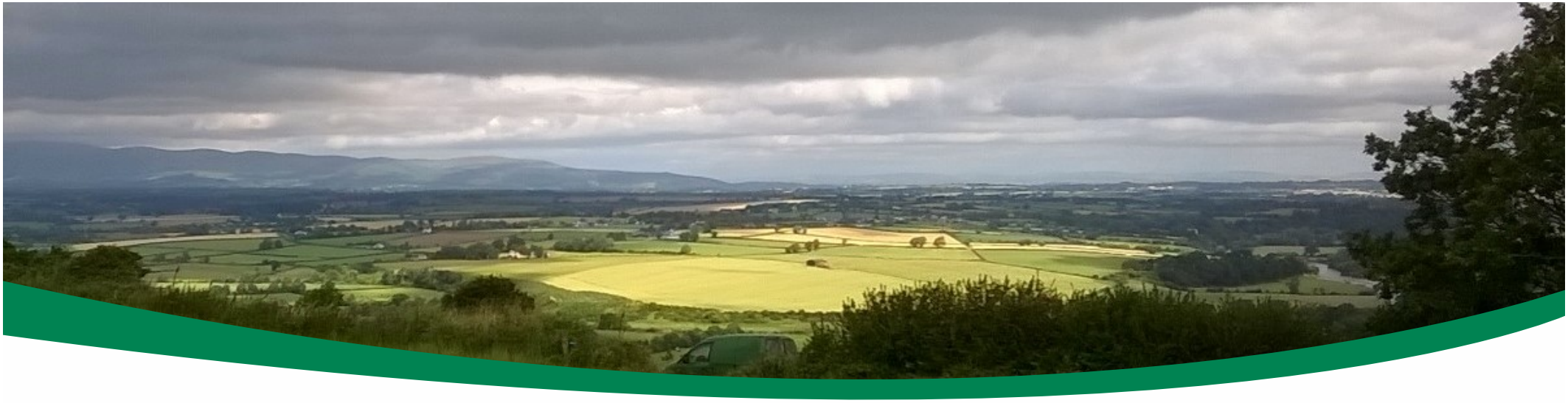
Agricultural Catchments Programme

Edward Burgess & Per-Erik Mellander



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Teagasc
Agriculture and Food Development Authority

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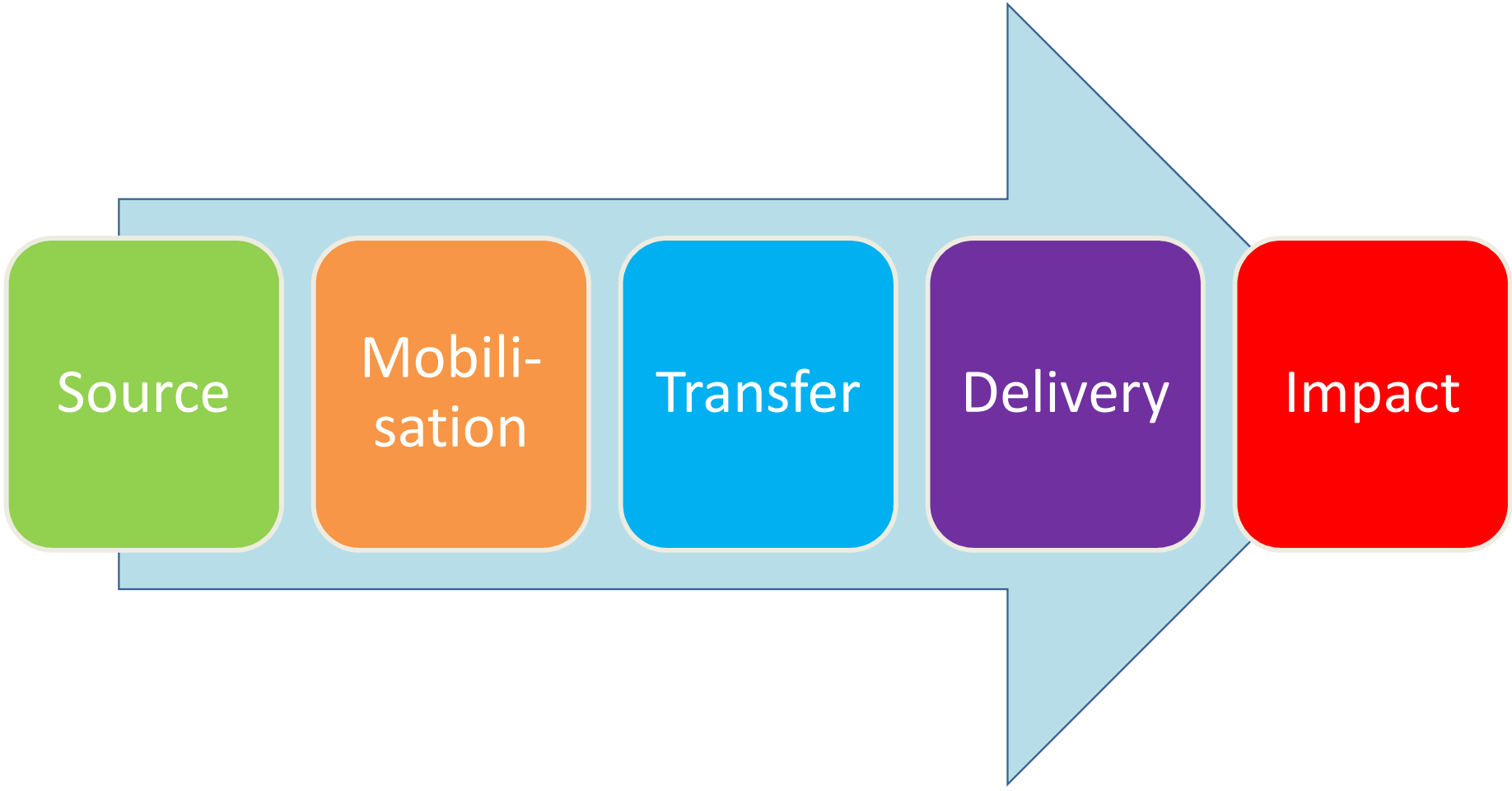
Nutrient Transfer Continuum

[Haygarth et al., 2005]

1. **Conceptual framework of ACP**
2. **Examples from catchment areas where P concentrations exceeds EQS**



Where and **how** do we most efficiently mitigate nutrient loss to water?

Catchments Selection

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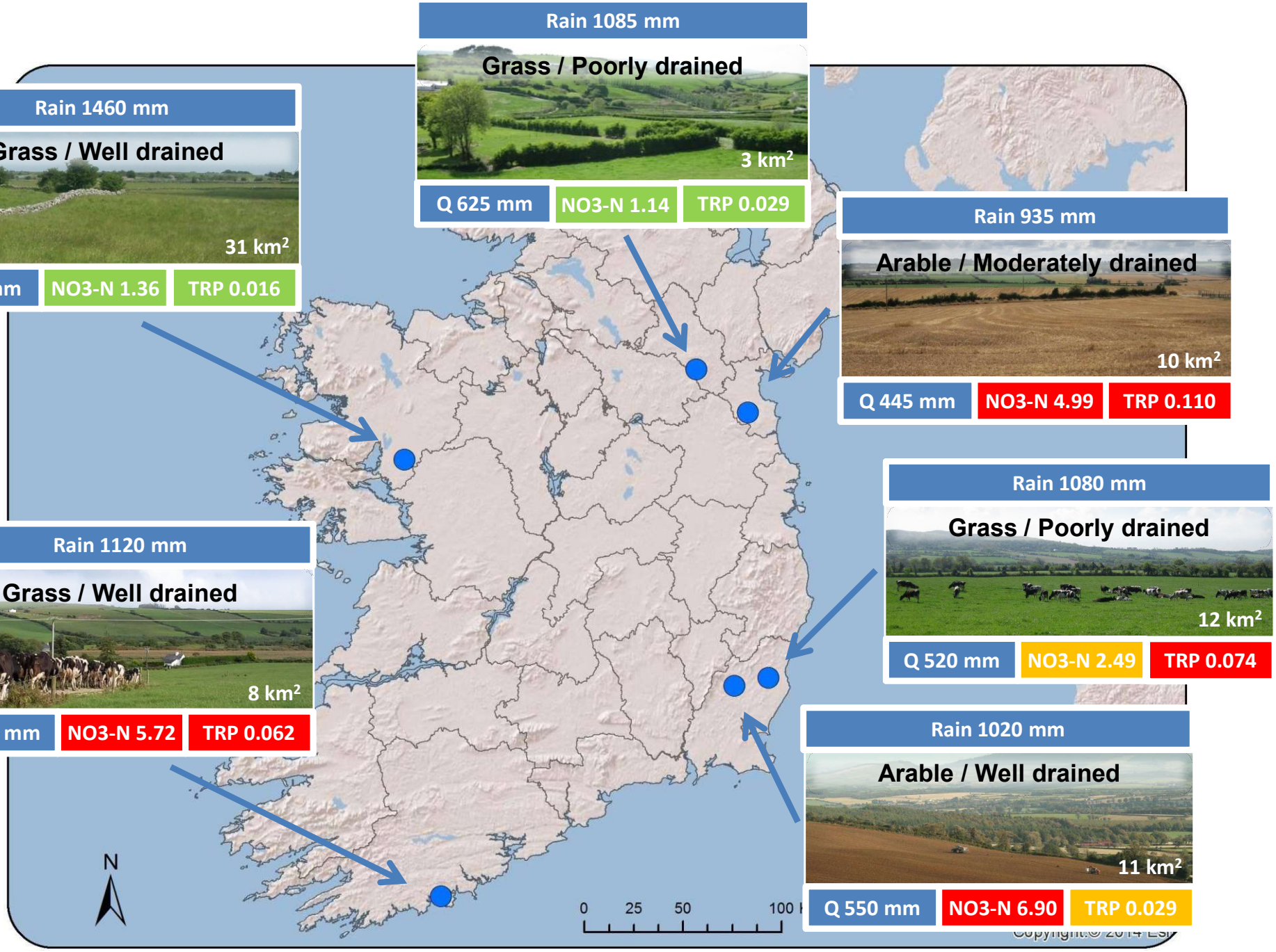


