Ashburton/Harakeke River Catchment

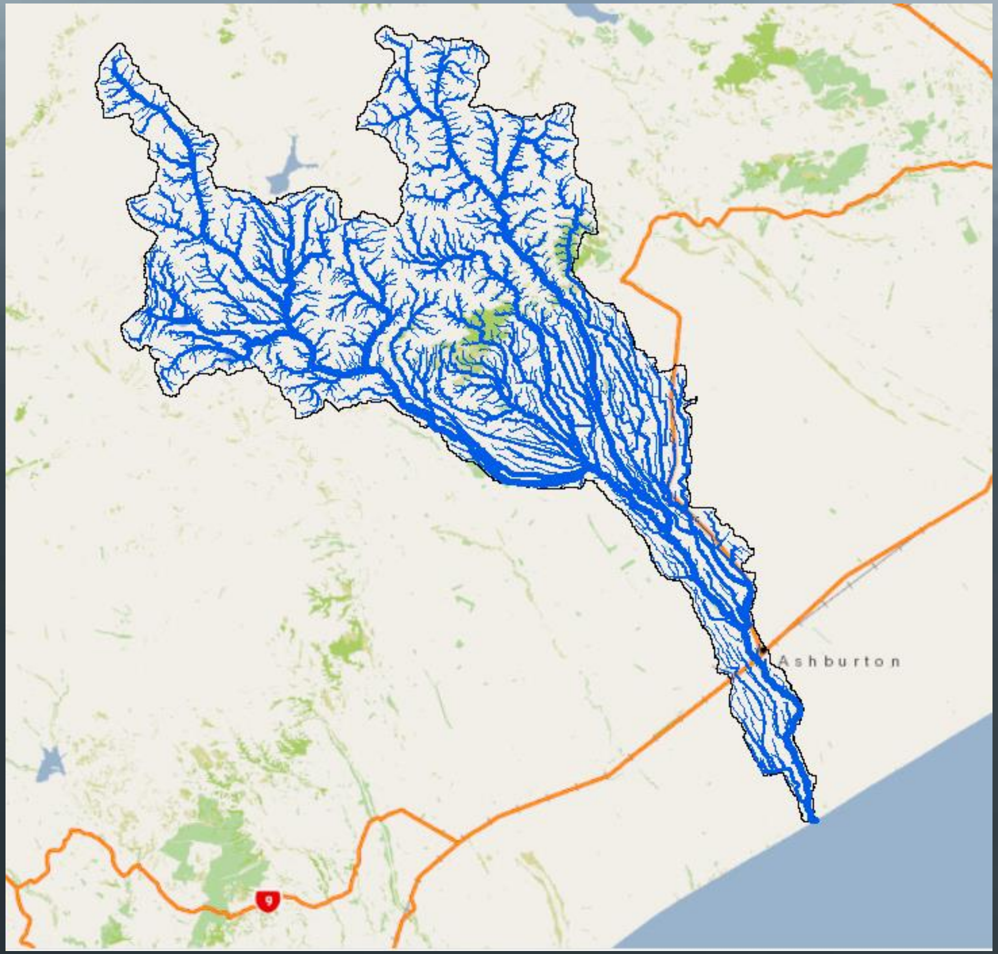
E.Coli Modelling Project

Ben Coventry

Ashburton Catchment

1) River mouth
2) Urban area
3) Farmland
4) Hills and lakes

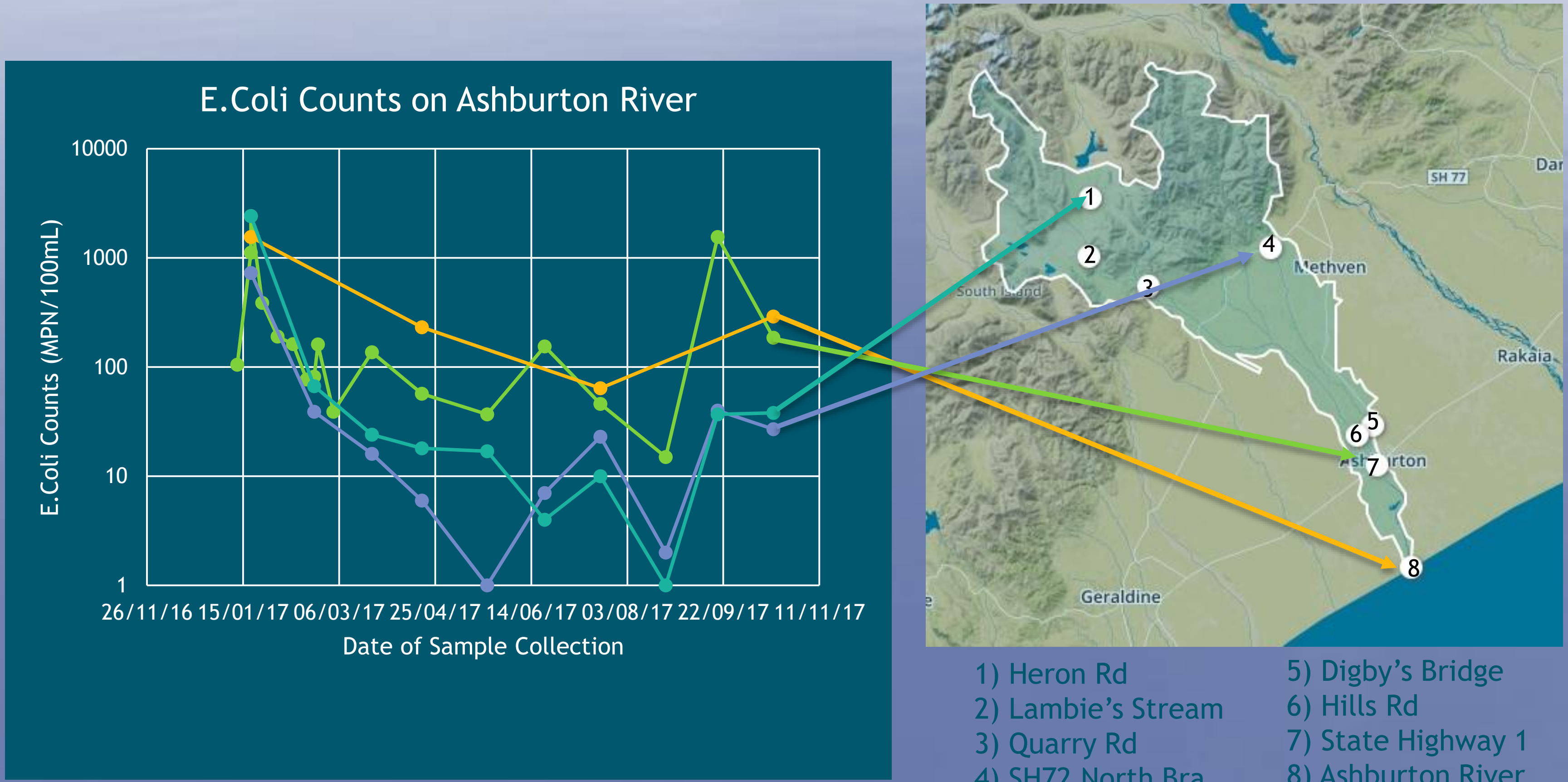
A good proof-of-concept catchment within Canterbury.



Goals and Objectives

- Estimate baseline E.Coli loading in the Ashburton River based on measurements taken for swimming advisories.
- Model the progression in E.Coli levels down the length of the river.
- Determine significant indicators of E.Coli loading based on the model and other data.

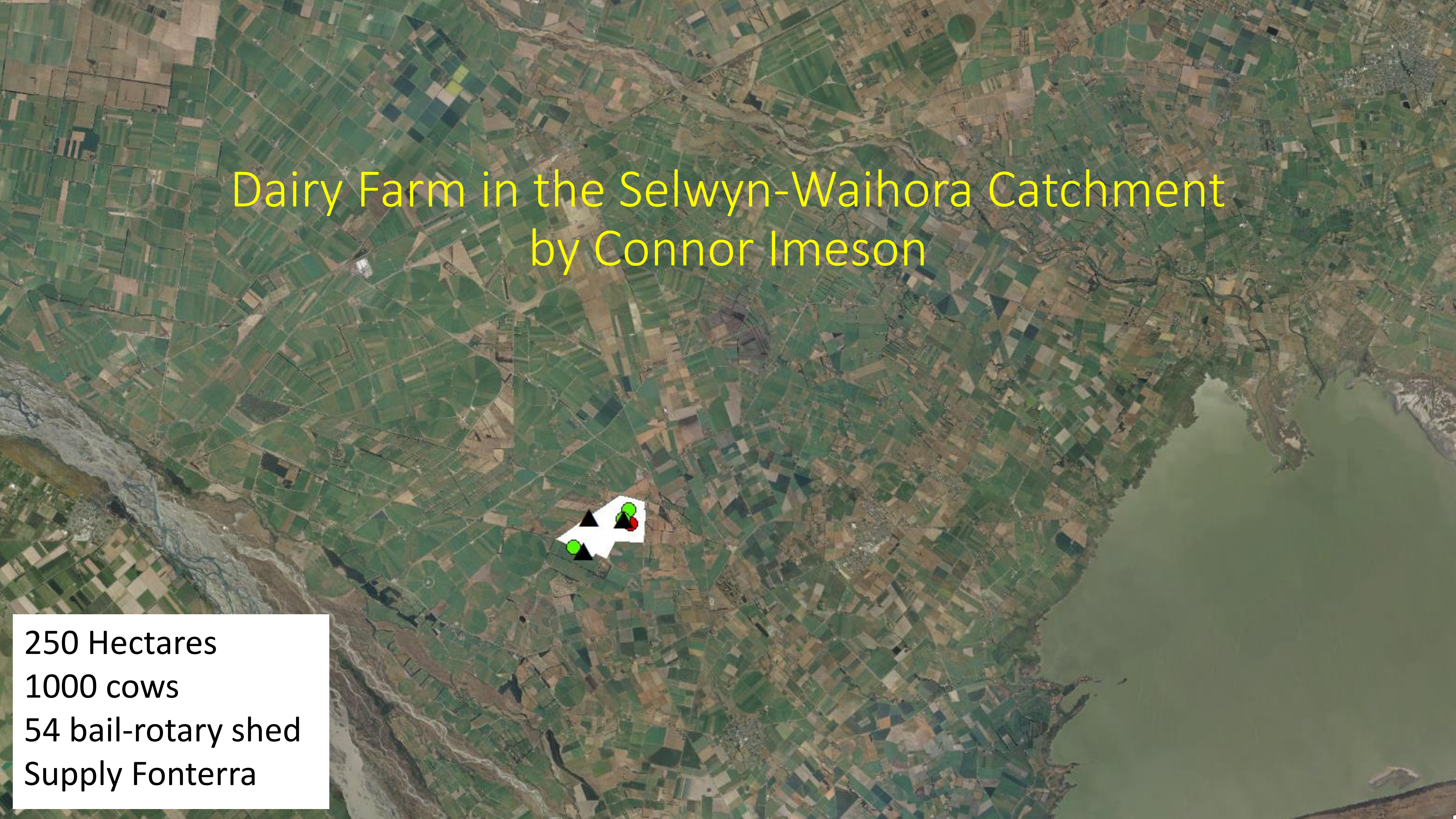
Current Progress



1) Heron Rd
2) Lambie's Stream
3) Quarry Rd
4) SH72 North Bra
5) Digby's Bridge
6) Hills Rd
7) State Highway 1
8) Ashburton River Above Mouth

https://www.lawa.org.nz/explore-data/canterbury-region/river-quality/ashburton-riverhakatere-catchment/

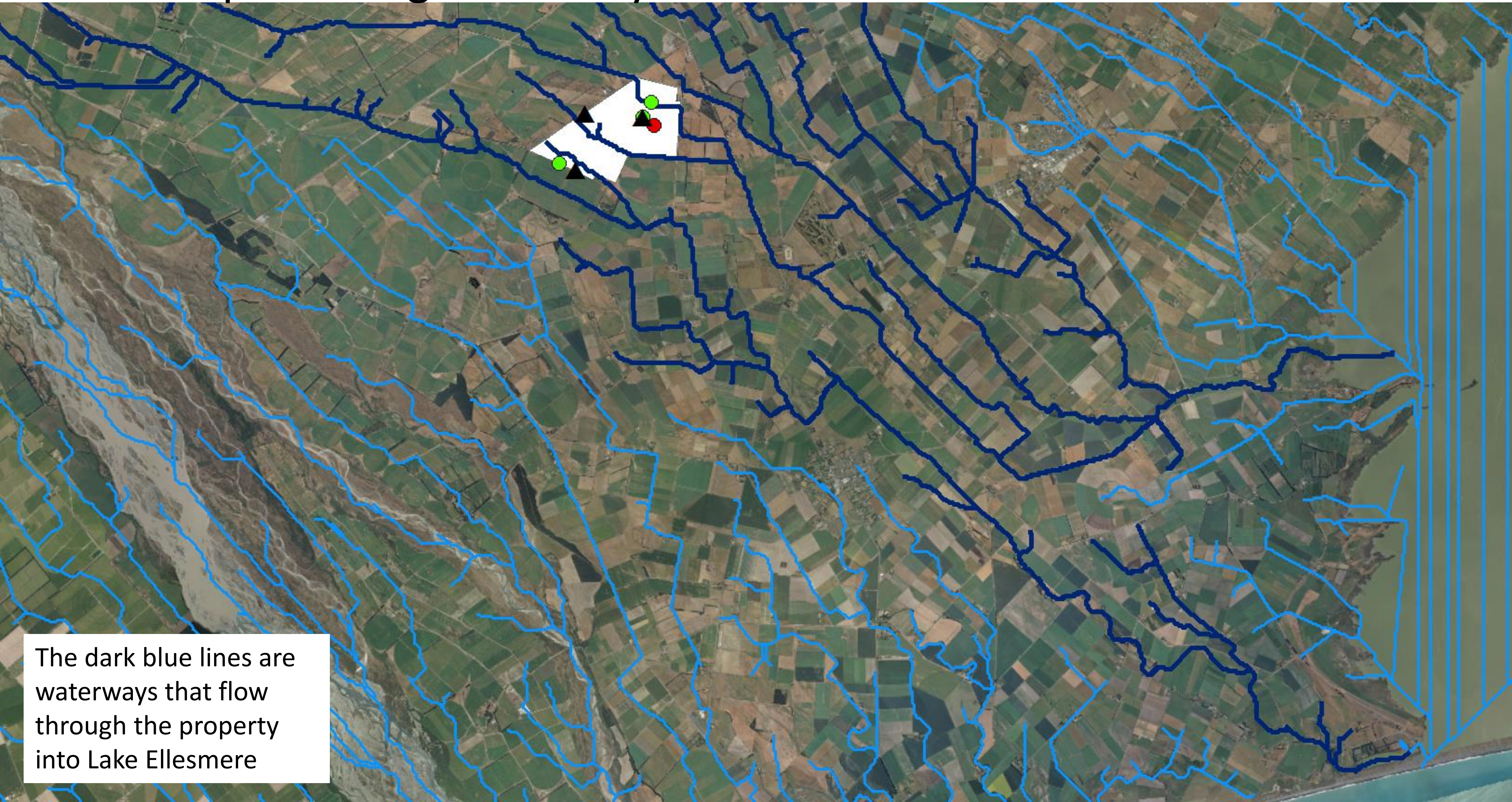
Dairy Farm in the Selwyn-Waihora Catchment
by Connor Imeson



