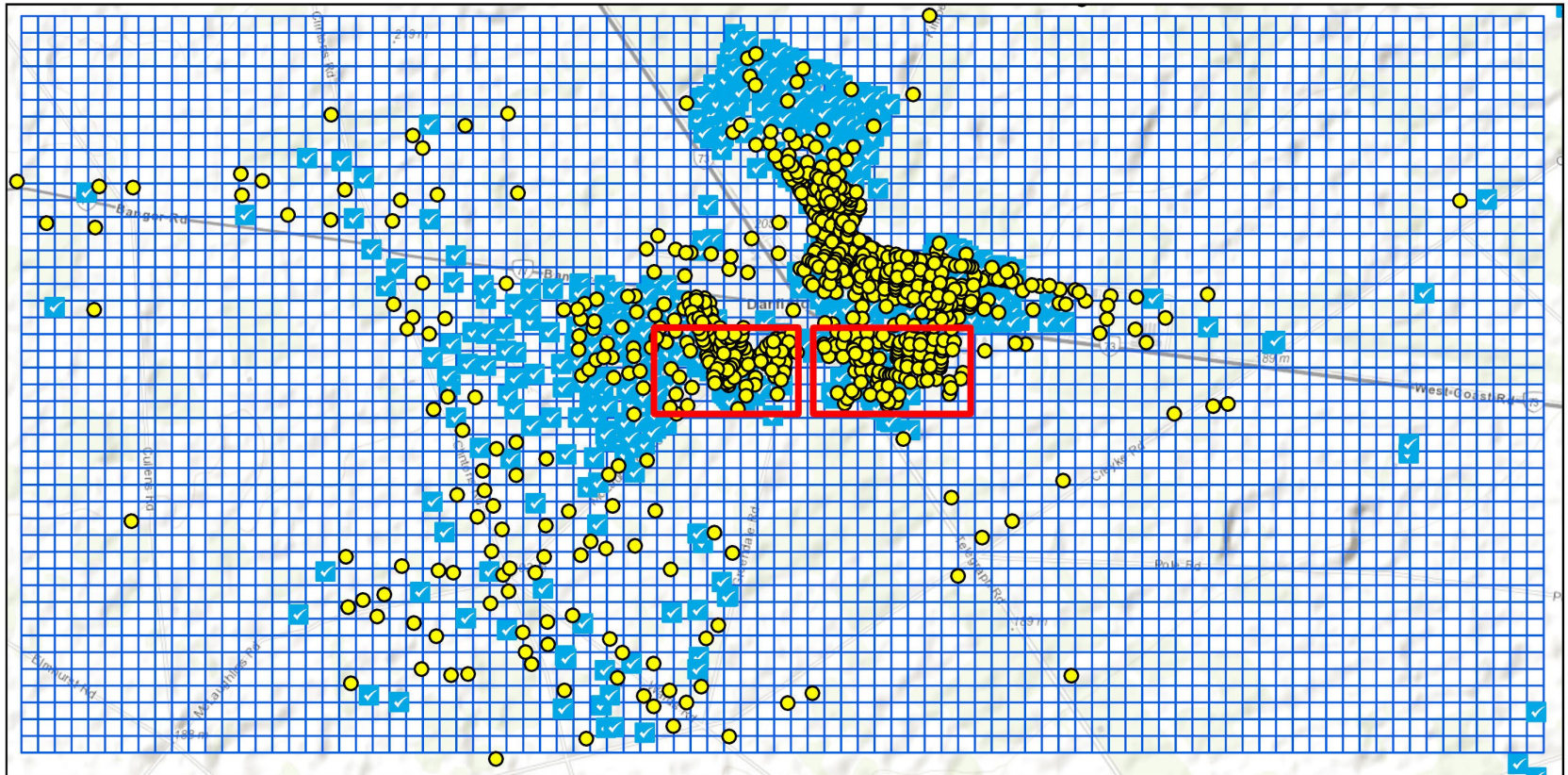
Lyttelton

Mount Somers

Rakaia River

Ashburton