Rain Gauge

Farmer surveys

Weather Station

Common Experimental Design

Socio-Economic and Biophysical

Partnership with 320 Farmers

Ecology Survey Site

Flow gauging

Soil Sampling / Nutrient Management

Continuous water quality analysis

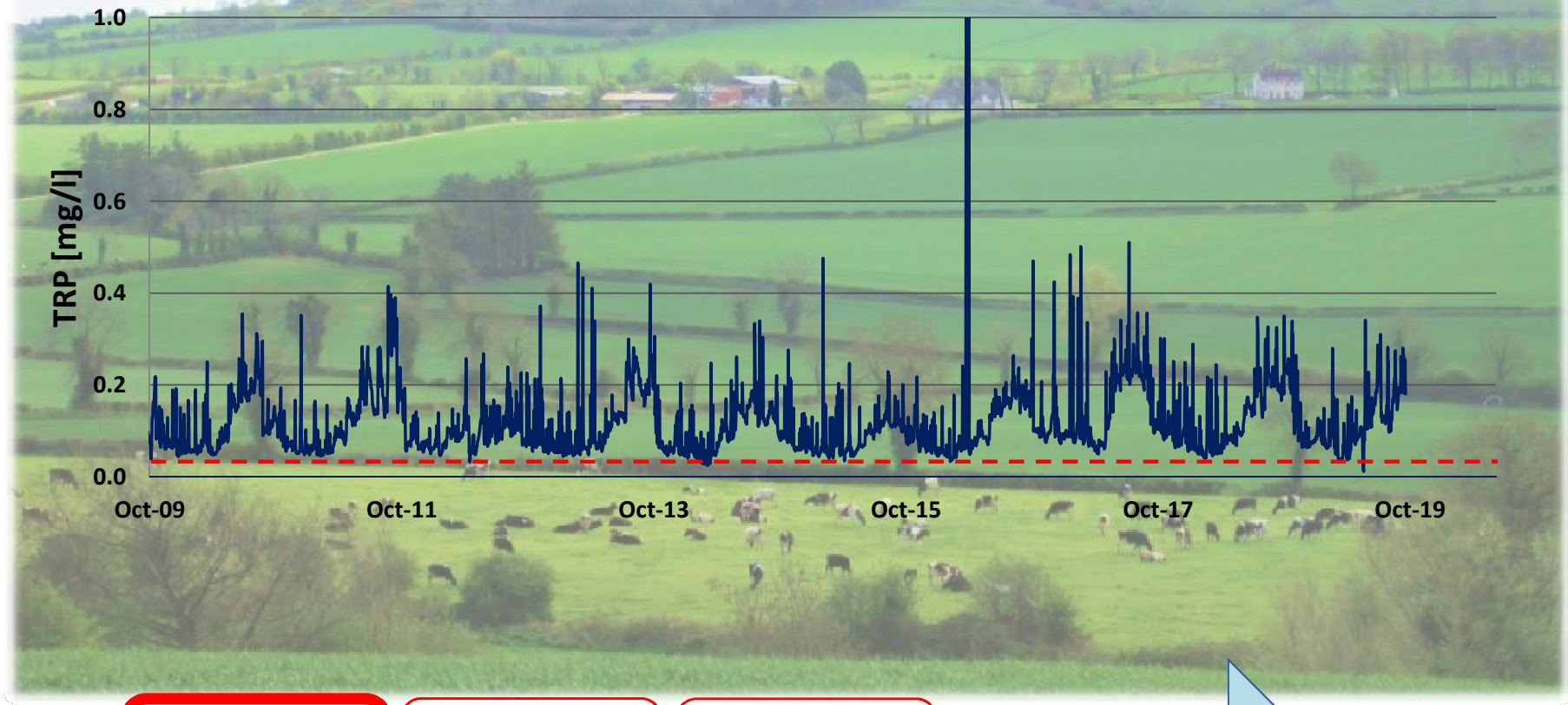
Multilevel Monitoring Wells

Snapshot Site

Dunleer

NO3-N 4.99 mg/l **TRP 0.110 mg/l**

- Arable land on moderately drained soils (mixed)
- P concentrations always > EQS
- Increase in P index 4 soils
- Complex pathways
- High P in all pathways

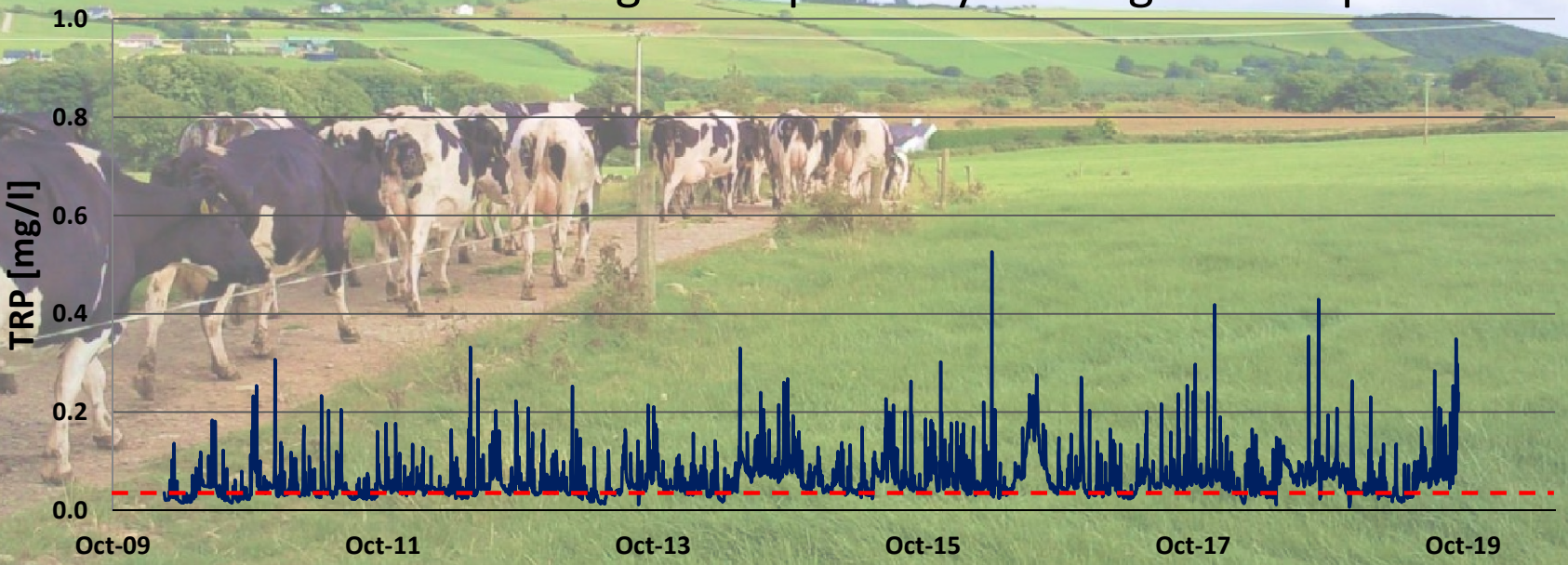


Source | Mobilisation | Transfer | Delivery | Impact

Timoleague

NO3-N 5.72 mg/l **TRP 0.062 mg/l**

- Grassland on well drained soils
- P concentrations mostly > EQS
- Low P index soils near stream
- Fe rich soils favoured P mobilisation into soluble form
- 65% TRP loss via belowground pathways during “closed period”



