Identifying and apportioning water and contaminant sources to stream – linking source and receiving environments in space and time

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Contaminant yields to freshwater vary in space and time, even when land-use pressures are similar

and

The main driver of both spatial and temporal variation in water quality, for a given land use pressure, is the landscape itself

Our Idea: un-mix the waters

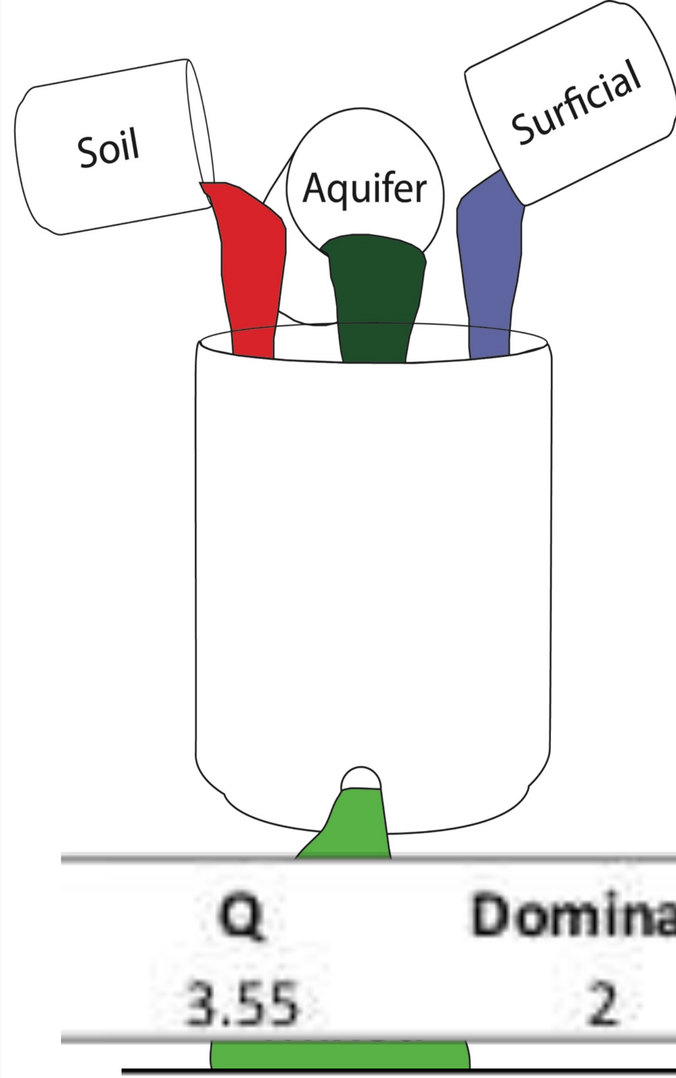
The quality and composition of water varies with flow, reflecting different sources and pathways to stream