Akaroa

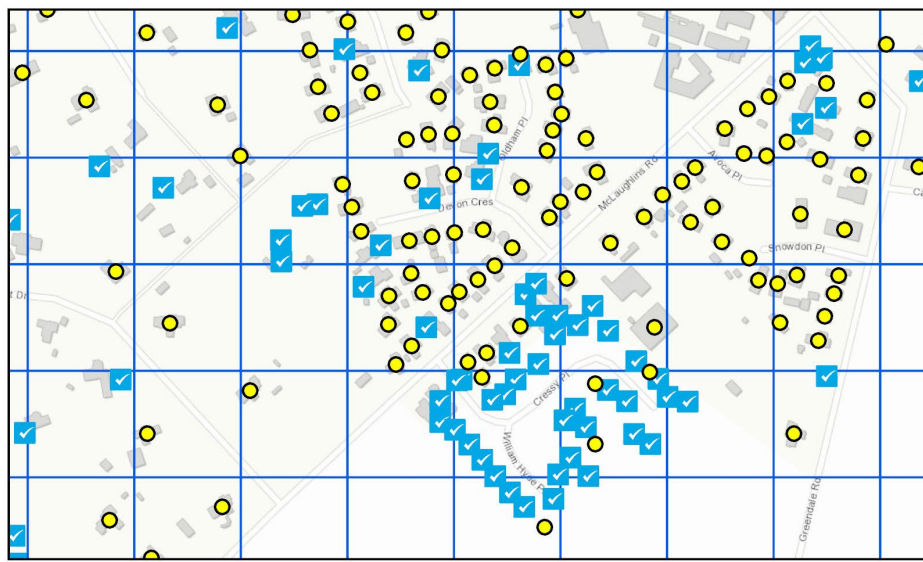
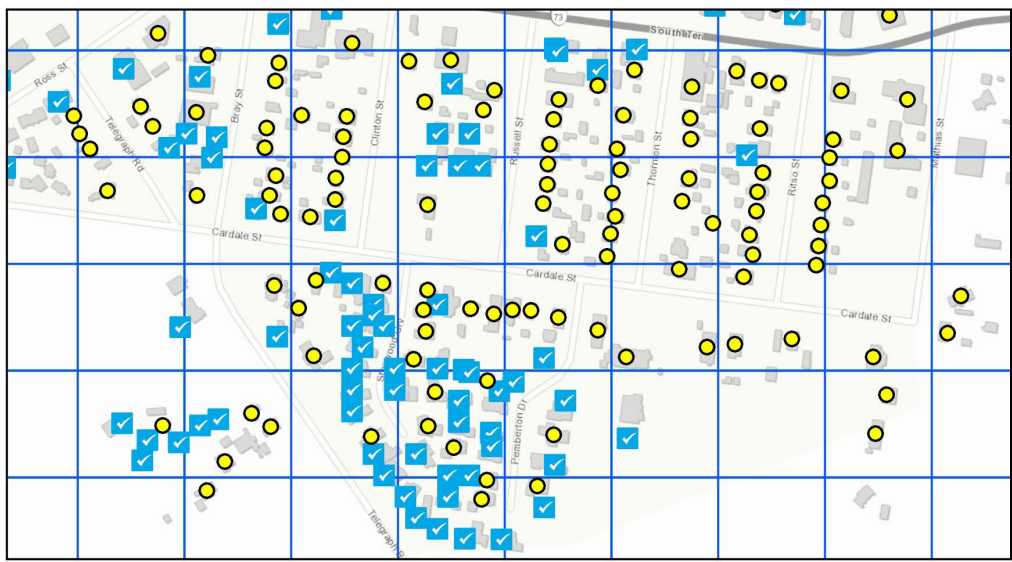