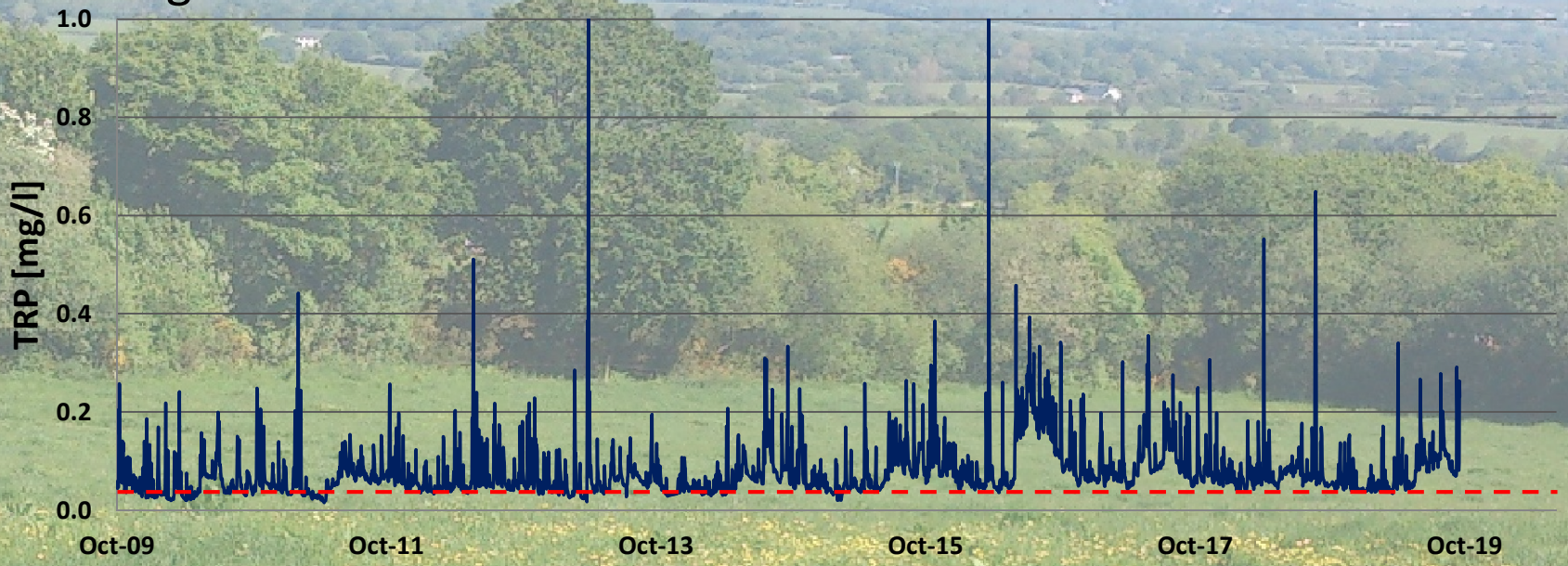
- Leaching of P can be important at catchment scale
- There may be hotspots for leaching of colloidal P

Ballycanew

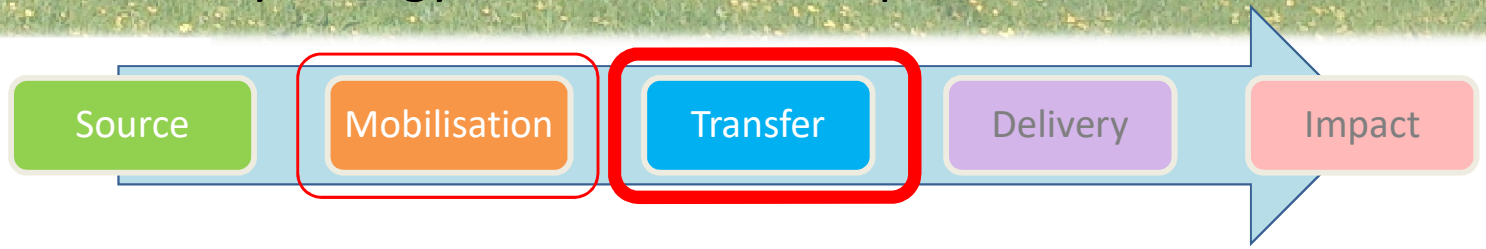
NO3-N 2.49 mg/l

TRP 0.074 mg/l

- Grassland on poorly drained soils
- P concentrations mostly > EQS
- Flashy hydrology – erosive, sediment
- Low P index soils
- Three times higher P loss than neighbouring arable catchment
- High P concentrations also in baseflow