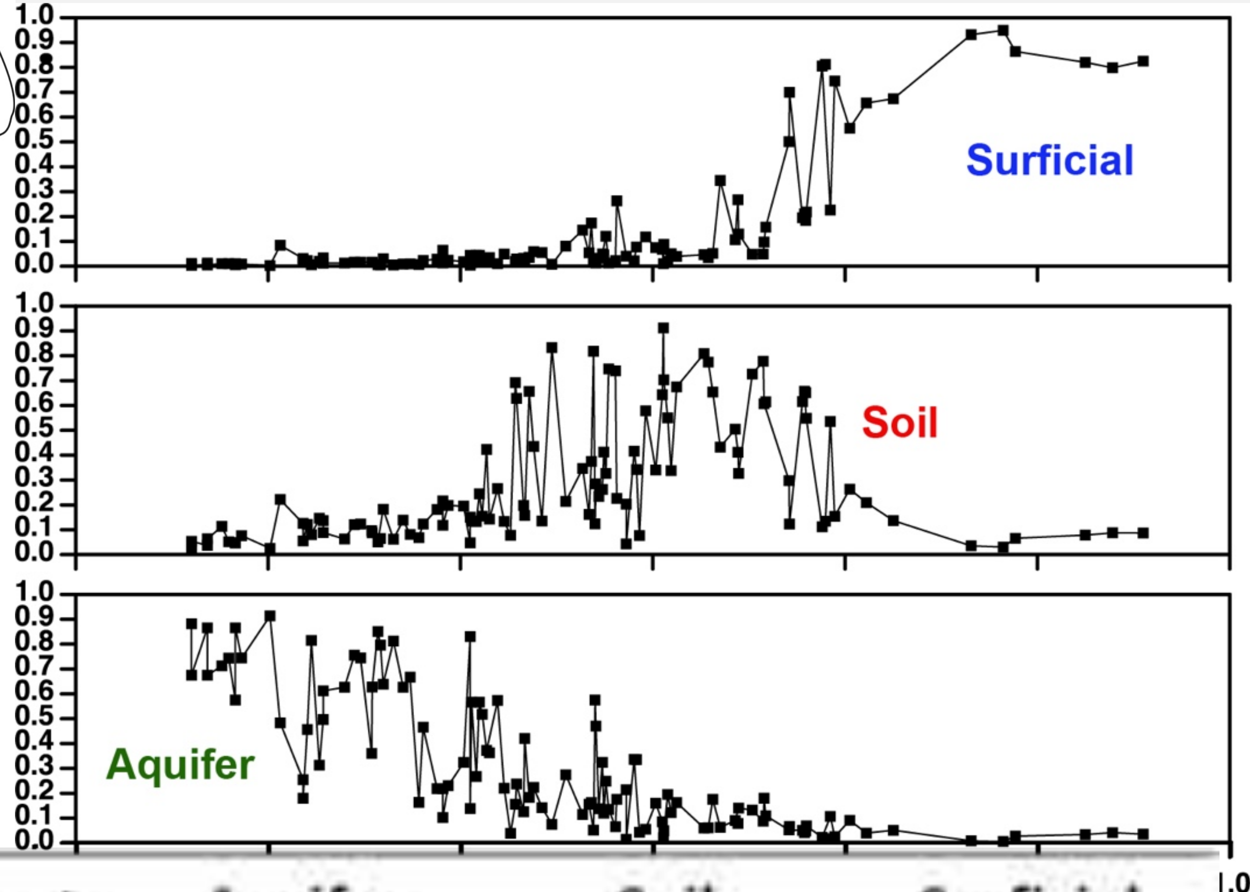
We can use the **<u>signatures in water</u>** to determine the source of the water but also the source of the contaminants

entering the stream

(form of hydrograph separation)

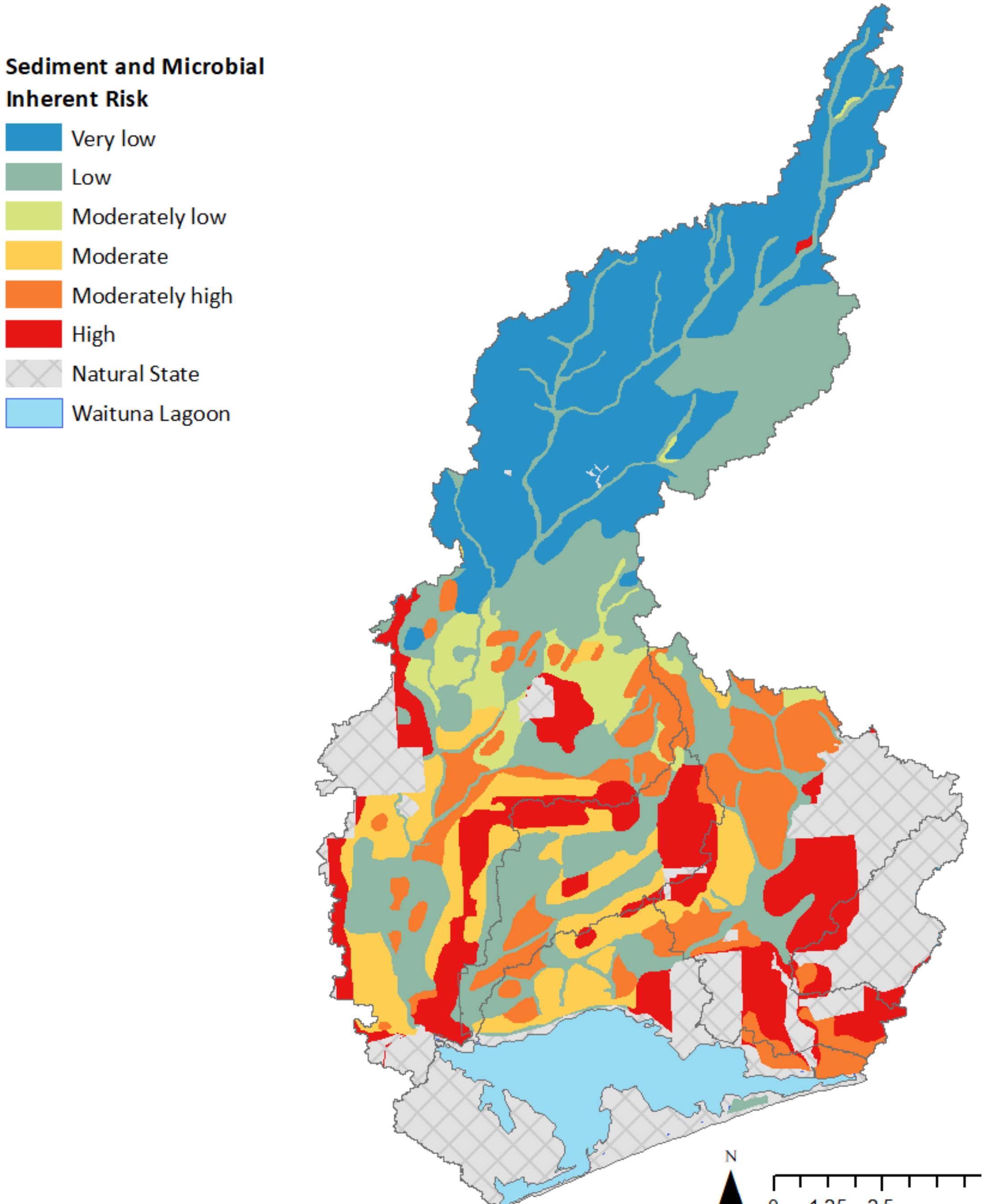
Transformative change can accelerate only if sources of contaminant excess can be clearly identified and managed cost effectively.