250 Hectares
1000 cows
54 bail-rotary shed
Supply Fonterra

Boundary Map Showing Locations of Wells, Pivots and Waterways

Map showing Waterways Path from Farm to Lake Ellesmere



The dark blue lines are waterways that flow through the property into Lake Ellesmere

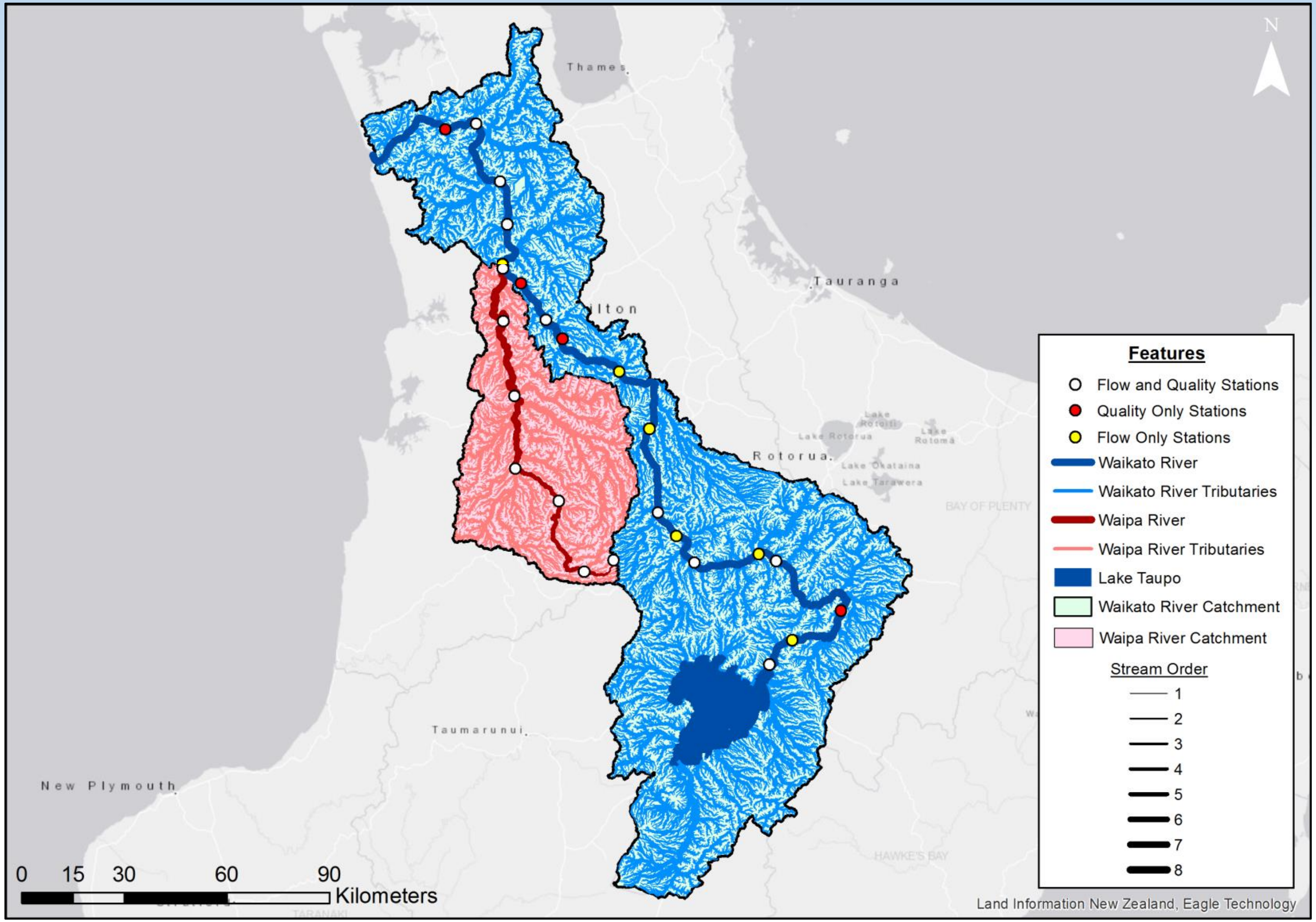
To do’s

- Work out the travel time of the ground water from farm to lake
- Work out travel time of surface water from farm to lake
- Look at the Overseer results for farm

Spatial Trends in Quality and Quantity Along the Waikato and Waipa Rivers

By Shaun Morgan

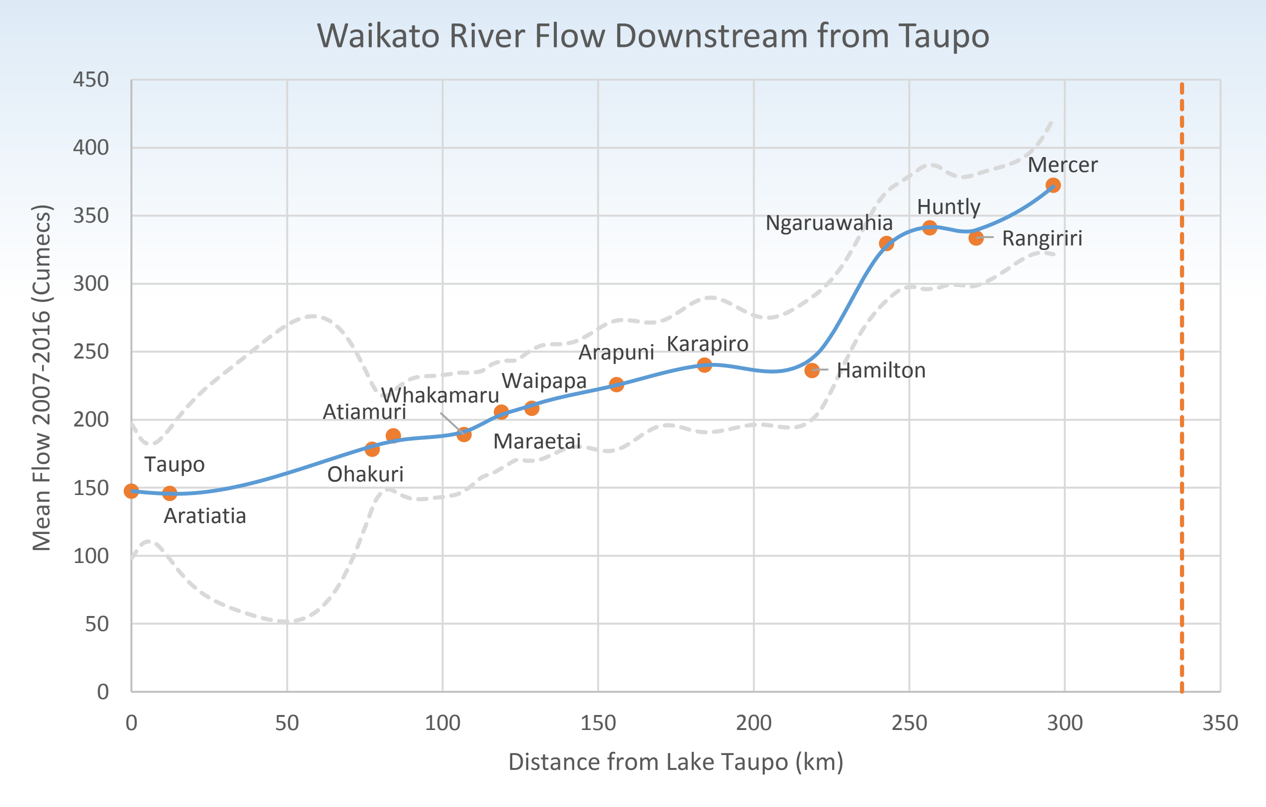
Waikato River Catchment and Waipa River Sub-catchment

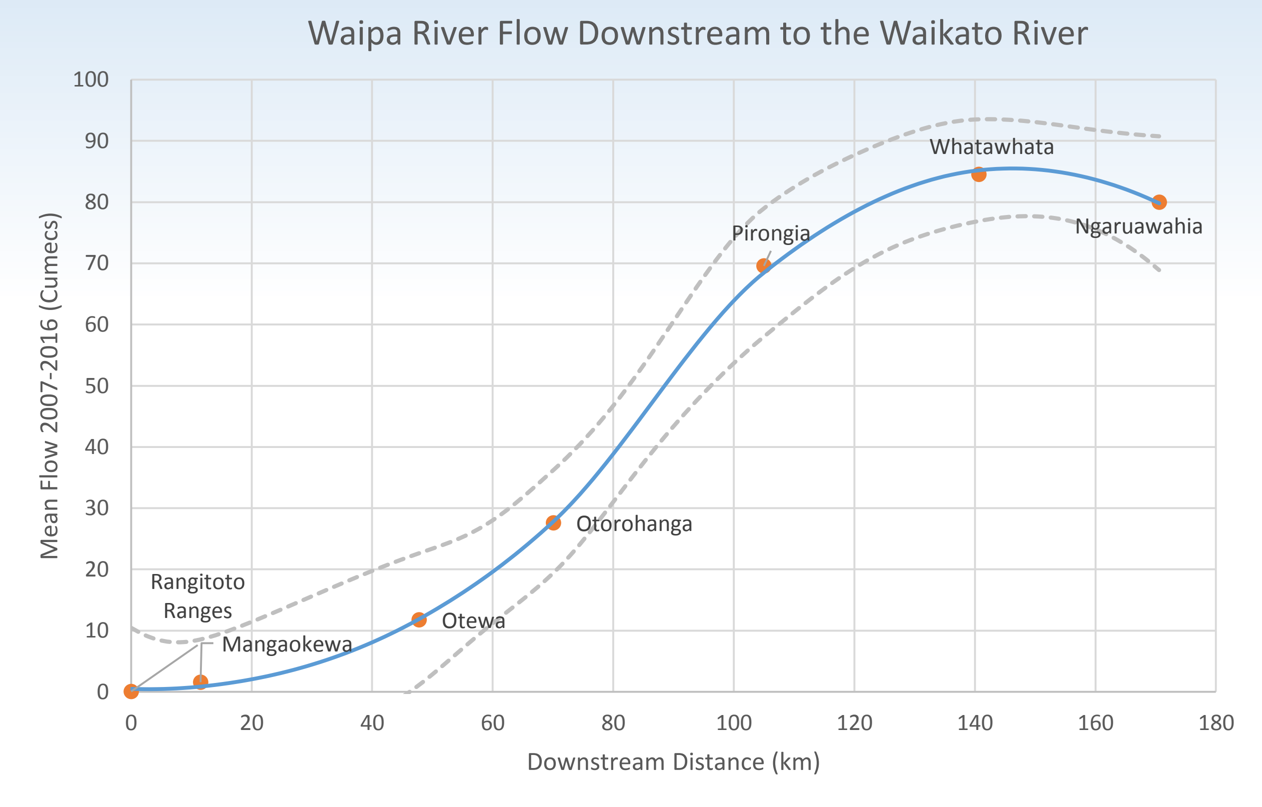


- **Aim:** To model downstream changes in river flow and quality indicators in order to examine the effects of the Waipa River on the Waikato River.
- Data obtained from: Waikato Regional Council, Mercury Energy, Genesis Energy and NIWA (2007-2016).
  - Flow
  - Turbidity
  - E. coli
  - Total Nitrogen
- Waikato River:
  - New Zealand's longest - 425km.
  - Catchment area - 14,473 km^2
- Waipa River:
  - Waikato's largest tributary - 173km.
  - Catchment area – 3,092 km^2
  - 21% of total Waikato Catchment