- Hydrology overrides source pressure

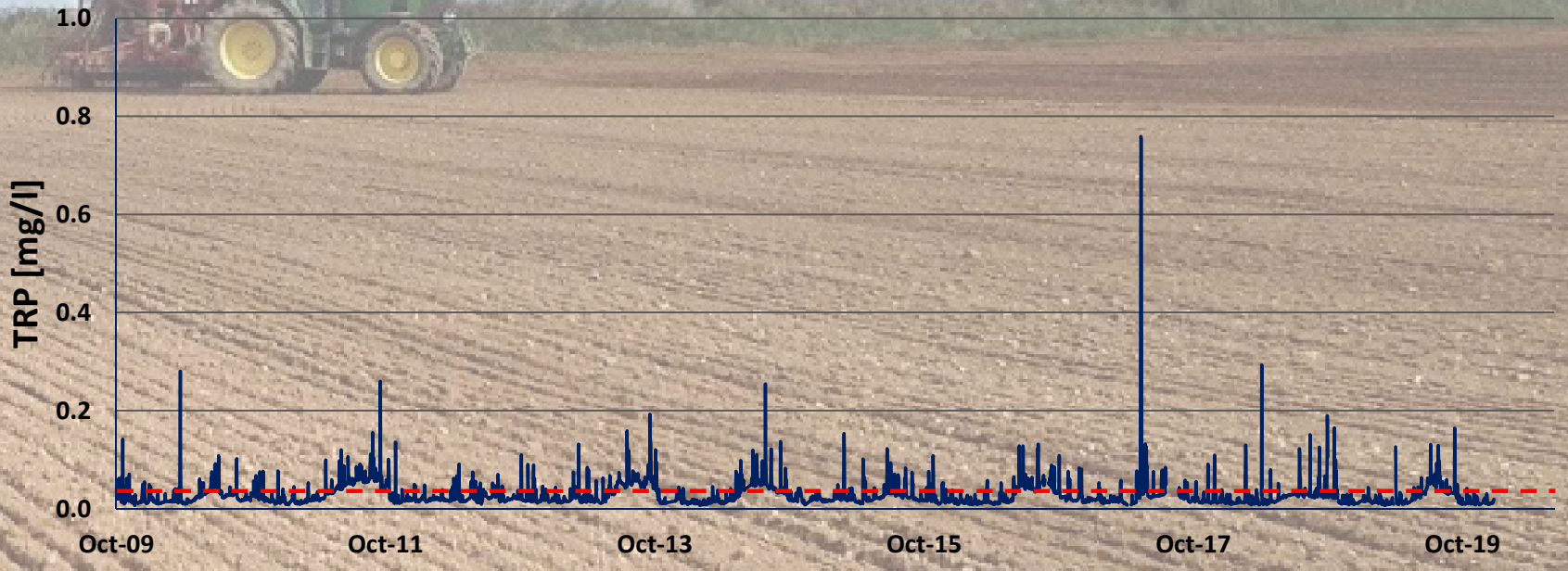


Temporal P loss risk

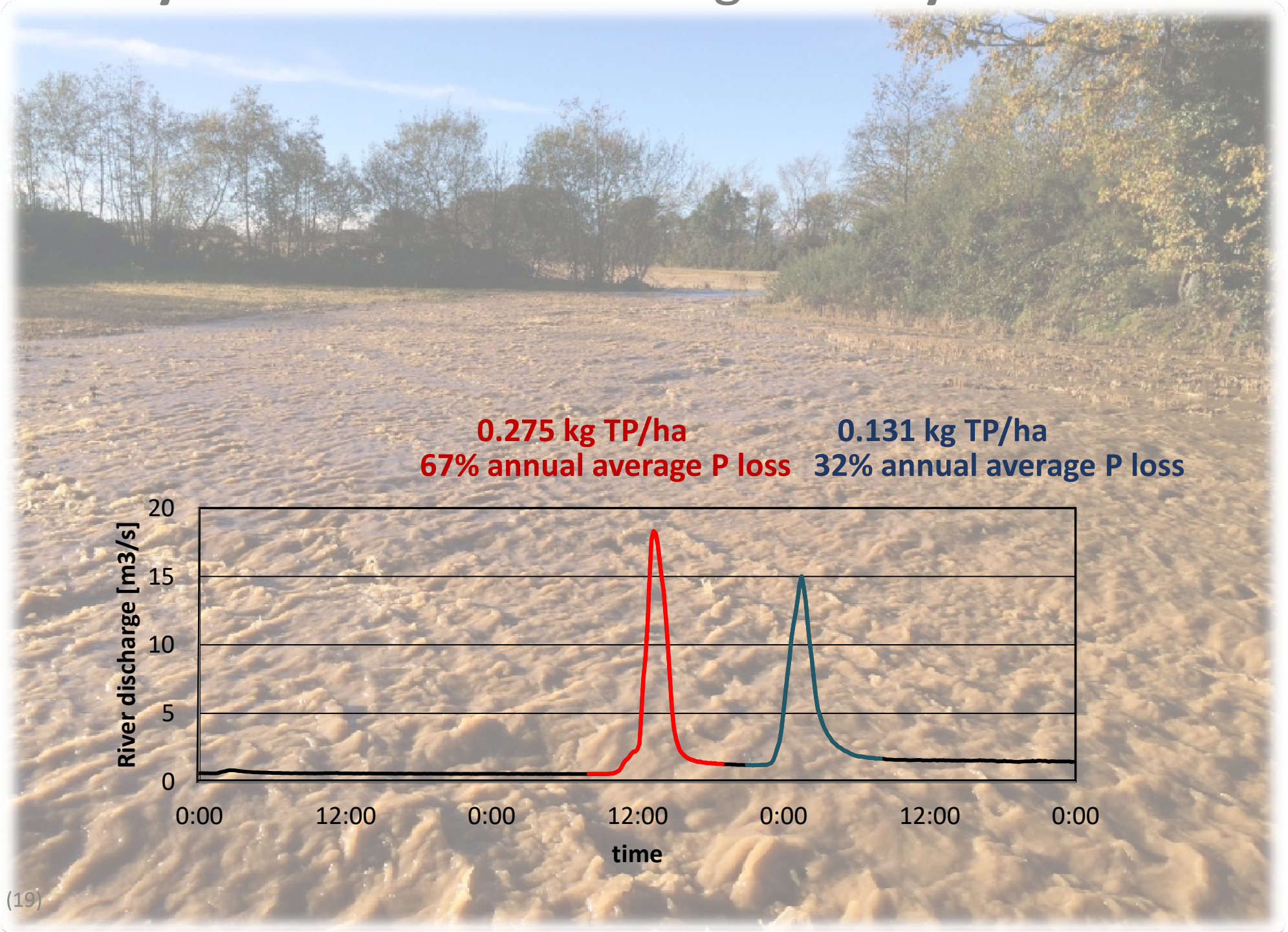
NO3-N 6.90 mg/l

TRP 0.029 mg/l

- Arable land on well drained soils
- P concentrations sometimes > EQS
- A winter rain event had four times higher P loss in a winter rain event compared to a similar sized summer event
- Two days of winter storms, on bare and saturated soils, resulted in a total P loss equal to the annual average loss



“N risky” catchment becoming “P risky” 13-14th Nov 2014



Example of variability at different times of the year

•Summer event (Jun 2012)

•SMD = 31 mm

•Rainfall = 25 mm

•Stream flow = 2 mm

•P loss = 1.6 g TRP/ha

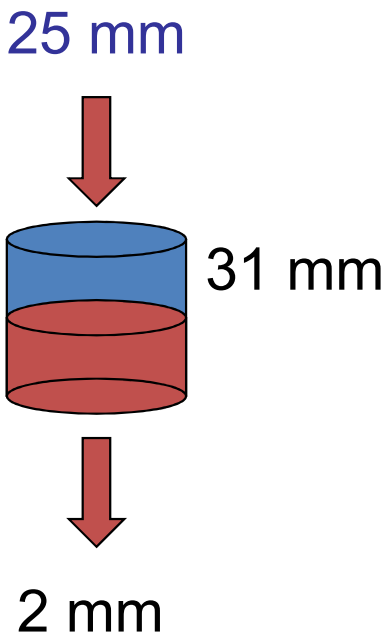
Winter event (Nov 2012)

SMD = 0 mm

Rainfall = 29 mm

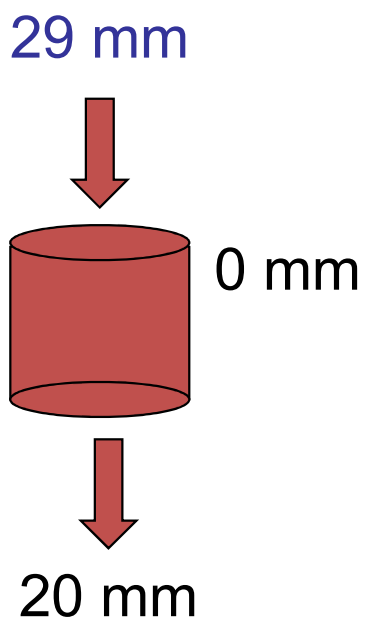
Stream flow = 20 mm

P loss = 6.5 g TRP/ha



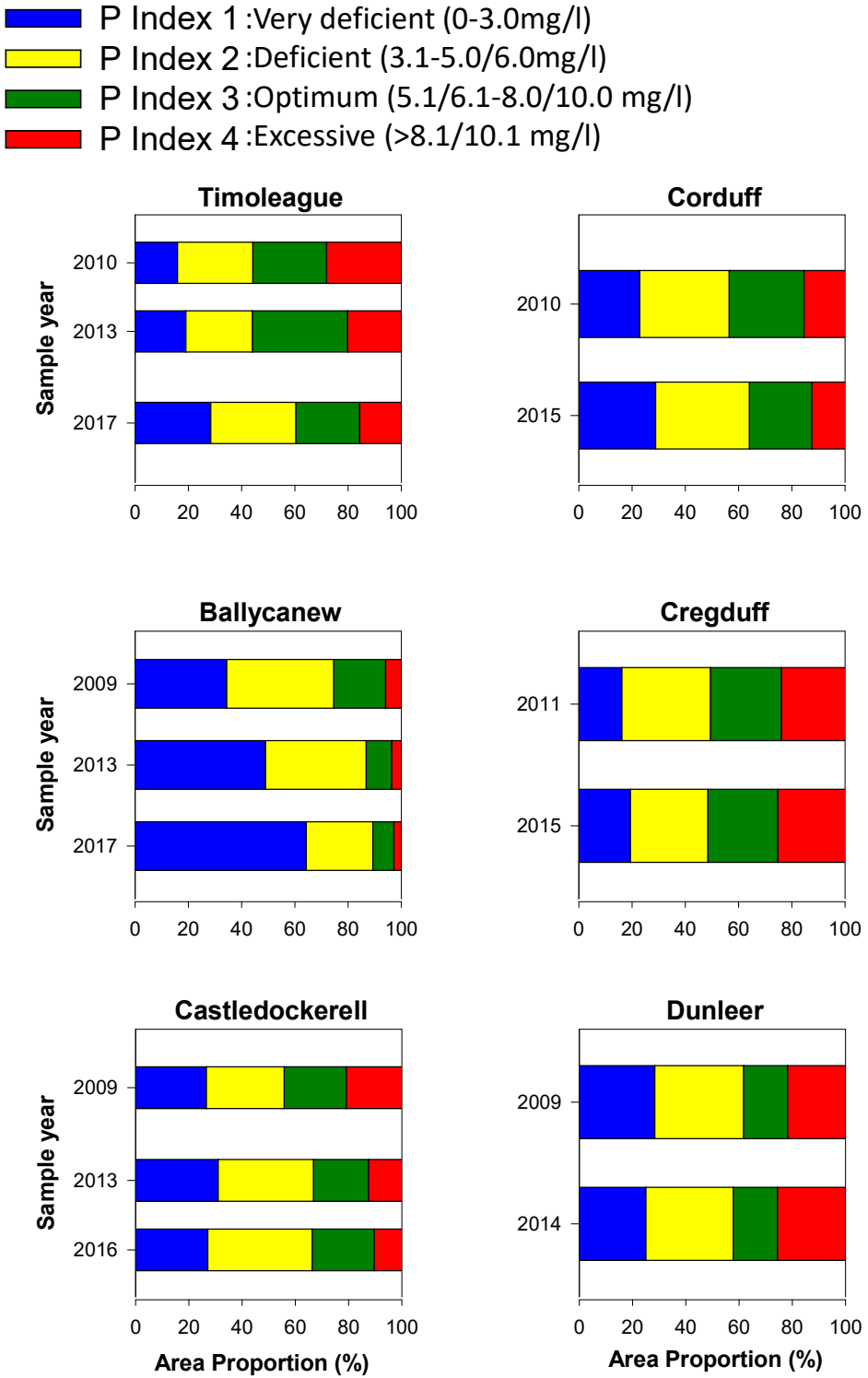
1.6 g TRP/ha

Four times higher P loss in the winter event!