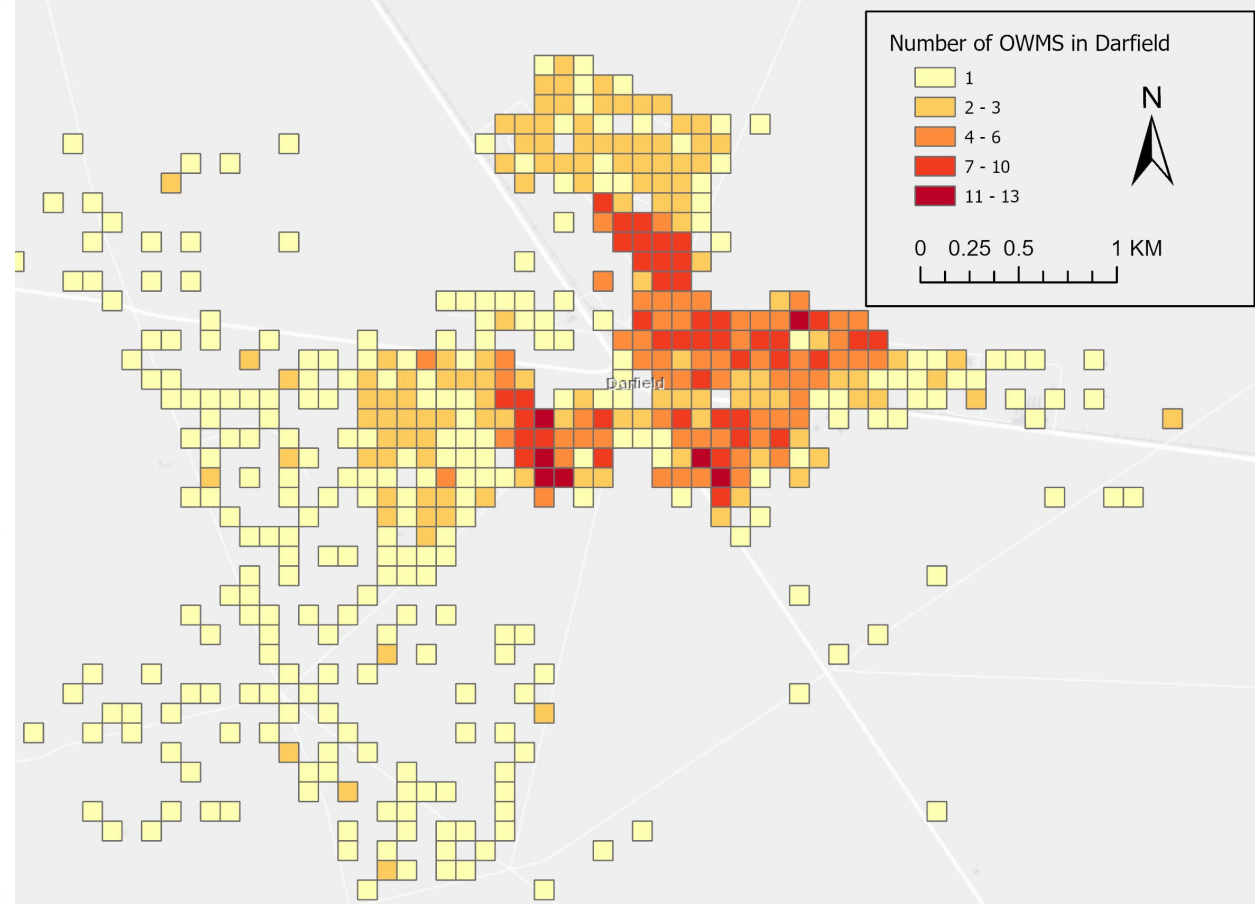
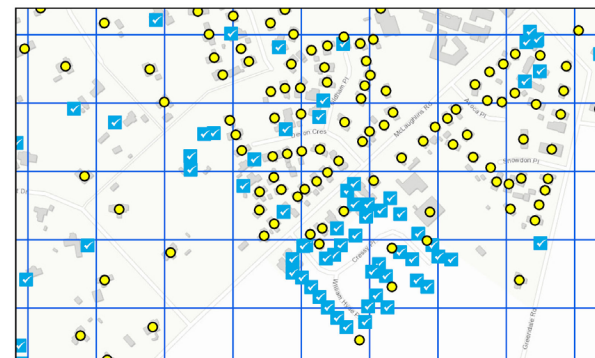