Modelled Mean Flows for the Waikato and Waipa Rivers

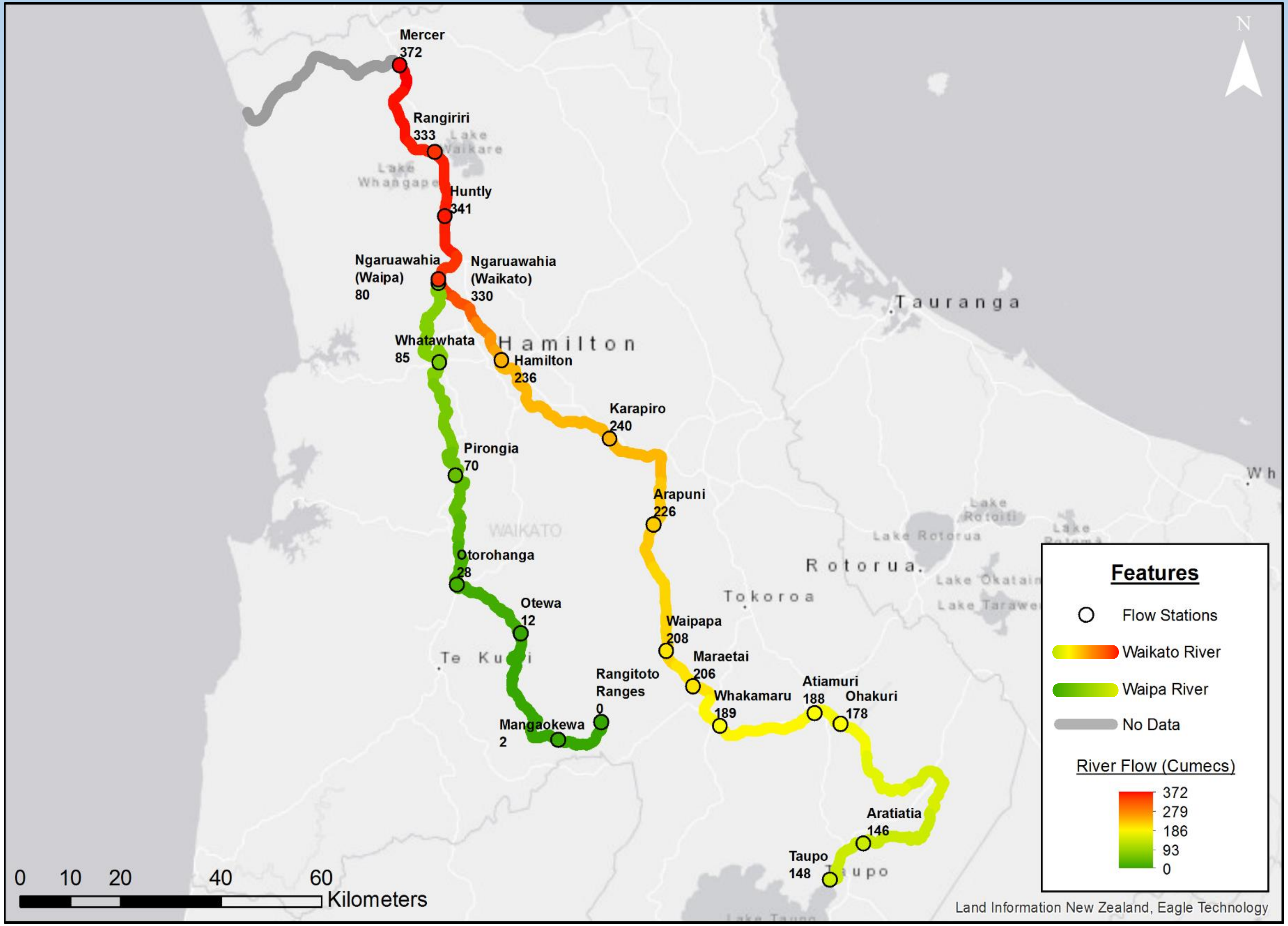
- Mean values calculated for flow data and median values for quality data.
- The RStudio statistical data analysis software was used to interpolate between values calculated for each site.
  - LOESS regression was used to predict intermediate values along the rivers based on distance downstream.
  - The degree of predictive smoothing was adjusted by examining LOESS curves with various span values.
- Both rivers show steep increases in flow where they are joined by major tributaries.





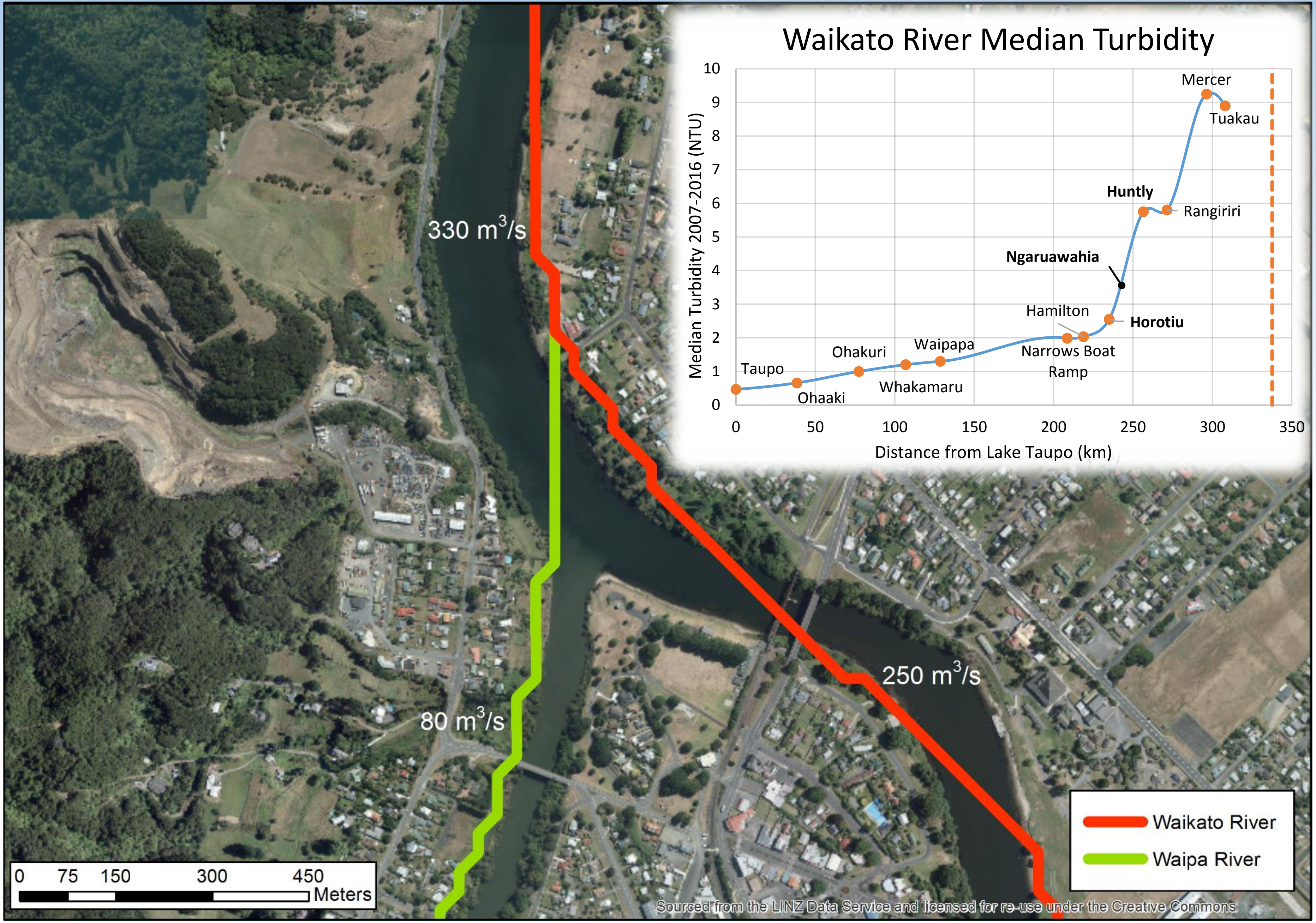
Measurement Locations — Loess Curve (span = 0.4) — 95% Confidence Interval — Port Waikato River Mouth

Mean Flows Along the Waikato and Waipa Rivers



- Flow predictions were generated for each river segment using the LOESS prediction equations in RStudio
- Flow tables were created and joined to the river database file using the common "river segment" field.
- The rivers were combined into a single file and an equal interval colour scale was used to show relative changes in flow.
- There is an obvious change from orange to red on the Waikato River where the rivers meet.

Waikato-Waipa Confluence at Ngaruawahia: Turbidity Changes



- The Waipa is noticeably lighter, suggesting higher turbidity.
- NTU more than doubles from Horotiu to Huntly.

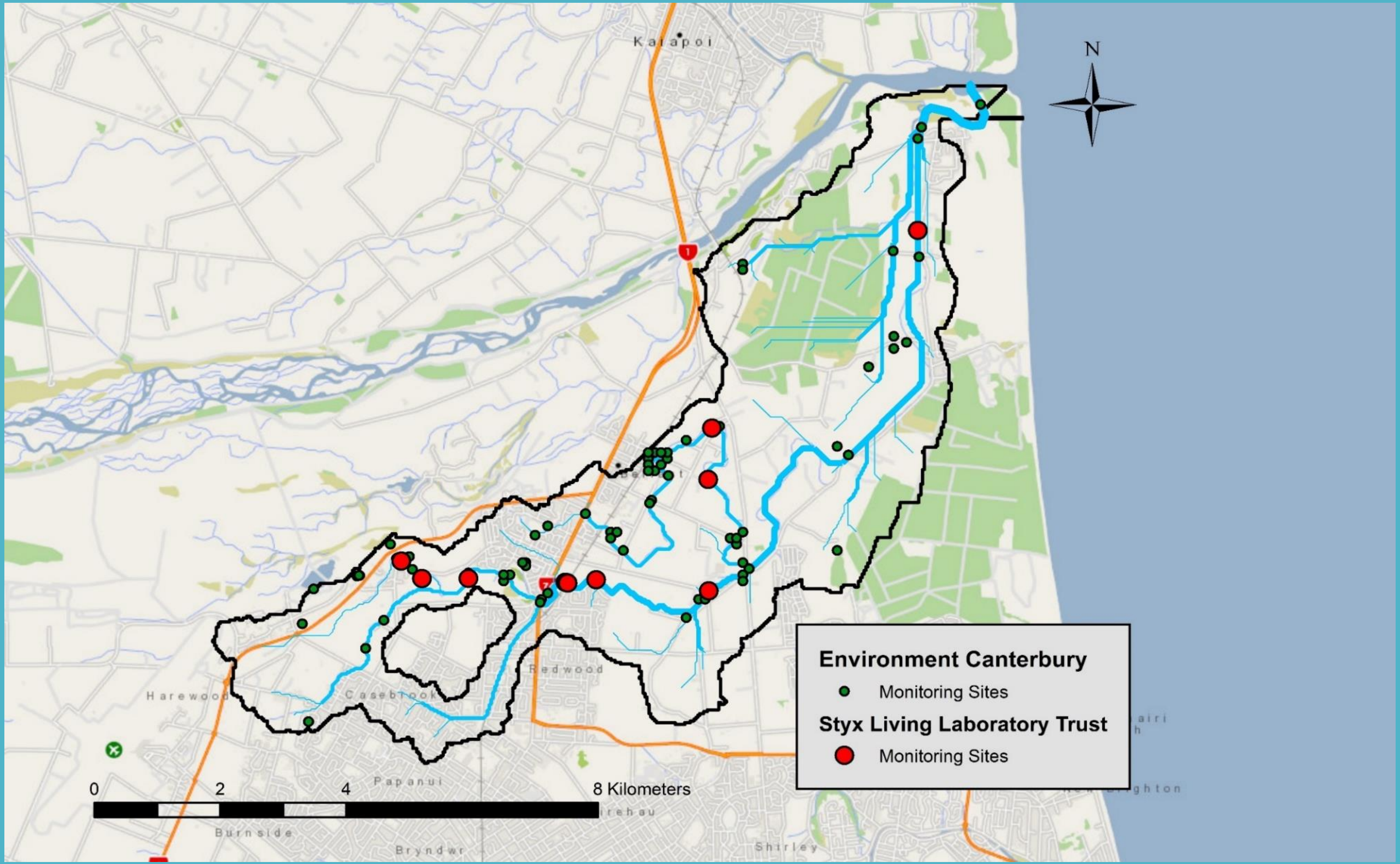
Rough Estimation

- Hamilt = 2.04 NTU x 219 m^3/s = 447
- Waipa = 11.32 NTU x 80 m^3/s = 905.6
- Huntly = 5.75 NTU x 341 m^3/s = 1962

905.6 / 1962 = 0.46

- We can estimate that 46% of the turbidity seen at Huntly is caused by the Waipa River (2.6).
- Similar analysis will be performed with Total Nitrogen and E. coli data.