Q	Dominant	Aquifer	Soil	Surficial
3.55	2	0.1	0.7	0.2

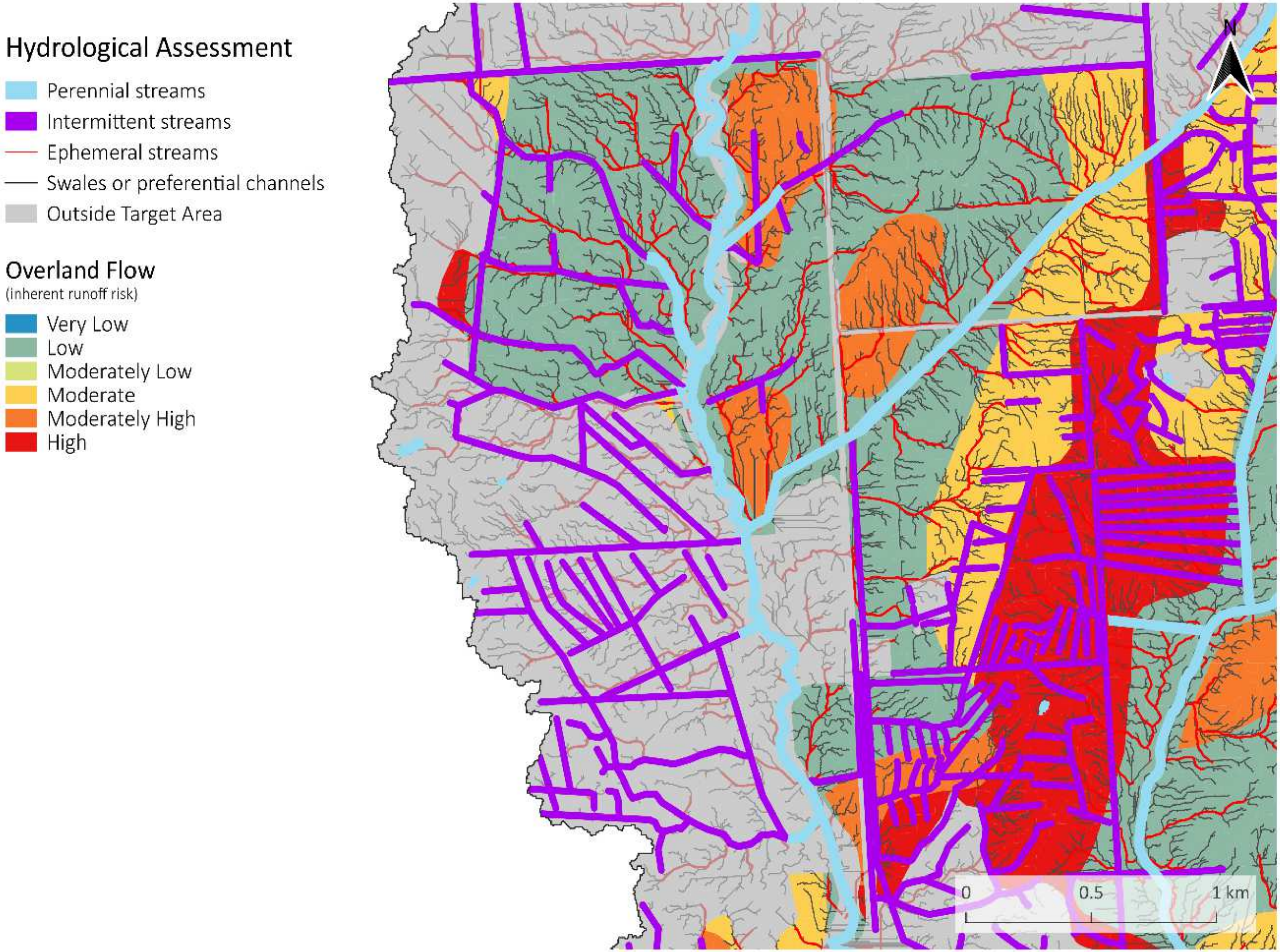
	TN	TP	TSS	E.coli
Aquifer	0.2	0.1	0	0
Soil	1.3	0.05	12	1,100
Surficial	5.6	0.5	100	20,000