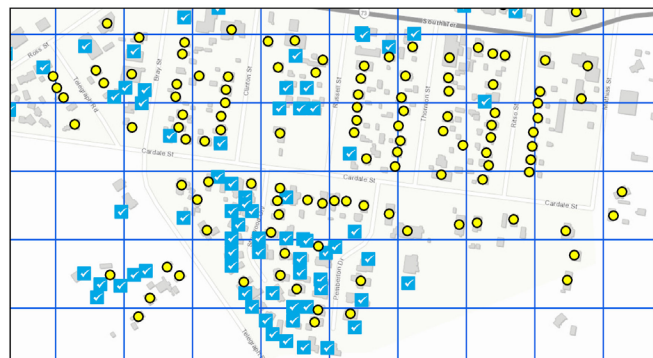
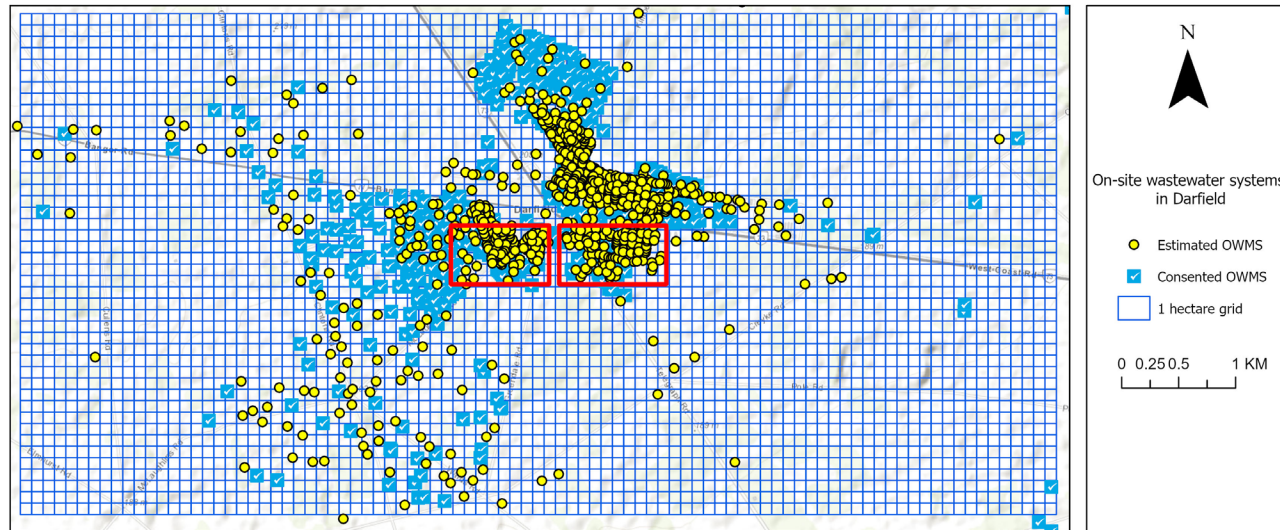
N