The Styx River Catchment – by Ariana Painter

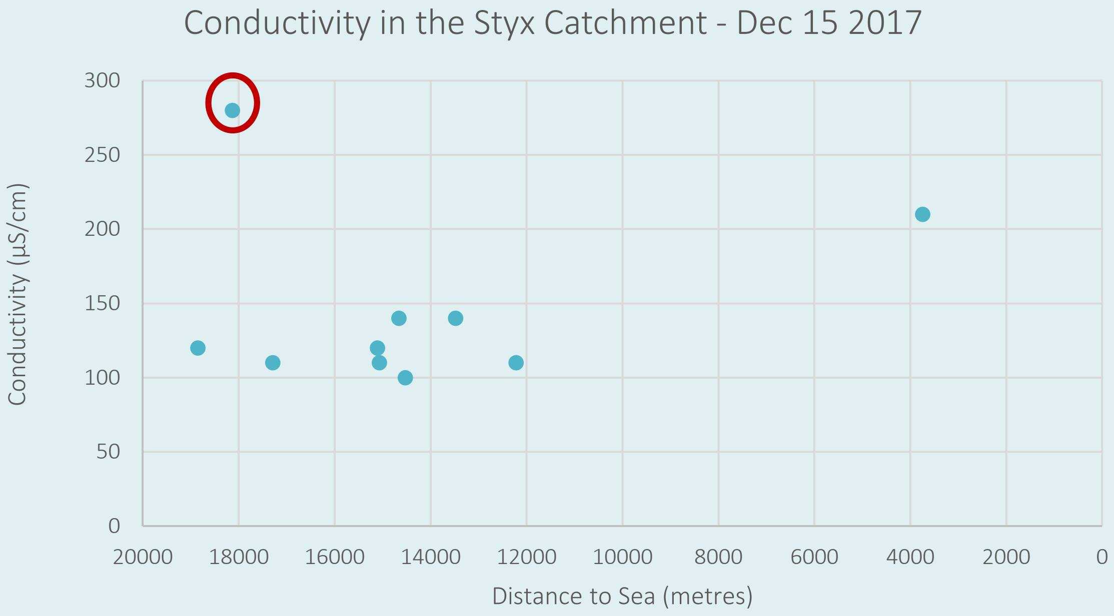


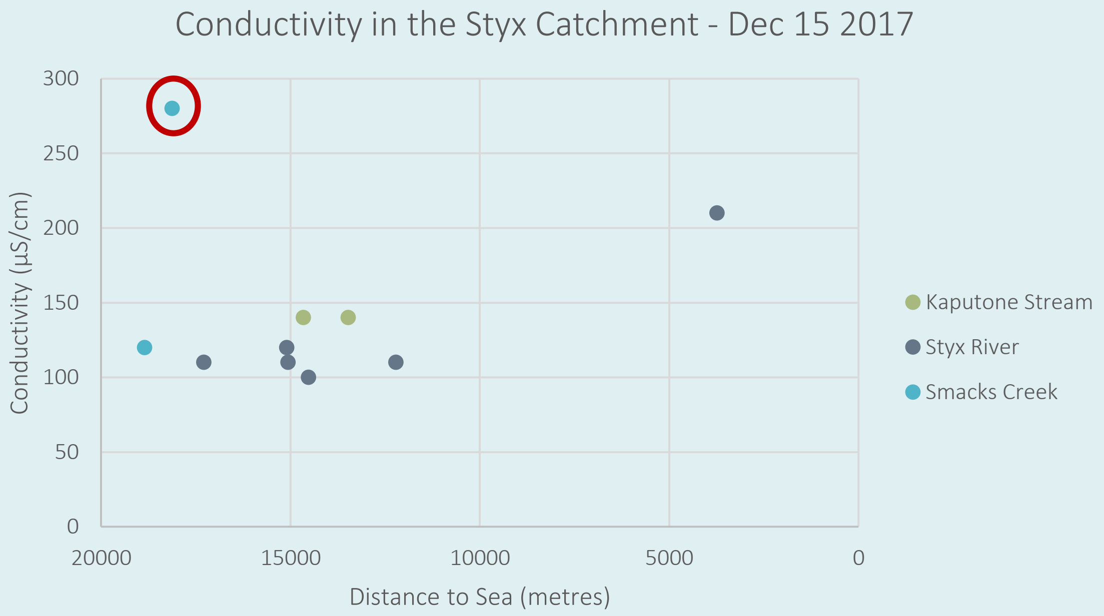
Is restoration working?: Examining spatial/temporal variation in water quality

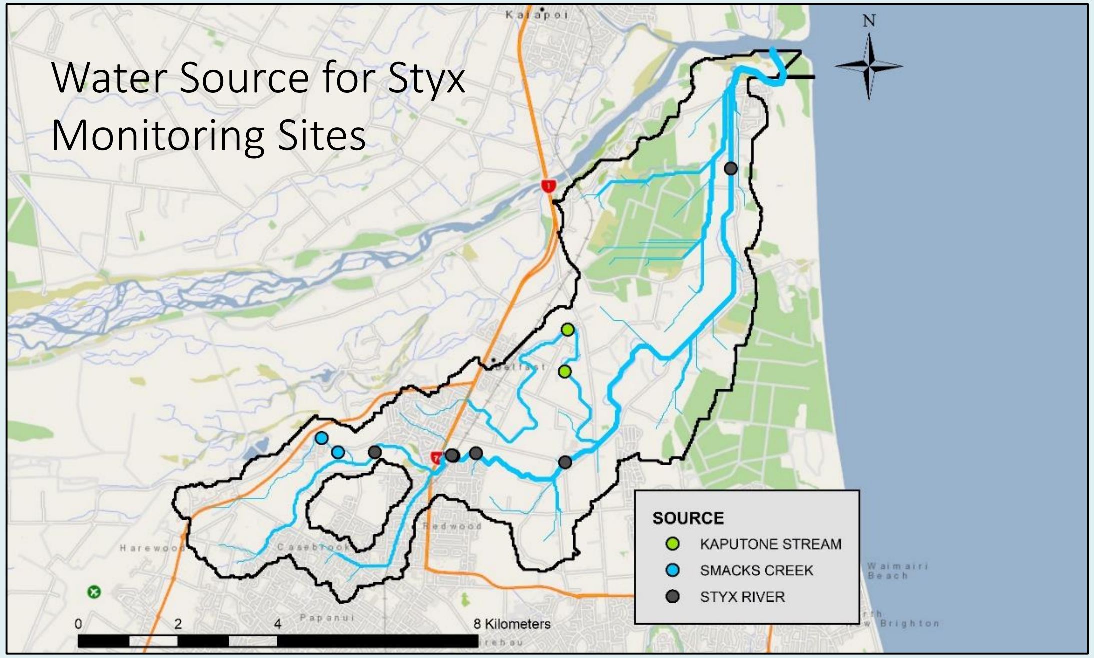
Ariana Painter

Spatial Variation

Longitudinal profile of conductivity in the Styx catchment: one outlier.