6.5 g TRP/ha

ACP Soil P Trends



- In 4/6 catchments there was a 3 to 12% decline in index 4 (excessive P) soils over an 8 year period.
- 2 catchments had a 1 to 4% increase after a 4 year period.
- However: >50% of the area in all catchments continue to be sub-optimal for soil test P (i.e. P index 1 and 2).
- On-going requirement for improved distribution of nutrients sources within and between farms across all catchments.
- These results are representative of national soil trends.

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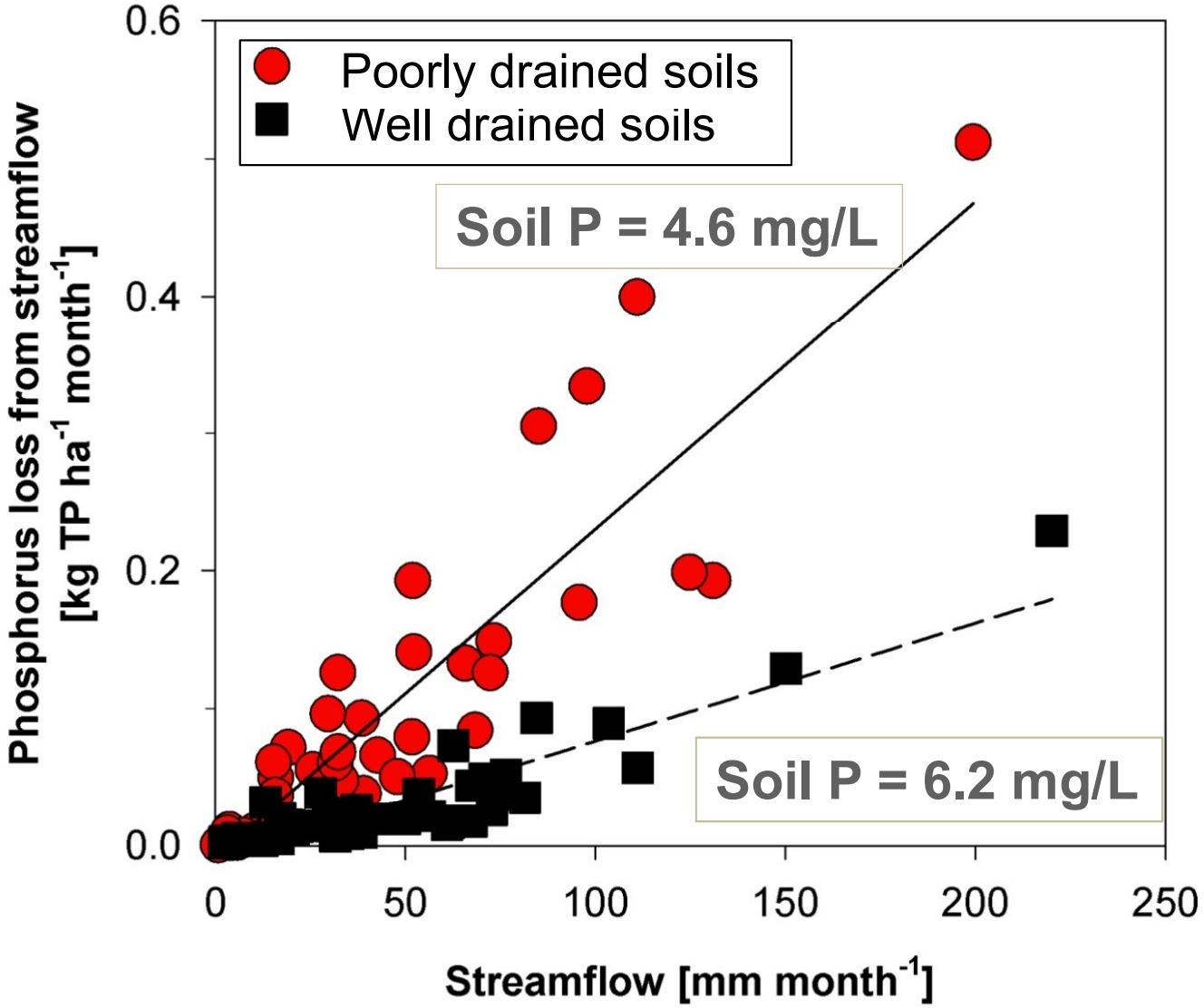
Source vs. pathways

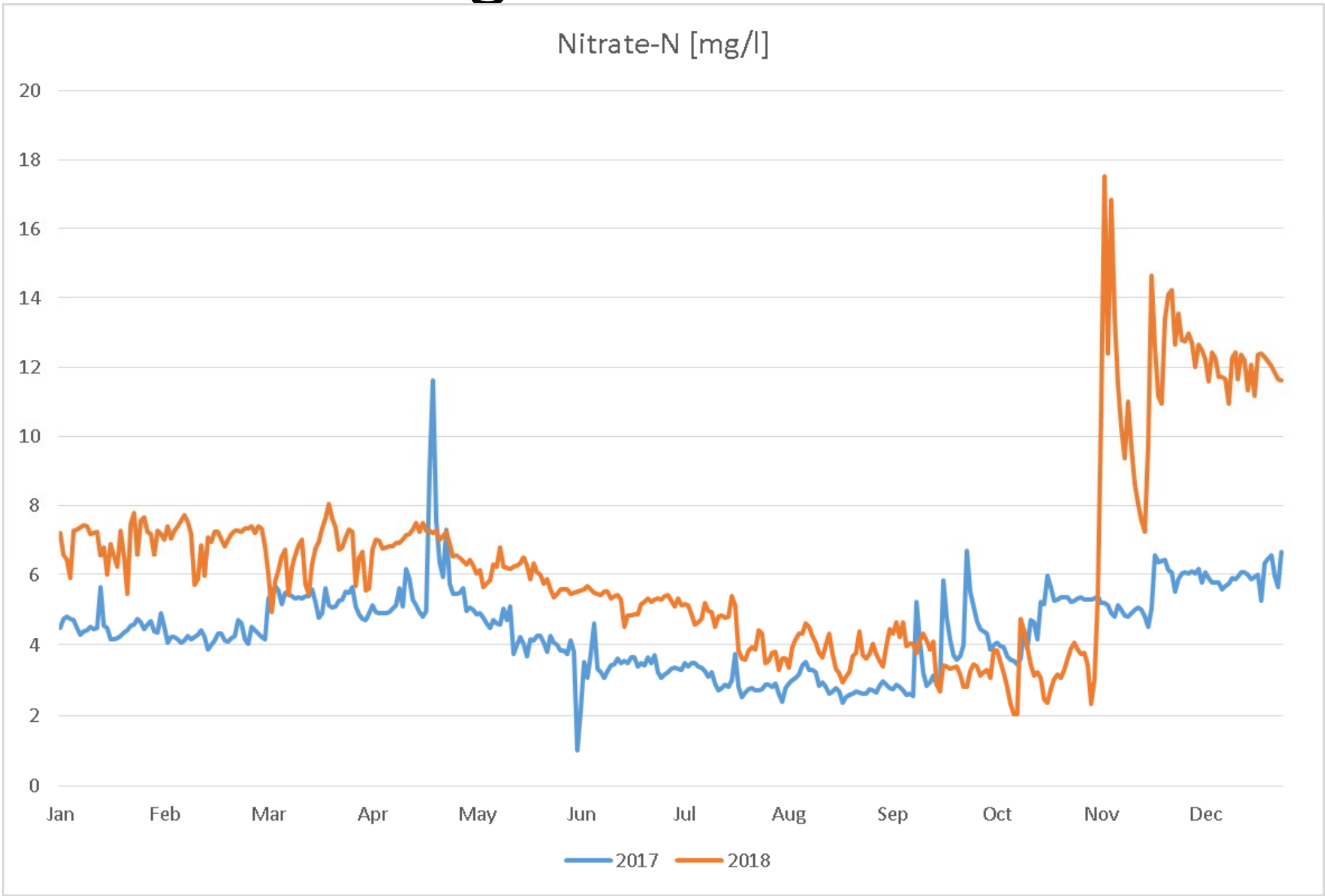


Key messages:

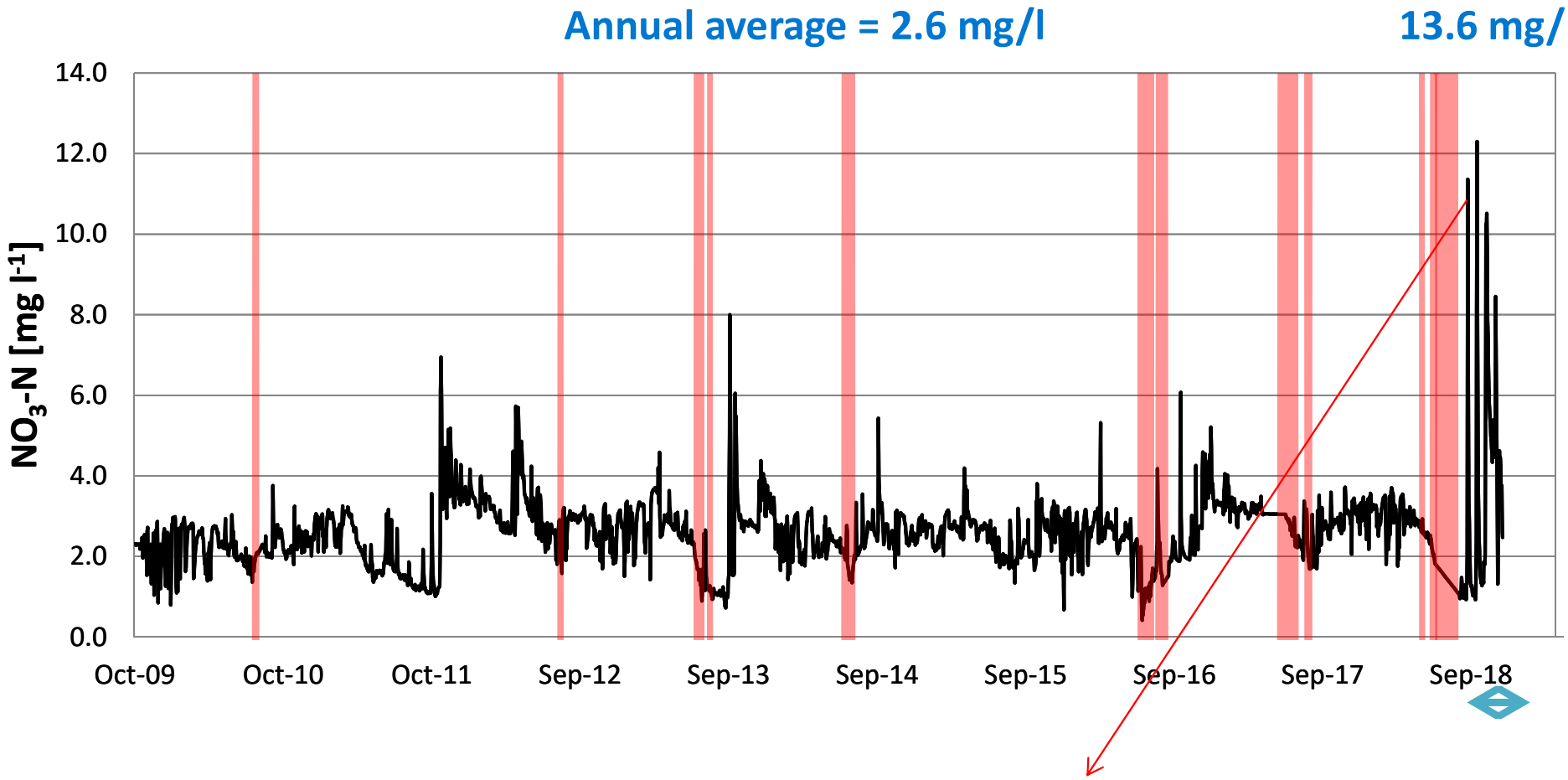
- Flow controls overrides source pressure
- Larger inter-annual P loss than between catchments
- One size does not fit all!

(Mellander et al., Hyd Proc 2015)

2018 Drought & Nitrate in Water



“P risky” catchment becoming “N risky” Sep - Nov 2018



- **19 days: 6.8 kg NO_3-N ha^{-1}**
  51% of annual average load
- **73 days: 19.6 kg NO_3-N ha^{-1}**
  147% of annual average load

Current status

Phosphorus

- 3 sites fail

Nitrate

- All sites meet drinking water standards
- 3 sites fail estuary standards

Ecology

- Spring: 3 sites fail
- Autumn: 5 sites fail

Catchment	TRP		NO_3-N		Ecology 2015-17	
	Mean [mg/L]	EPA EQS	Mean [mg/L]	EPA EQS	Macro-invert Spring	Macro-invert Autumn
Dunleer	0.112	χ	4.9	√	χ	χ
Ballycanew	0.076	χ	2.5	√	χ	χ
Timoleague	0.063	χ	5.8	√	χ	χ
Castledockrell	0.029	√	7.0	√	√	χ
Corduff	0.029	√	1.1	√	√	χ
Cregduff	0.017	√	1.3	√	√	√

Different dominating drivers/processes

1. Dunleer: **Nutrient management**
2. Castledockrell: Summer **point sources** impacting autumn ecol.
3. Grassland A & B: Hydrology and soil chemistry - **CSAs**