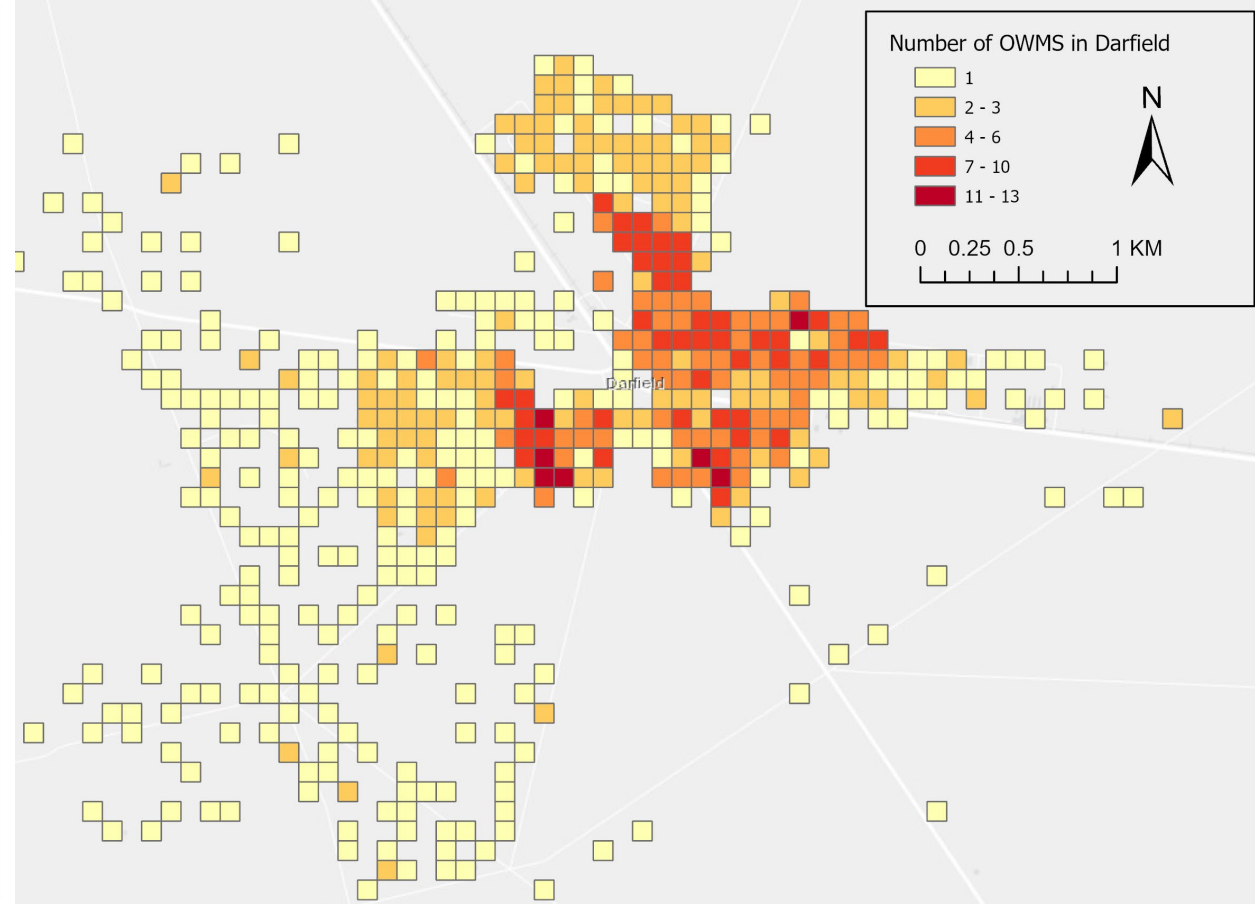
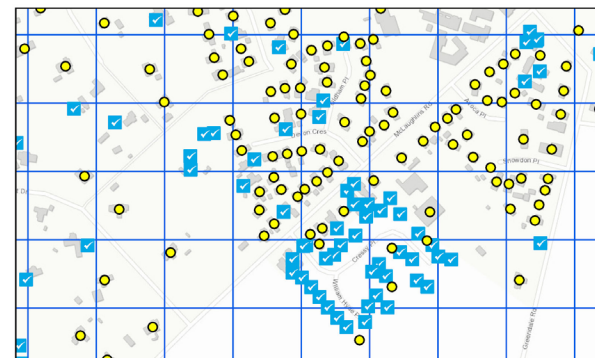