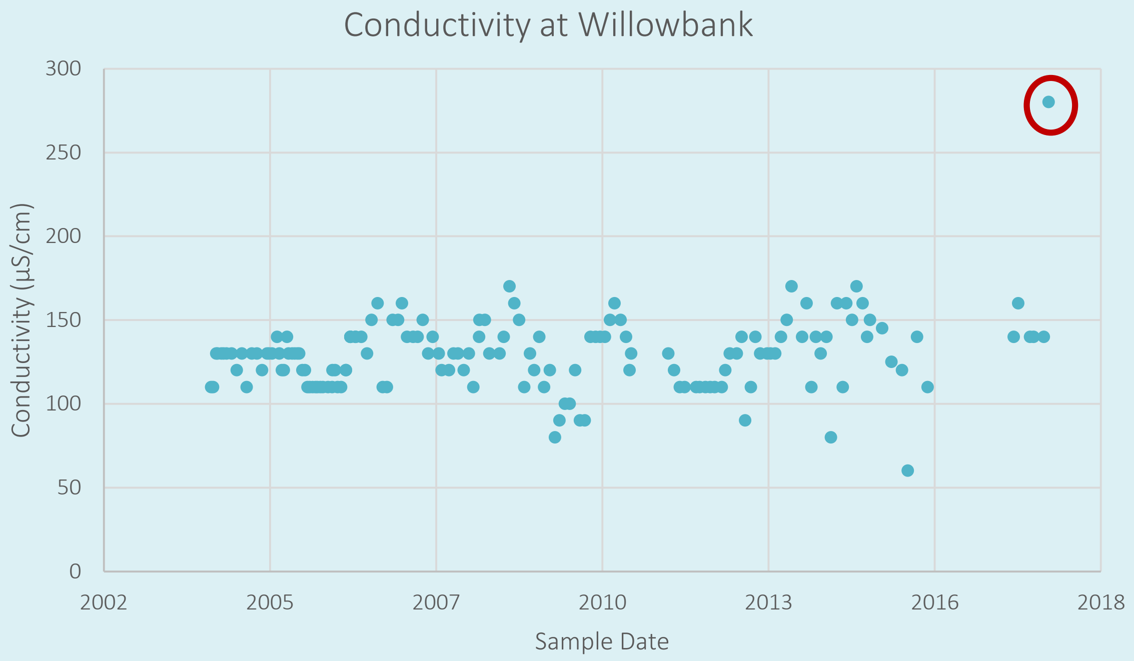


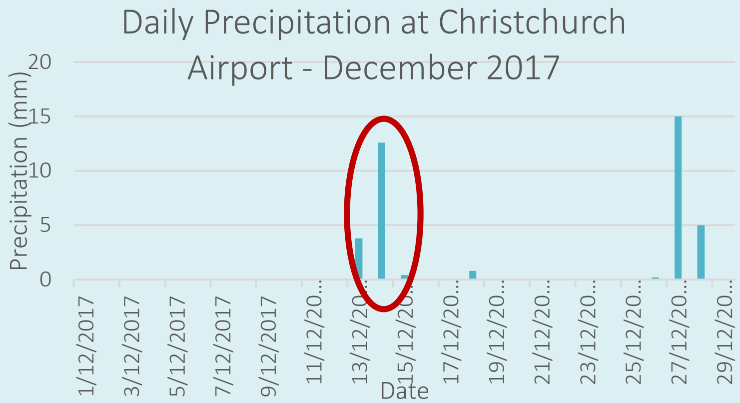


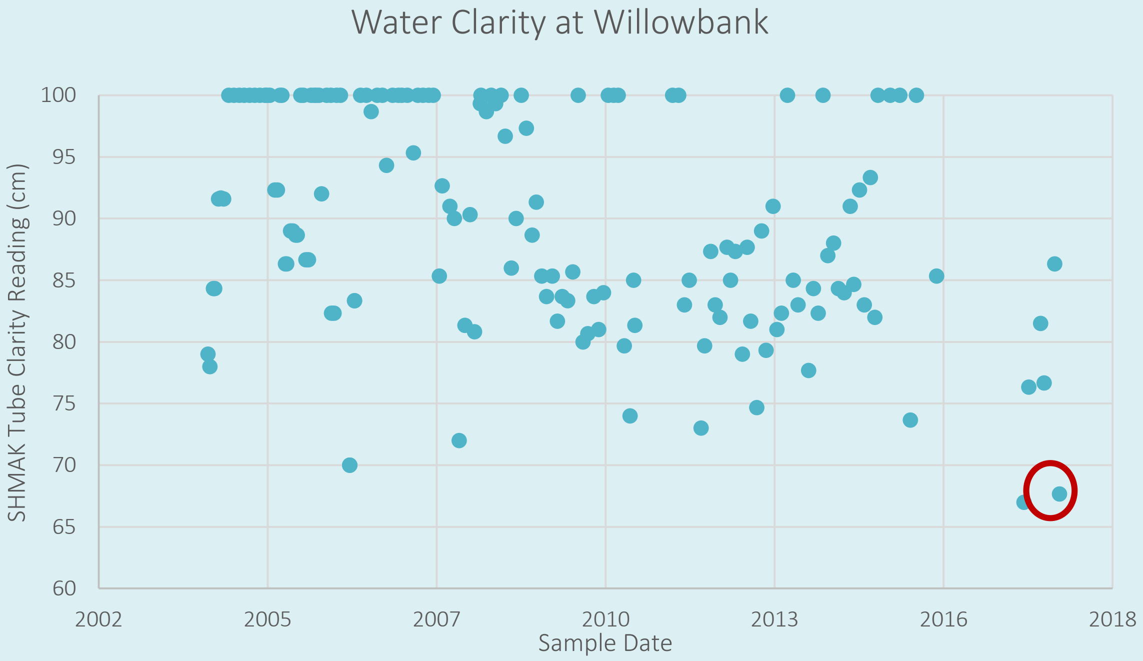


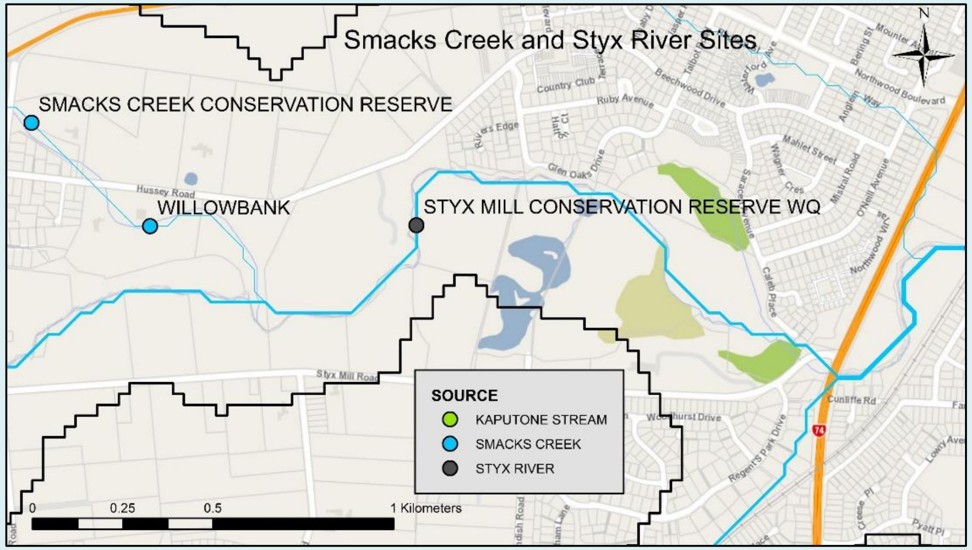
Temporal Variation

Conductivity outlier at Willowbank and links to clarity and rainfall over time







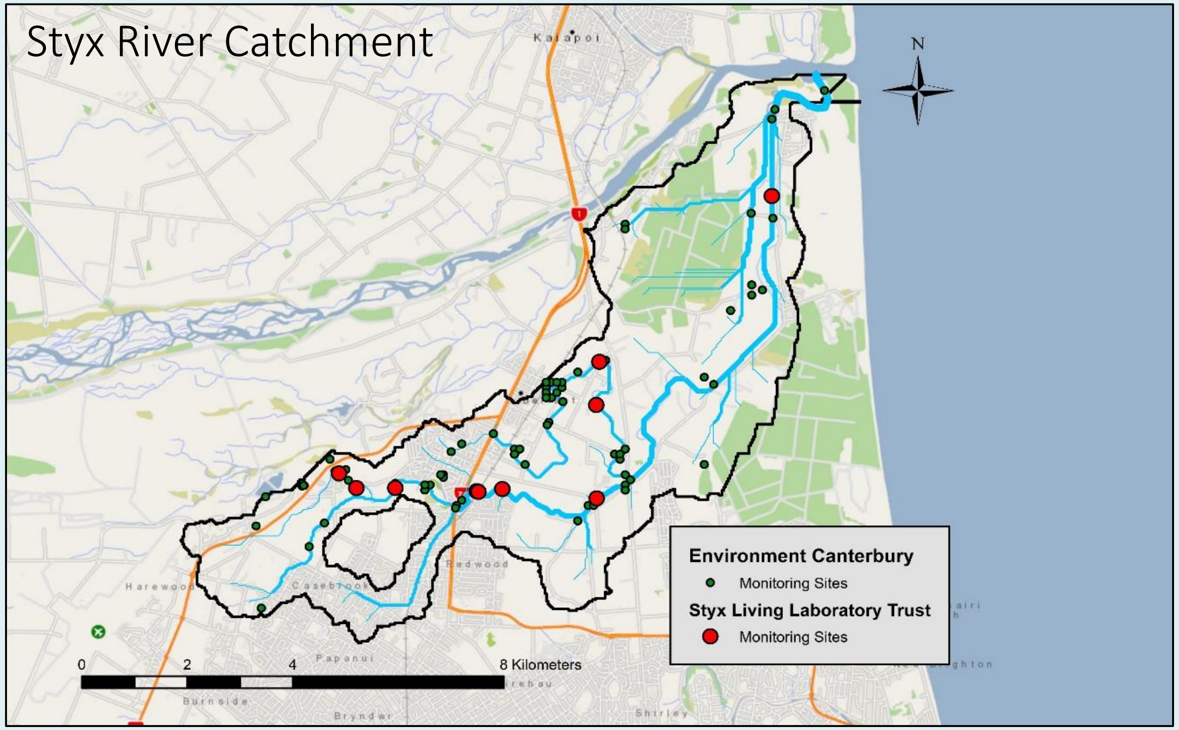


Limitations

- Single monthly samples
- Site locations and parameters

Recommendations and Next Steps

- Point source investigation
- Continuous meter
- Other sites/parameters



Riparian buffer planning with geographic information data modelling

by Phoebe Siva

- Efficiency in removing coliform bacteria (Young et al., 1980; Coyne et al., 1998)
- Buffer width and slope affects concentration of sediment in runoff (Yuan et al., 2009)
- Efficiency of buffer reduces as volume of runoff/rainfall increases (Tate et al., 2004; Tate et al., 2006)
- Dilution by rainfall affects concentration of dissolved contaminants (Schmitt et al., 1999)

Soil

- Infiltration
- Texture and bulk density
- Moisture and temperature
- Soil type and nutrient affinity/permeability

Vegetation

- Vegetation type and nutrients
- Vegetation size and efficiency

Auckland regional council recommended buffer widths

5 metres

- Only for very small waterways
- require maintenance

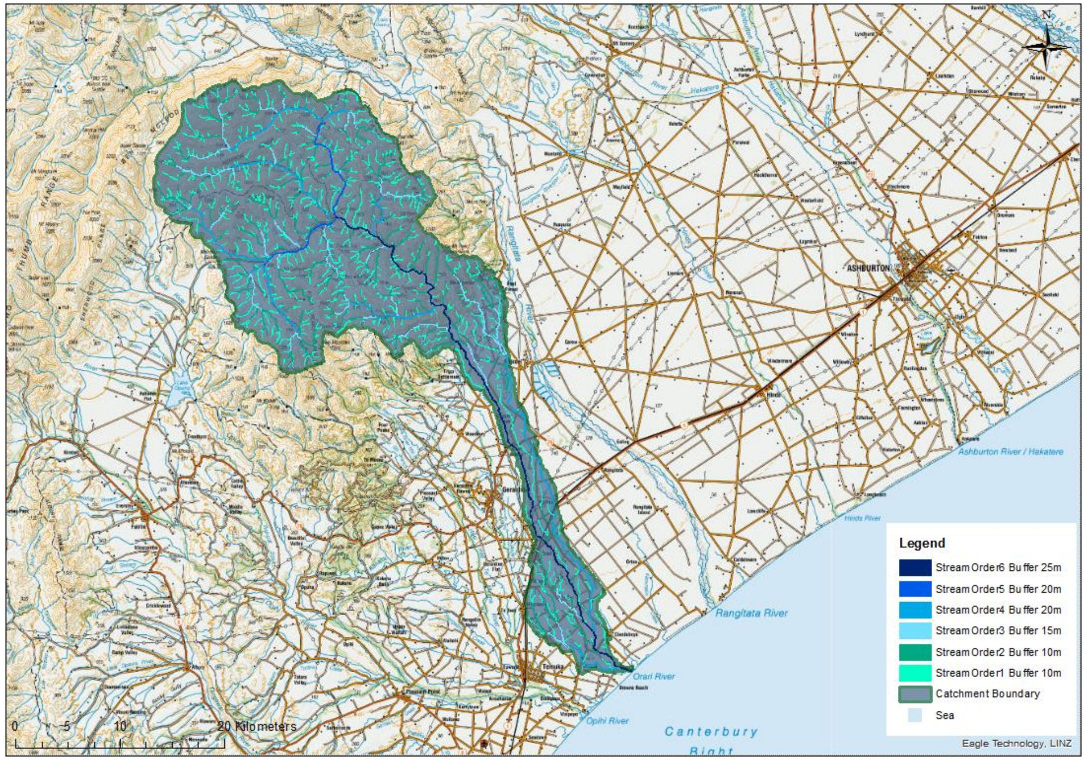
10 metres

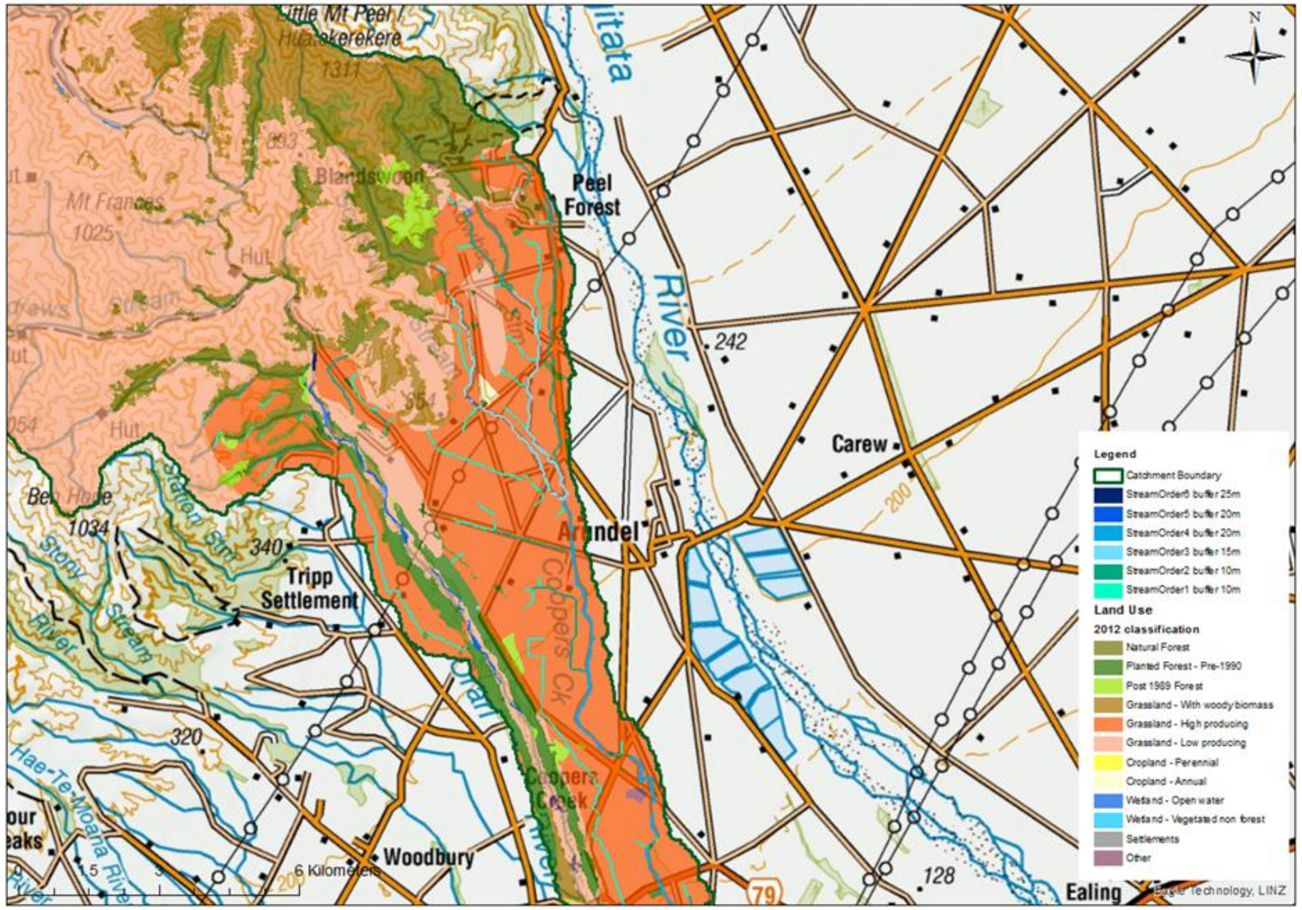
- Guideline for minimum buffer width
- Sustainable succession of indigenous vegetation

15 metres

- Most likely self sustaining

Stream order	Buffer width (m)	
	Default	Adjusted
1	5	10
2	10	10
3	15	15
4	20	20
5	25	20
6	30	25





Adjusted riparian buffer width to suit land use in the Orari catchment

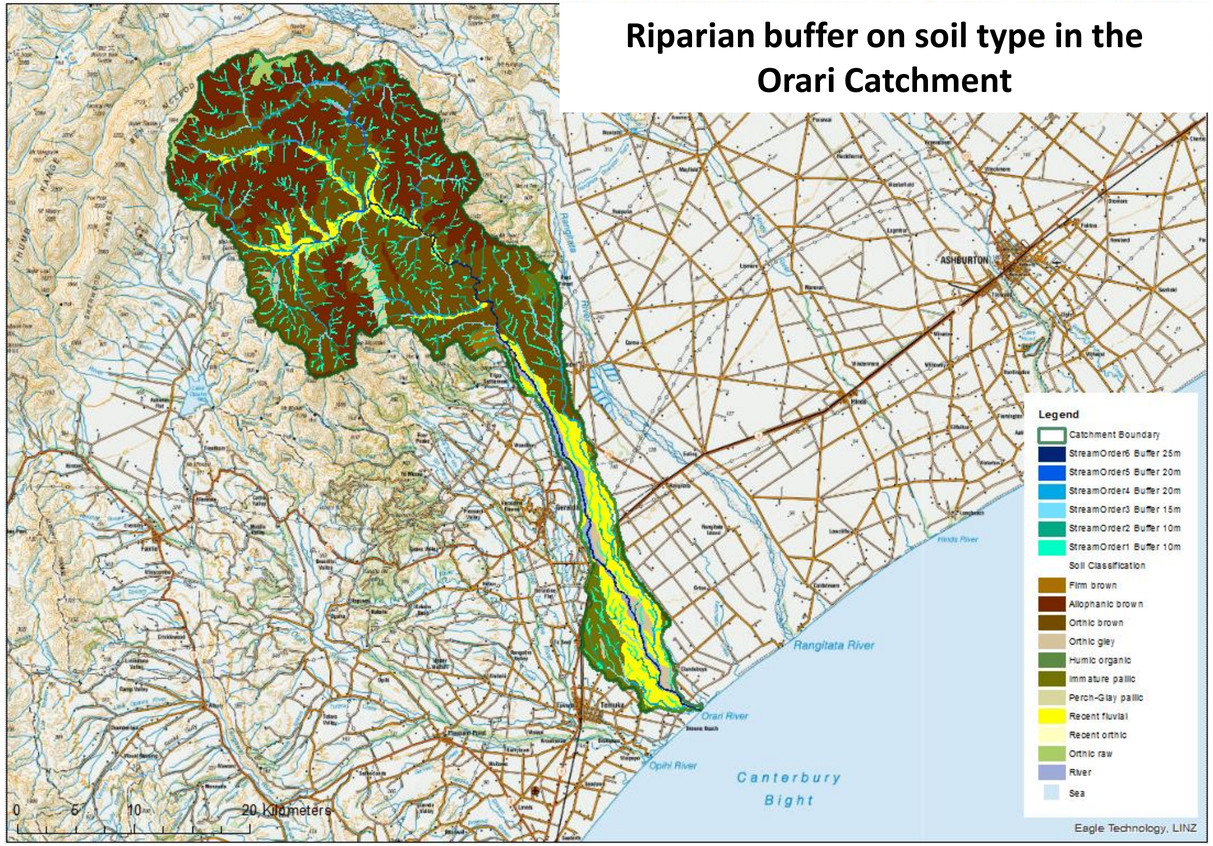
- Larger widths for smaller streams and slightly adjusted widths for bigger streams to compensate for intensive land use
- Reduced total land used for riparian buffers