Link to parts of the landscape that generate the signal
(geographical and compartmental)

Surficial = areas of high %OLF
Soil = areas of imperfectly to poorly drained soils
Aquifer = areas of well drained soils and transmissive aquifers

Map back to to source regions at management (farm), monitoring (catchment) and policy (regional) scales - for “co-innovation" with decision-makers


Hydrological Assessment
Perennial streams
Intermittent streams
Ephemeral streams
Swales or preferential channels
Outside Target Area
Overland Flow
(inherent runoff risk)
Very Low
Low
Moderately Low
Moderate
Moderately High
High
N
0
0.5
1 km

By identifying and apportioning water and contaminant source to stream

We will:

- **Link** in-stream signals of water quality to geographical areas and dominant compartment

- **Identify** the thresholds in stream flow (or other, soil moisture) at which the geographical and compartmental sources supplying contaminants are switching on an off

- **Estimate** the relative contributions (loads) from geographical and compartmental sources
  - % from aquifer % from soil, % from surficial runoff

- **Forecast** temporal variation in water quality from antecedent data
  - Prediction of time variant *E. coli*, sediment, N, P, DO, pH, water temperature

Importance

Using refined spatial and temporal knowledge, our decision making is much more likely to be environmentally <u>effective</u> and economically <u>efficient</u>:

- Mitigations – what and where
- Where will wetland and riparian restoration add the most value
- Advantageous alternate land-uses or system changes
- Critical context to farm extension activities (virtual buffers?)
- Regulatory activities (i.e., compliance, policy)

By working <u>with</u> spatial and temporal knowledge of our environment:

– We will be able to demonstrate our values and as a result exceed the expectations of others

– Current and future generations will know there is a **pathway** to a future we can be proud of

Relevance

To resource users, managers and advocates

Provides a basis for targeted investment

Provides landscape level information of the drivers of variation in water quality outcomes critical to:

- Ecological and human health researchers
- Mangers of biodiversity
- Mahinga Kai
- Land users and managers
- Regulatory authorities seeking a more targeted platform to guide activities
  - Consenting, compliance, planning and monitoring

Co-innovation

farm ←→ catchment ←→ region

Co-innovation comes into play when working at multiple scales:

- with multiple actors (farmers, scientists, regulators and industry groups), and
- multiple interests (economic, environmental, social, cultural, institutional).

It's all very well doing the science… but using it requires multiple perspectives and contributions

Seeking Feedback and Collaboration

Thank You