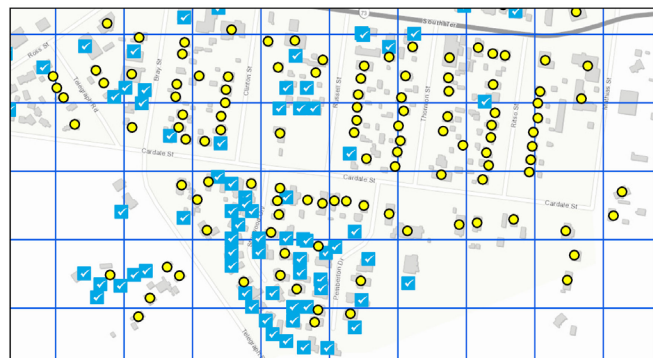
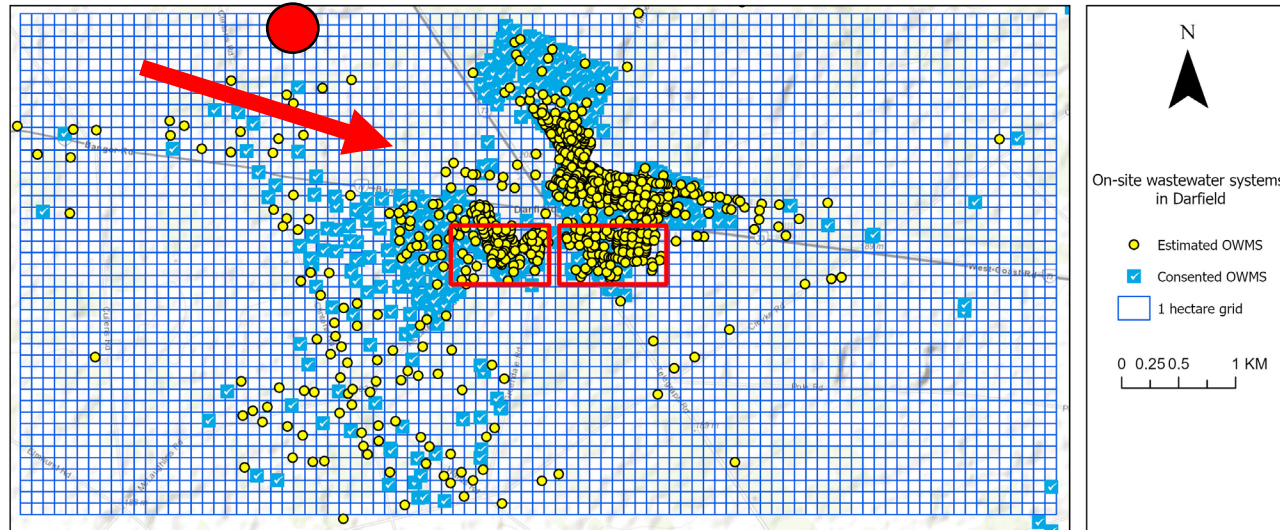
On-site wastewater systems in Darfield