Soil and riparian buffers

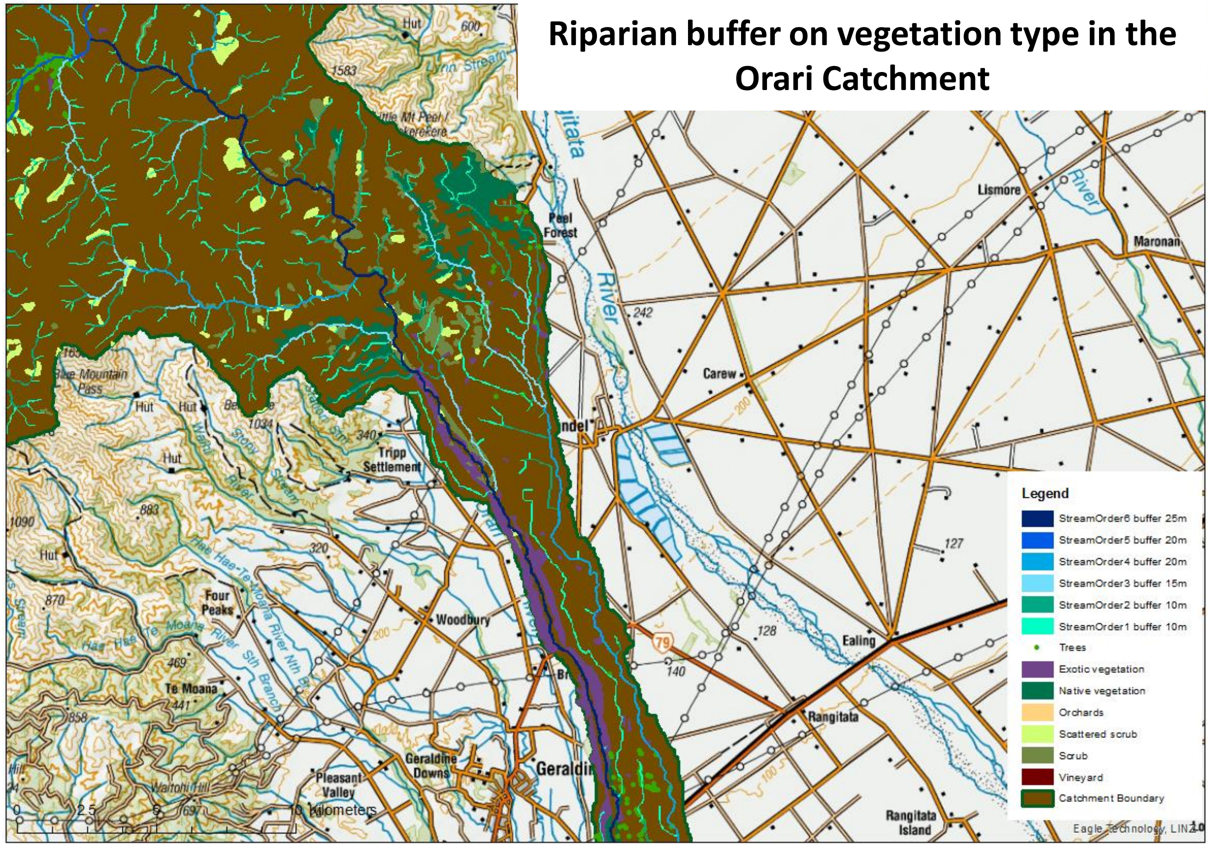
Infiltration

- soil type, texture and bulk density
- Water flow directions and accumulation

Potential adjustments for buffer planning and management on Allophanic and Pallic soil



Riparian buffer on soil type in the Orari Catchment



Riparian buffer on vegetation type in the Orari Catchment

Vegetation and riparian buffers

- Planning riparian buffers in relation to vegetation type (species, size)
- Indigenous vegetation is best for long term stability and sustainability (Auckland regional council)

Other factors to consider

- Microclimate

- Maintenance

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- Atwill, E. R., Hou, L., Karle, B. M., Harter, T., Tate, K. W., & Dahlgren, R. A. (2002). Transport of cryptosporidium parvum oocysts through vegetated buffer strips and estimated filtration efficiency. *Applied and Environmental Microbiology, 68*(11), 5517-5527.
- Coyne, M. S., Gilfillen, R. A., Villalba, A., Zhang, Z., Rhodes, R., Dunn, L., & Blevins, R. L. (1998). Fecal bacteria trapping by grass filter strips during simulated rain. *Journal of Soil and Water Conservation, 53*(2), 140-145.
- Entry, J. A., Hubbard, R. K., Thies, J. E., & Fuhrmann, J. J. (2000). The influence of vegetation in riparian filterstrips on coliform bacteria: I. Movement and survival in water. *Journal of Environmental Quality, 29*(4), 1206-1214.
- Schmitt, T. J., Dosskey, M. G., & Hoagland, K. D. (1999). Filter strip performance and processes for different vegetation, widths, and contaminants. *Journal of Environmental Quality, 28*(5), 1479-1489.
- Tate, K. W., Pereira, Maria Das Gracas C, & Atwill, E. R. (2004). Efficacy of vegetated buffer strips for retaining cryptosporidium parvum. *Journal of Environmental Quality, 33*(6), 2243-2251.
- Tate, K. W., Atwill, E. R., Bartolome, J. W., & Nader, G. (2006). Significant escherichia coli attenuation by vegetative buffers on annual grasslands. *Journal of Environmental Quality, 35*(3), 795-805.
- Young, R. A., Huntrods, T., & Anderson, W. (1980). Effectiveness of vegetated buffer strips in controlling pollution from feedlot Runoff1. *Journal of Environment Quality, 9*(3), 483-487.
- Yuan, Y., Bingner, R. L., & Locke, M. A. (2009). A review of effectiveness of vegetative buffers on sediment trapping in agricultural areas. *Ecohydrology, 2*(3), 321-336.

Databases

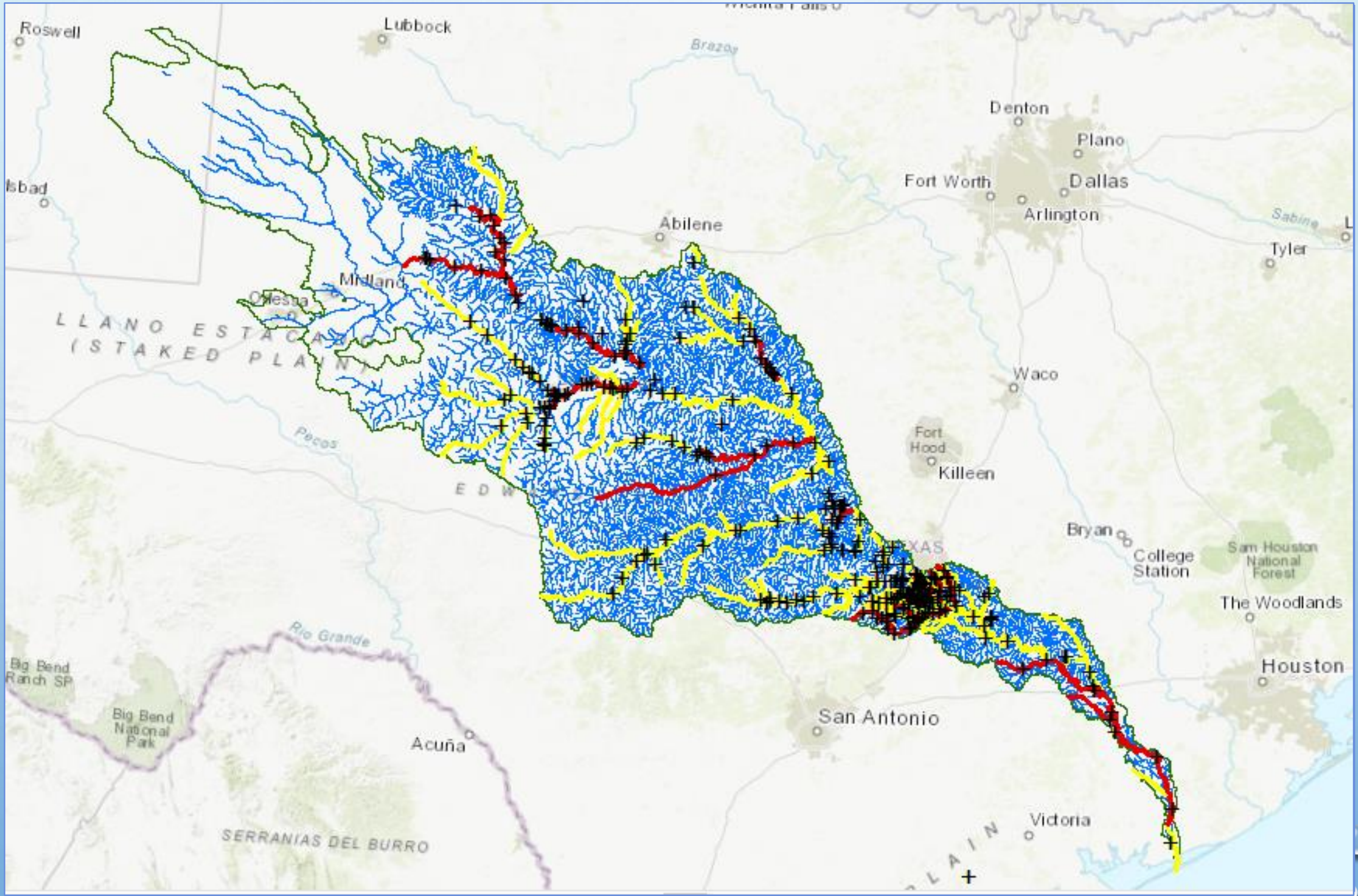
- Land Information New Zealand data service
- Ministry for the Environment data service
- Land Resource Information Systems Portal

TOTAL MAXIMUM DAILY LOADS

A US APPROACH TO MANAGING DIFFUSE CONTAMINATION OF WATERWAYS, AND COMPARISON WITH NZ

RACHEL SKEWS, WATR404 TERM PROJECT 2018

ASSESSMENT
EXAMPLE: COLORADO RIVER, TEXAS



TMDL

=

Total amount of contaminant allowed while meeting the water quality standard

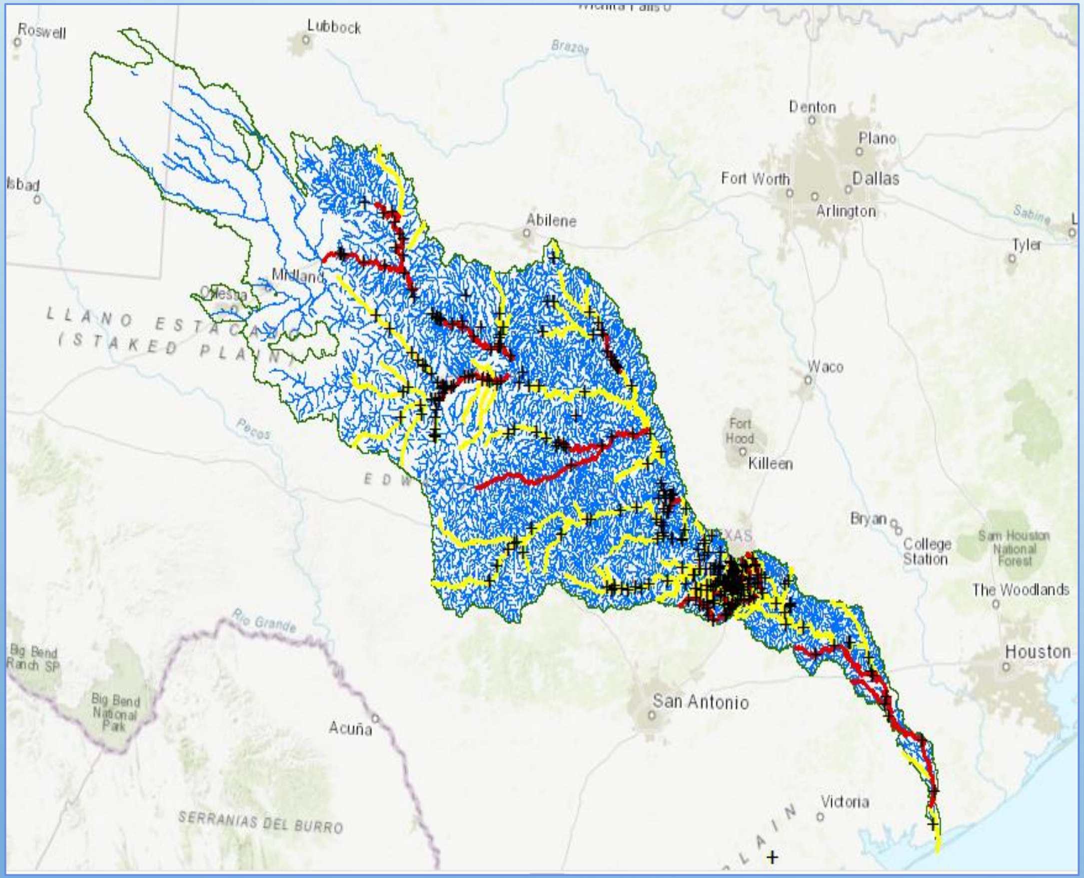
$$\text{TMDL} = \sum \text{Point source discharges} + \sum \text{Diffuse discharges} + \text{Background} + \text{Safety margin}$$