- **All confounded by weather changes!**

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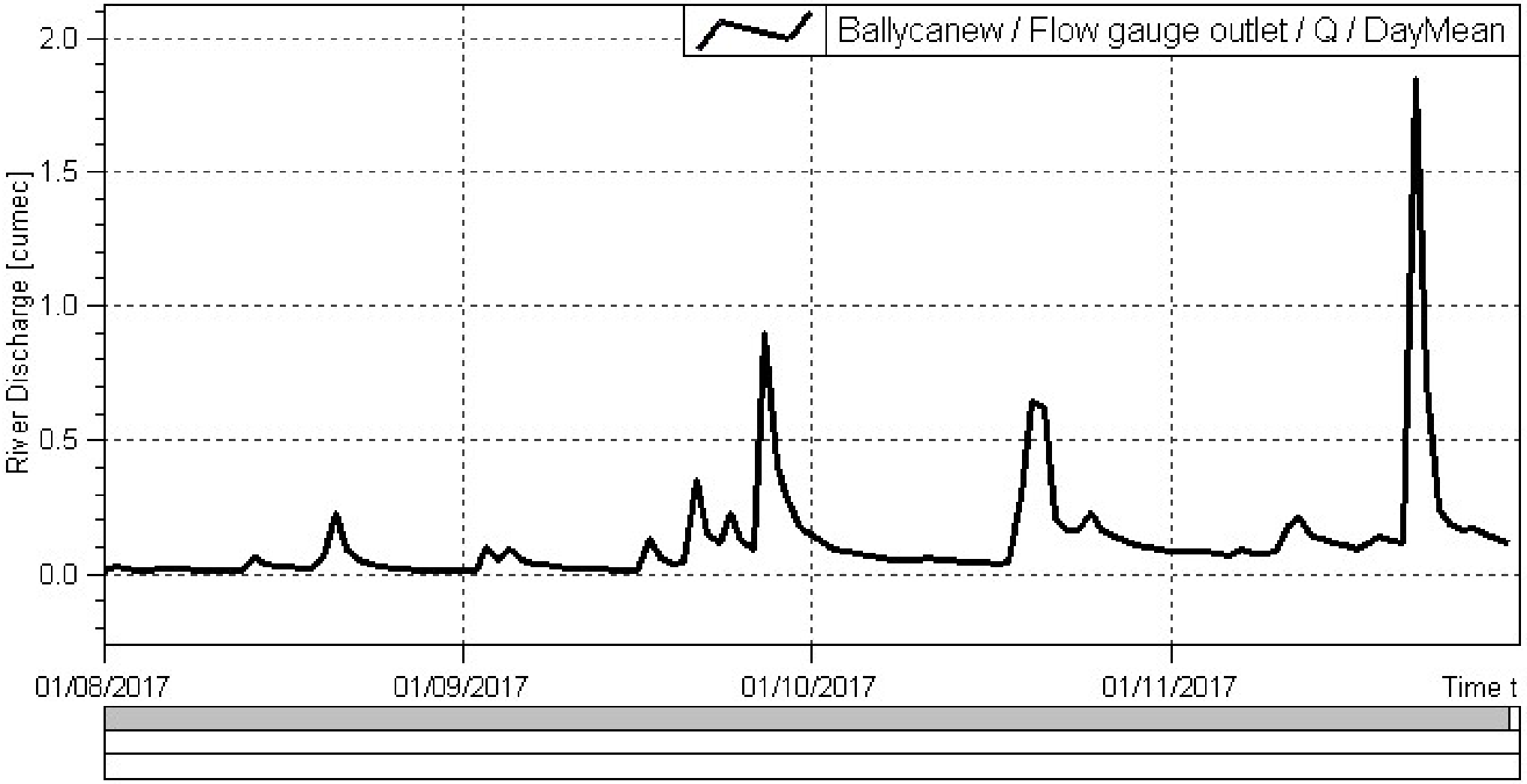
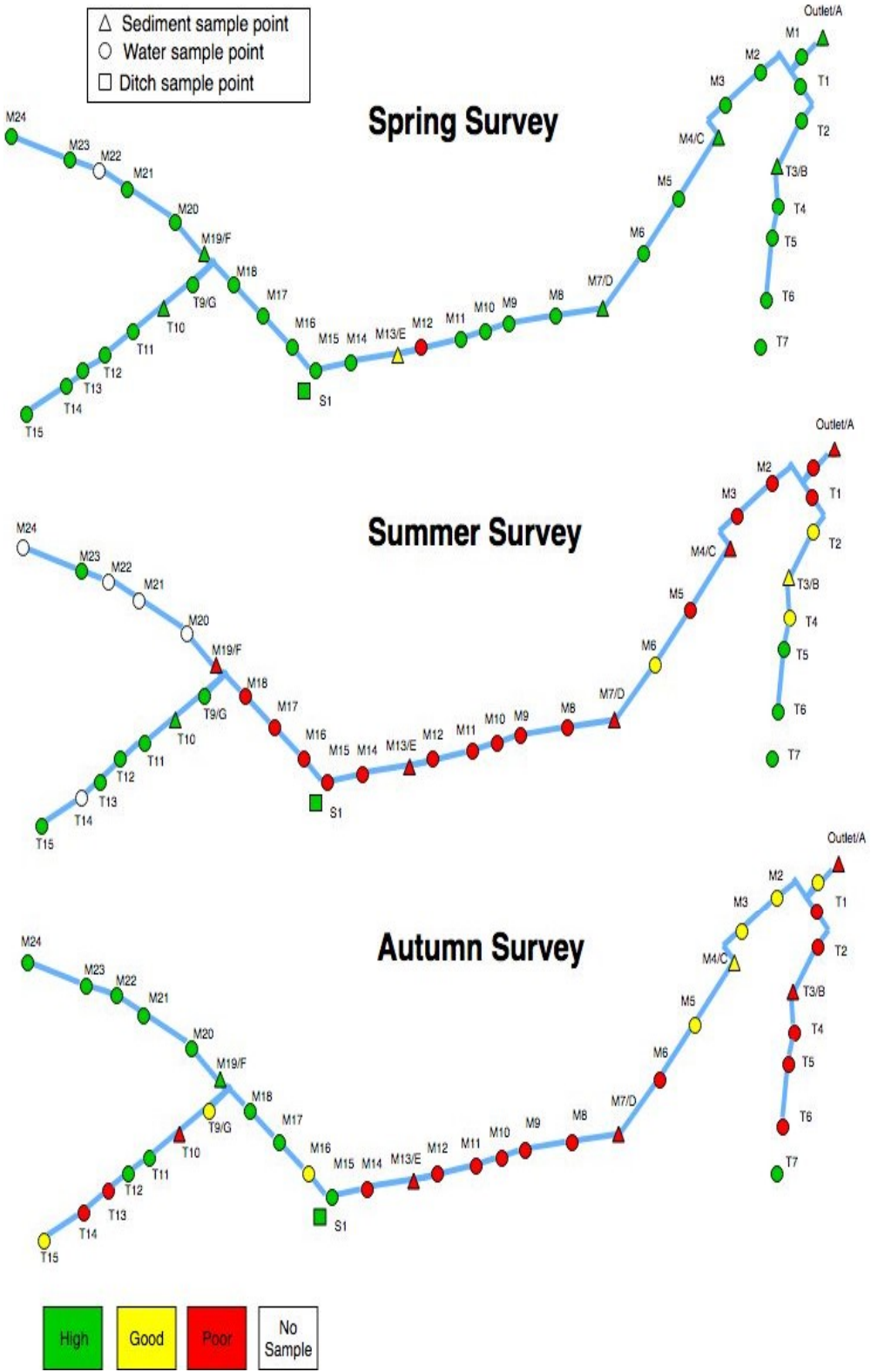
Low Flow Stream P





Timoleague

- Free draining grassland
- High stocking rate dairying
- 5 samples per Km (~ 50)

	Spring	Summer	Autumn
Min	0.000	0.003	0.002
Mean	0.010	0.040	0.032
Max	0.059	0.187	0.051
≥ 0.035	3%	57%	50%

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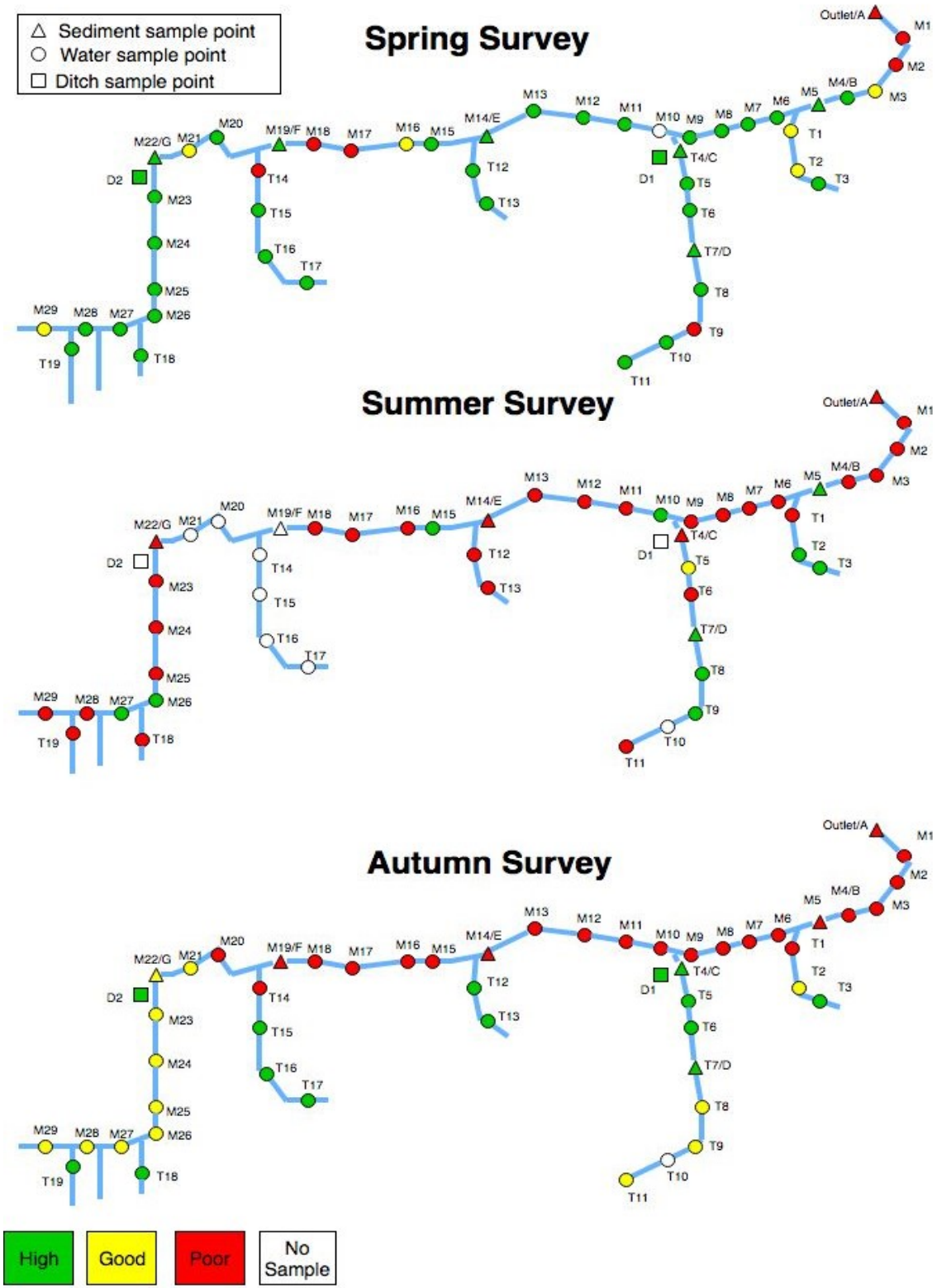