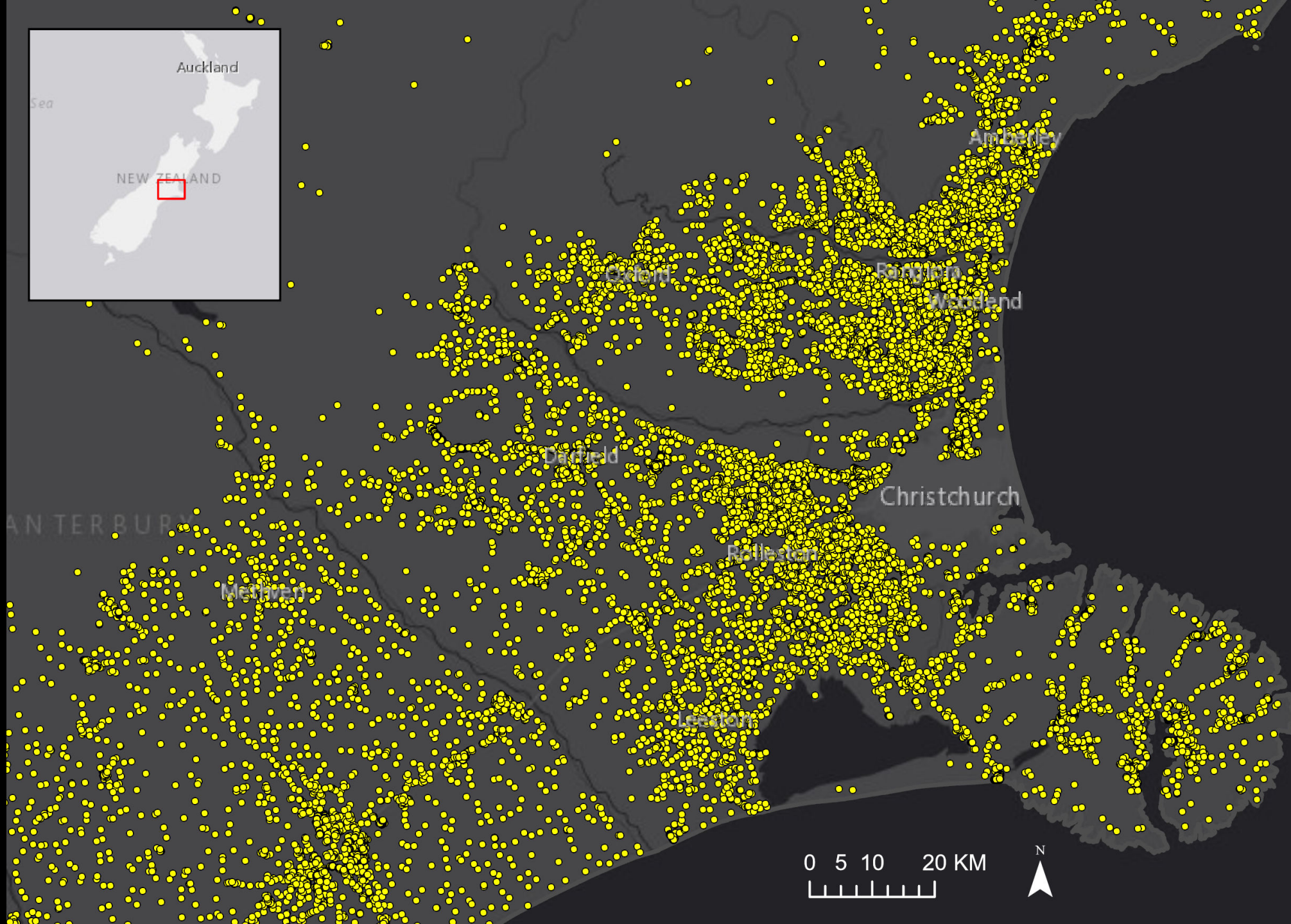
- Estimated OWMS
- ☑ Consented OWMS
- 1 hectare grid