→ Solve for Diffuse discharges

→ Plan to reduce to meet the TMDL

COLORADO RIVER CATCHMENT:

- 99,052 KM^2
- 114 SEGMENTS (868 KM^2/SEG)
- > 348 MONITORING SITES (3 SITES/SEG)



RANGITIKEI RIVER CATCHMENT:

- 3,917 KM^2
- 14 SUB MANAGEMENT ZONES (279 KM^2/ZONE)
- 13 MONITORING SITES (1 SITE/SEG)

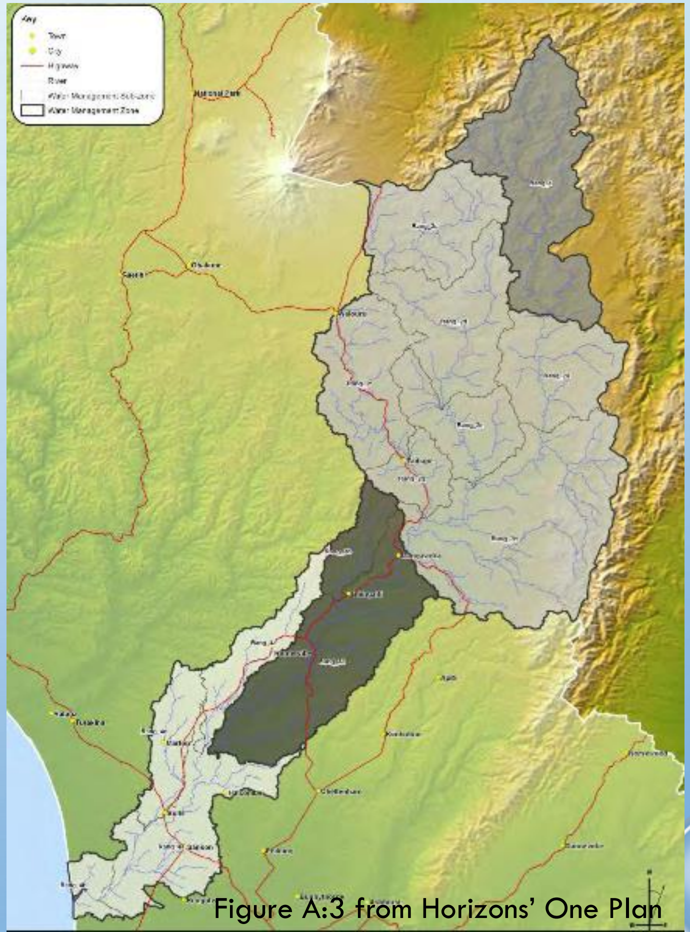
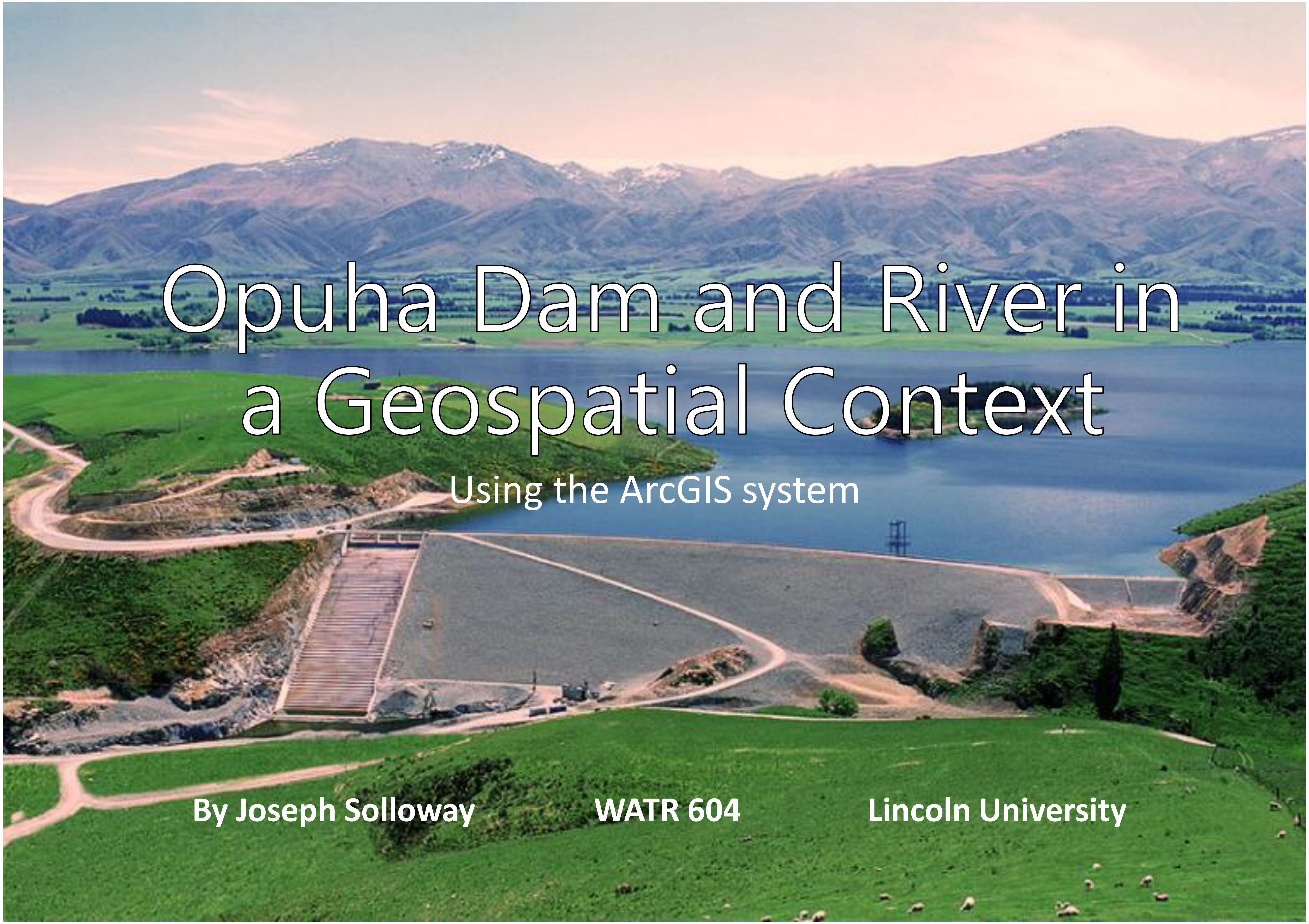


Figure A:3 from Horizons' One Plan

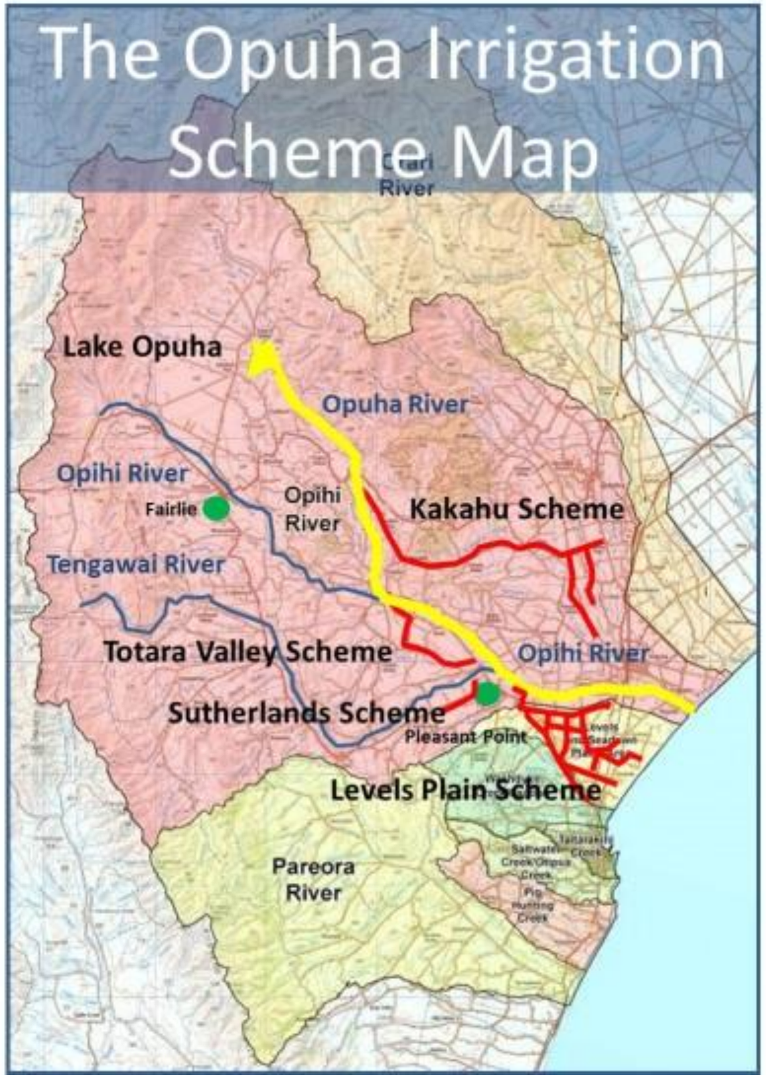
OTHER KEY DIFFERENCES TO NZ

- Nutrients not part of majority of standards in Texas (but they are in other states)
- Focus on calculation of TMDL
- Pass/fail concept


Opuha Dam and River in a Geospatial Context
Using the ArcGIS system
By Joseph Solloway
WATR 604
Lincoln University

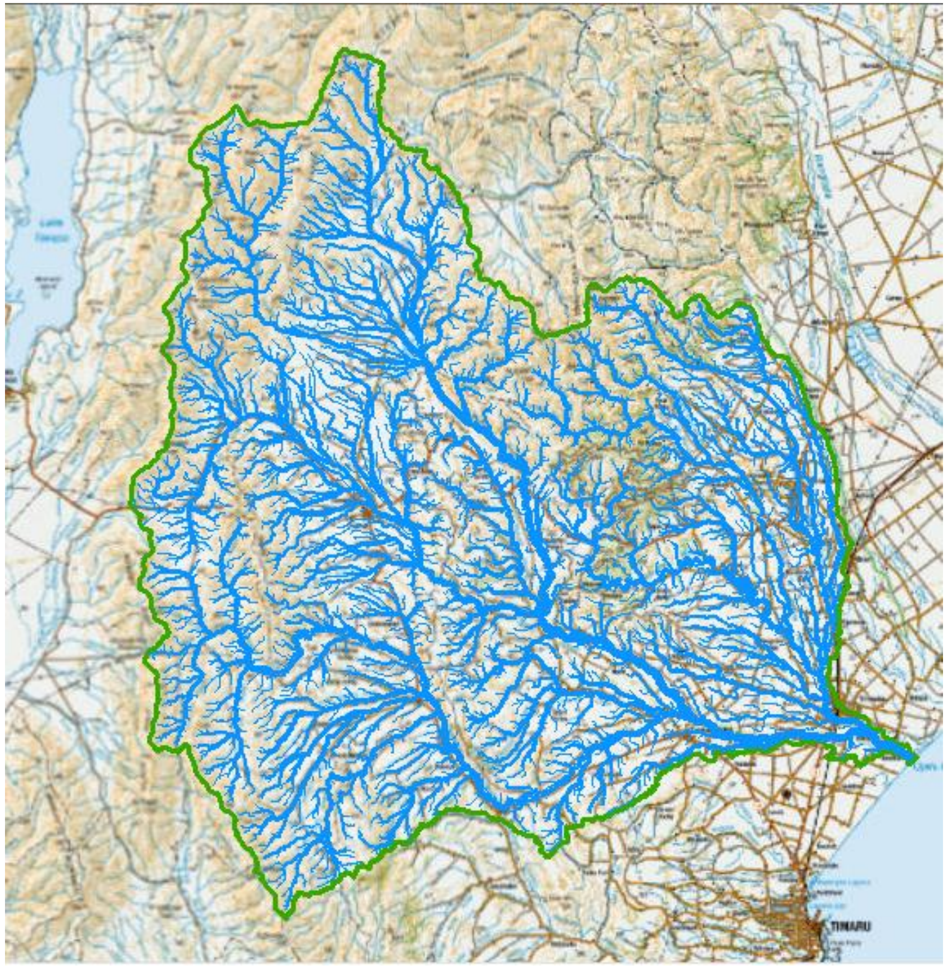
History of the Dam Project

- Located at the confluence of the North and South Opuha rivers, South Canterbury.
- Construction began 1995 and despite a minor delay due to flooding in 1997, became fully operational in 1999 (Doug Hood Limited).
- 50m high earth dam, with downstream weir to maintain minimum flows of 1.5 cumecs.
- Lake storage of over 74 million cubic meters of water, supplying 16000 hectares of irrigation land and industry.
- Managed by Opuha Water Limited and supplies the Levels Plain, Kakahu, Totara Valley and Sutherlands irrigation via Opuha/Opihi river.