0 0.25 0.5 1 KM









<https://mra-tool-nz.streamlit.app/>



Microbial Risk Assessment Tool

Parameter options:

- OWMS*
- Community OWMS*
- Dairy*
- Sheep & beef*
- Wildfowl*
- Stormwater*
- Animal effluent*

Norovirus ×

E. coli ×

Campylobacter ×

Contaminant source parameters ^

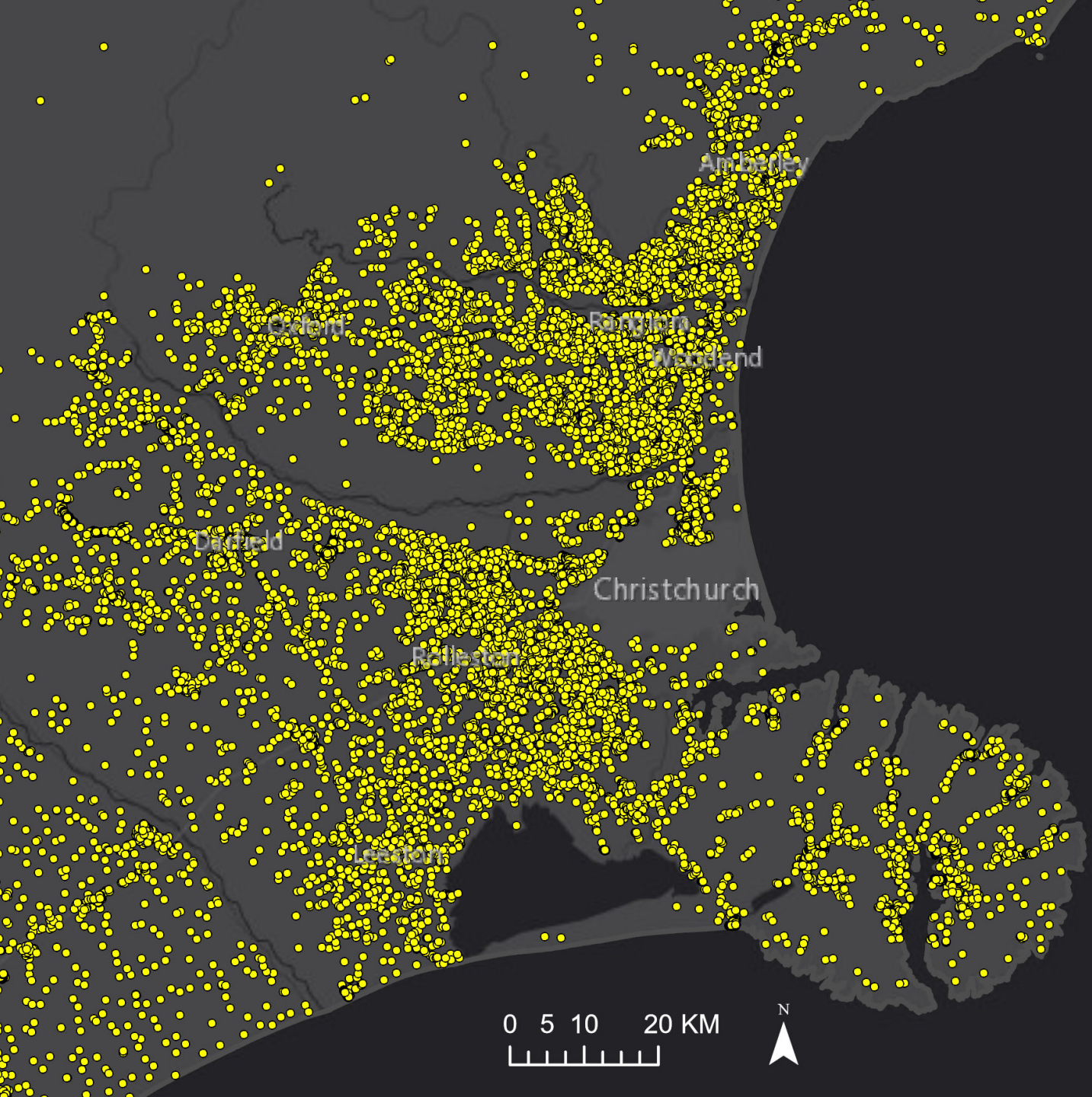
Climate Land use Soil Vadose zone Aquifer Source location Pumping scenario Treatment (OWMS only) Herd size (Dairy only)

Awareness

Awareness Technology

Awareness Technology National
 consistency

Awareness Technology National Leadership
 consistency



E/S/R

Science for Communities

He Pūtaiao, He Tāngata