My Project

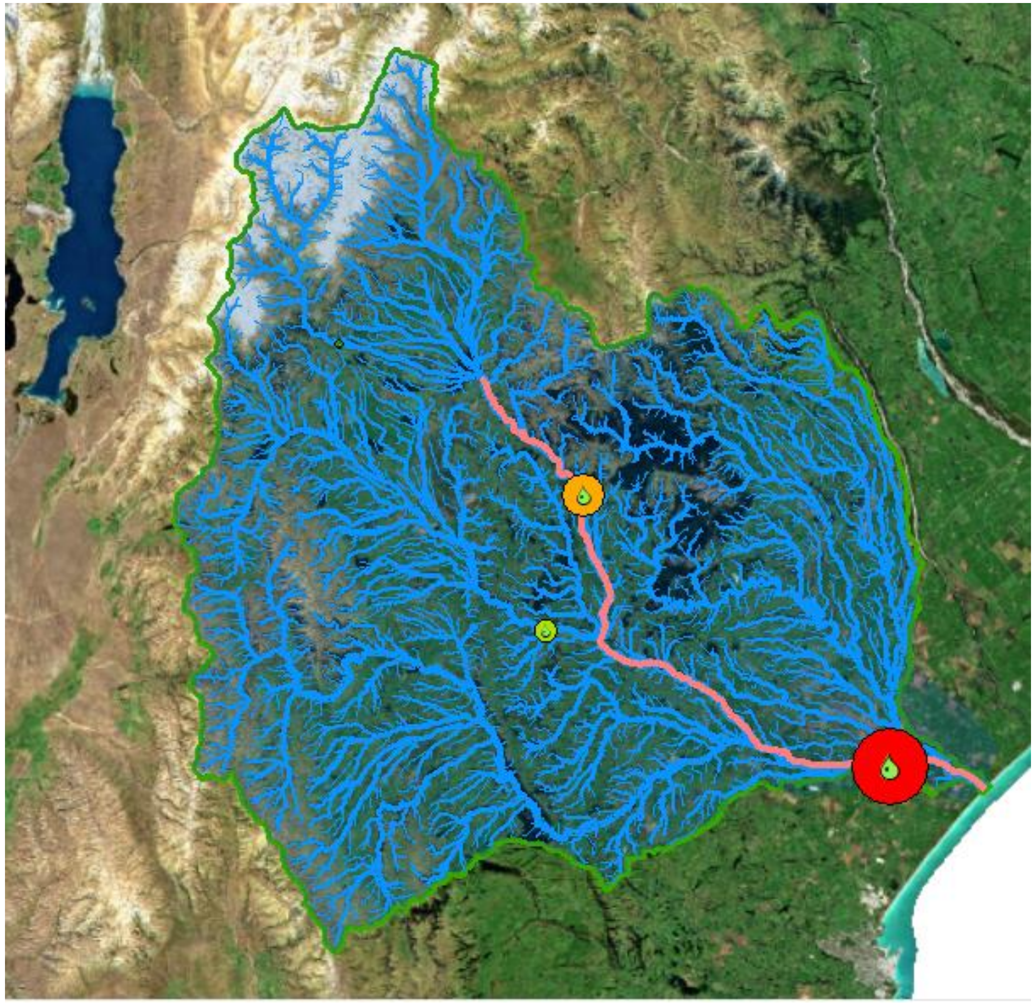
- Investigating the impact(s) of artificially generated flow upon a hydrological system.
- View Opihi catchment river flow in a geospatial context through ArcMap/hydrological map.
- Looking into the variation between summer and winter flows and comparing pre-dam flows of Opuha/Opihi rivers.
- Assessing how hydrological systems impact the water quality of the Opuha and Opihi rivers.



Project Progression

Where do I want to be by semesters end?

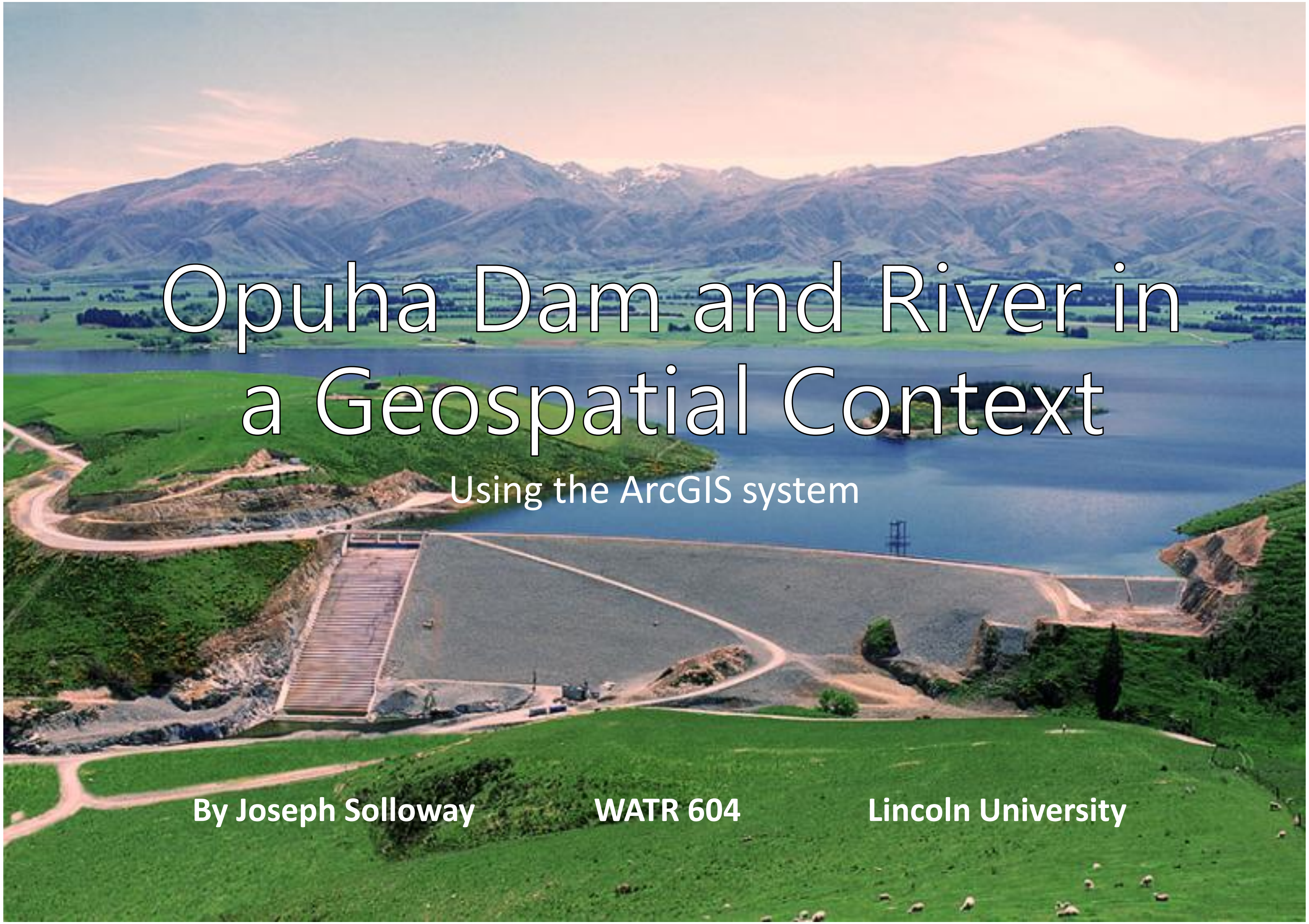
- Gather relevant flow and quality data from ECAN.
- Determine if artificial flow is impactful when compared to natural flow events (rainfall).
- Develop Map layers defining pre-dam, post-dam and irrigation season flows.
- Display water flow and quality data relationships.
- In an ideal world, further link the river flow map/model with Overseer nutrient budgets.



References

Opuha Water Limited. (2018) *Scheme Operation,* accessed http://opuhawater.co.nz/about-us/scheme-operation

Doug Hood Mining. (2018) *Opuha Dam, Fairie, South Island,* accessed http://doughood.co.nz/projects/civil-engineering/opuha-dam-fairie-mackenzie-district-south-island/



Opuha Dam and River in a Geospatial Context

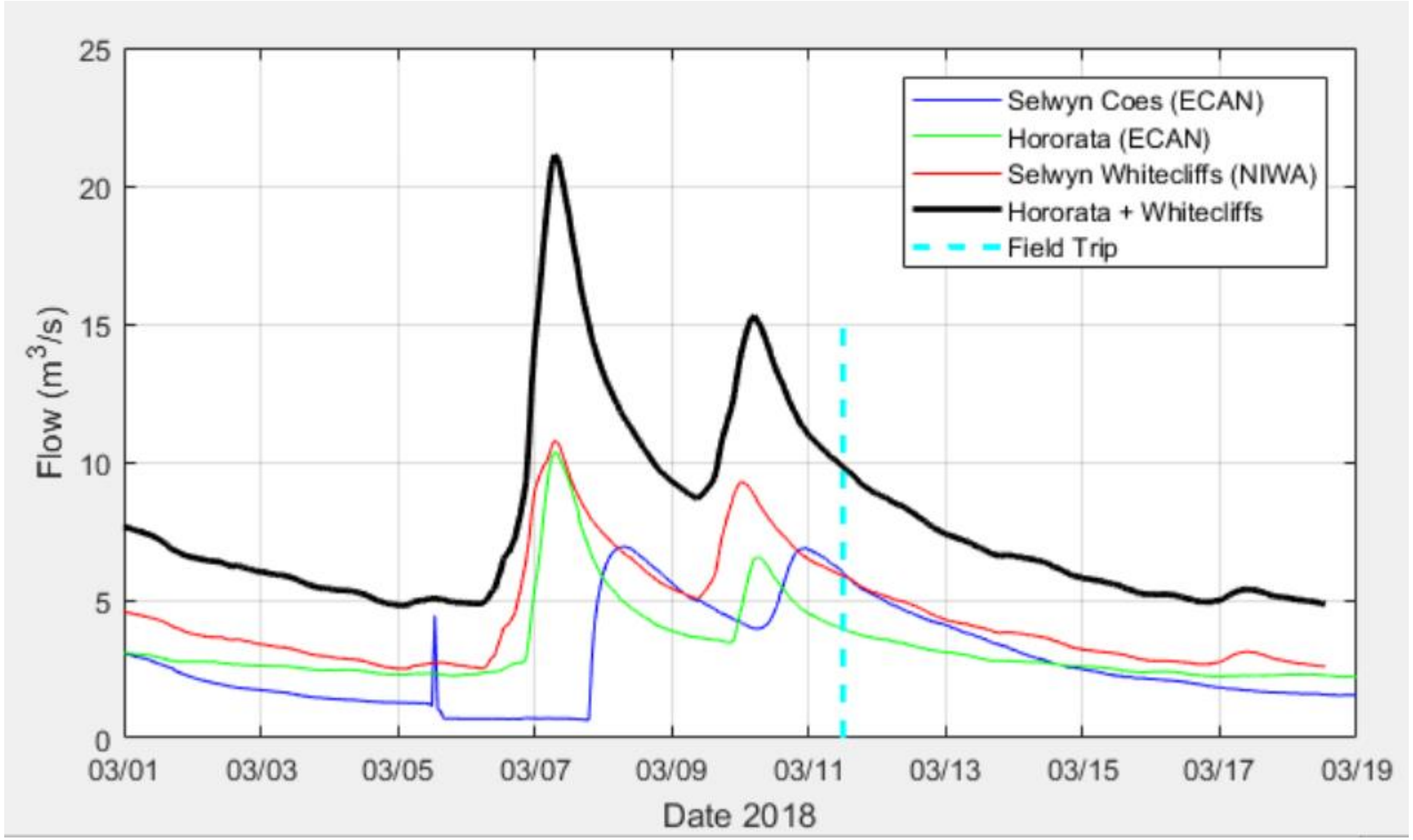
Using the ArcGIS system

By Joseph Solloway **WATR 604** **Lincoln University**

MATLAB Retrieve of ECAN River Flow Data – Justin Rogers

- Need to know Site #
- Only 1 year available
- Can be converted to Python

```
url =
'http://data.ecan.govt.nz/data/79/Water/River%20stage%20flow%20data%20for%20individual%20site/CSV?SiteNo=68006&Period=1_Year&StageFlow=River%20Flow&zip=0'
```



Python Retrieve of ECAN Borehole Data

```python
def get_all_ECAN_depth():
    df = pd.read_excel("01_Grand_average.xlsx")  #Can be any list of wells
    wlist = df["WELL_NO"][124:189]
    wurl0 = ("http://data.ecan.govt.nz/data/89/Water/Groundwater%20Well%20Depth%20to%20Water%20Reading

    for wno in wlist:
        print(wno)
        payload = {'WellNo' : wno}  #Handles the request syntax from strings
        r = requests.get(wurl0, params=payload)
        r.url
        download_file(r.url,wno.replace("/","_")+'.csv')
```

```
  876,784 M36_0424.csv
   12,831 M36_0465.csv
   21,621 M36_0592.csv
   26,603 M36_0599.csv
   25,301 M36_0693.csv
   17,390 M36_0768.csv
1,131,560 M36_0932.csv
  170,998 M36_10577.csv
  178,444 M36_10578.csv
  477,777 M36_1160.csv
   82,696 M36_1273.csv
   23,809 M36_1328.csv
   10,988 M36_1902.csv
   24,922 M36_1918.csv
   46,873 M36_20108.csv
   29,389 M36_2452.csv
   27,435 M36_2476.csv
  978,335 M36_2775.csv
   18,324 M36_3194.csv
  914,107 M36_4018.csv
  783,121 M36_4633.csv
```

ArcHydro GW Workflow:

- Concatenate all CSVs, import to ArcGIS GDB
- Join by WellIndex to Point Shapes
- Fix Time String -> Date
- Re-write CSV with working dates
- Create blank AH-GW TimeSeries table
- Use AHGW "Text Import" to fill TimeSeries Table

ArcHydro Groundwater + ECAN Monitoring Boreholes