Ballycanew

- High clay content
- Mostly grassland
- Dairying, Drystock & Tillage
- 5 samples per Km (~ 50)

	Spring	Summer	Autumn
Min	0.008	0.010	0.009
Mean	0.024	0.046	0.037
Max	0.054	0.093	0.090
≥ 0.035	14%	71%	53%

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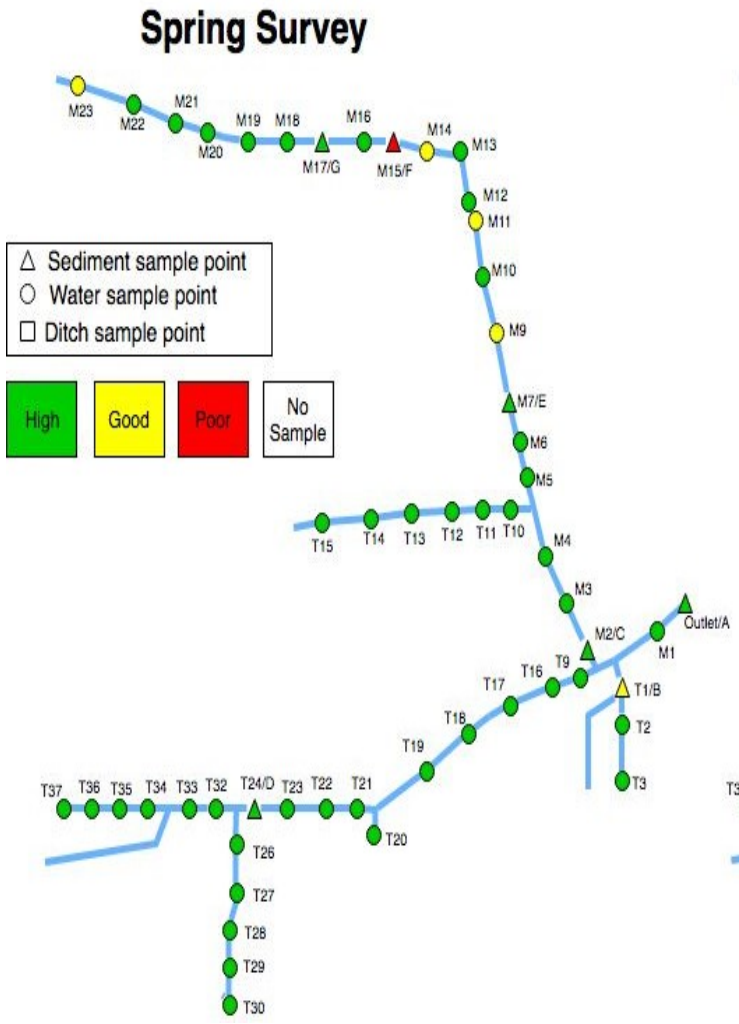
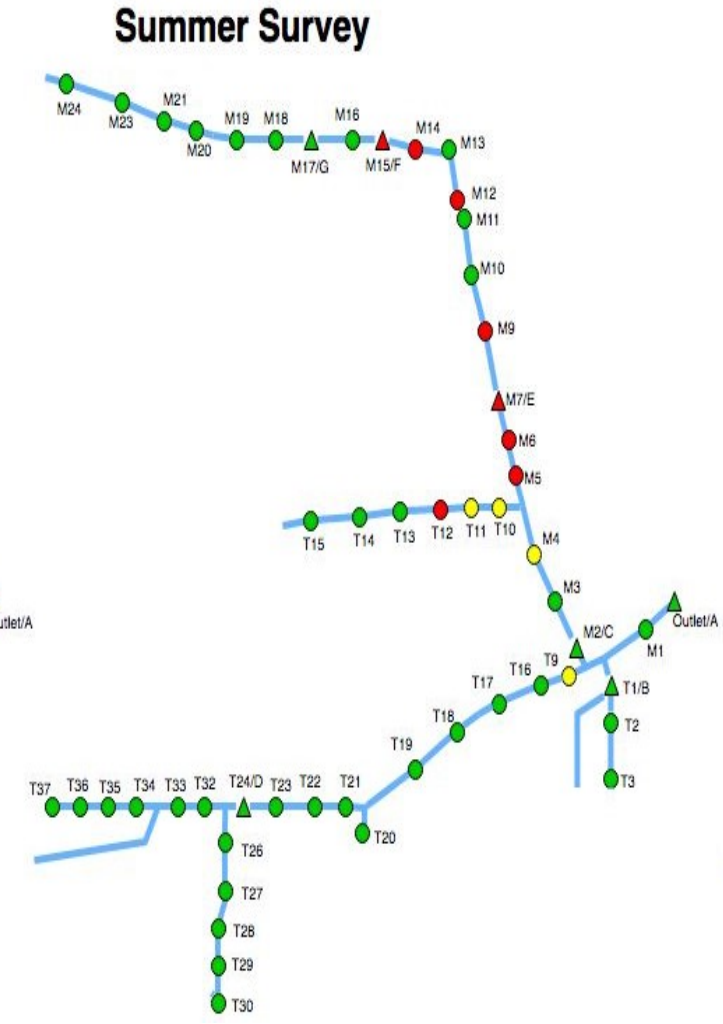
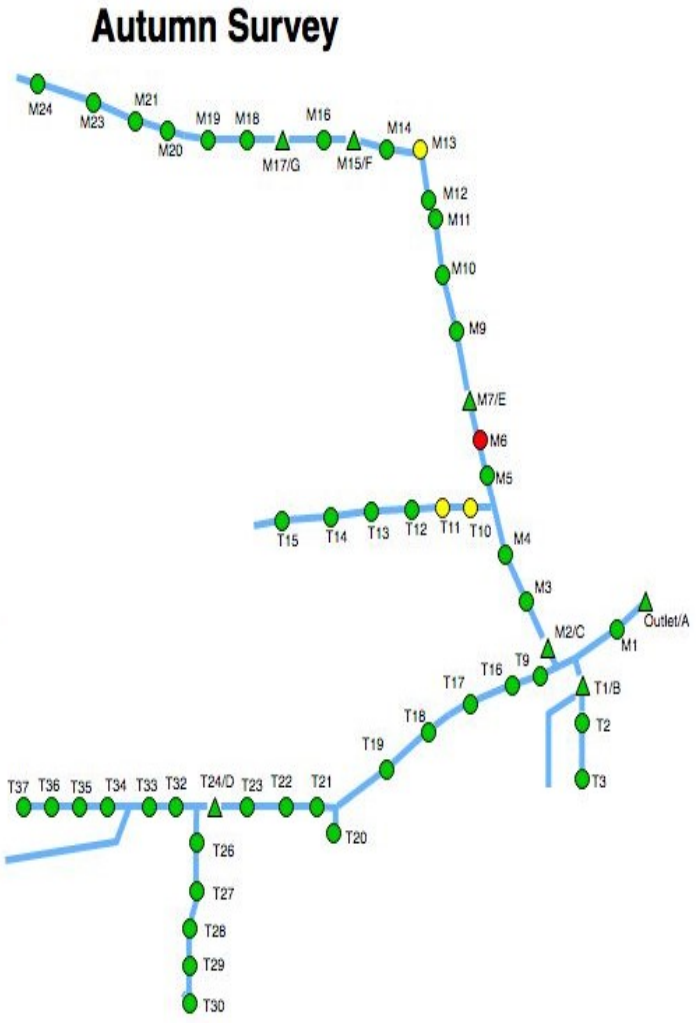
Castledockrell

- Free draining soil
- Mostly Tillage

	Spring	Summer	Autumn
Min	0.003	0.006	0.004
Mean	0.011	0.019	0.015
Max	0.034	0.059	0.143
≥ 0.035	0%	11%	2%







Synoptic Sampling Findings

- Ballycanew had poorest water quality (mean)
  - Surface driven & point source P losses
  - Cumulative loading along stream length
- Timoleague had the highest P concentration
  - Consistent levels along the stream (mostly)
  - Diffuse, ground water fed source of P
- Castledockrell had the lowest P across the stream
  - Soil binds P and is free draining
  - Point sources an issue
- P highest in Summer > Autumn > Spring

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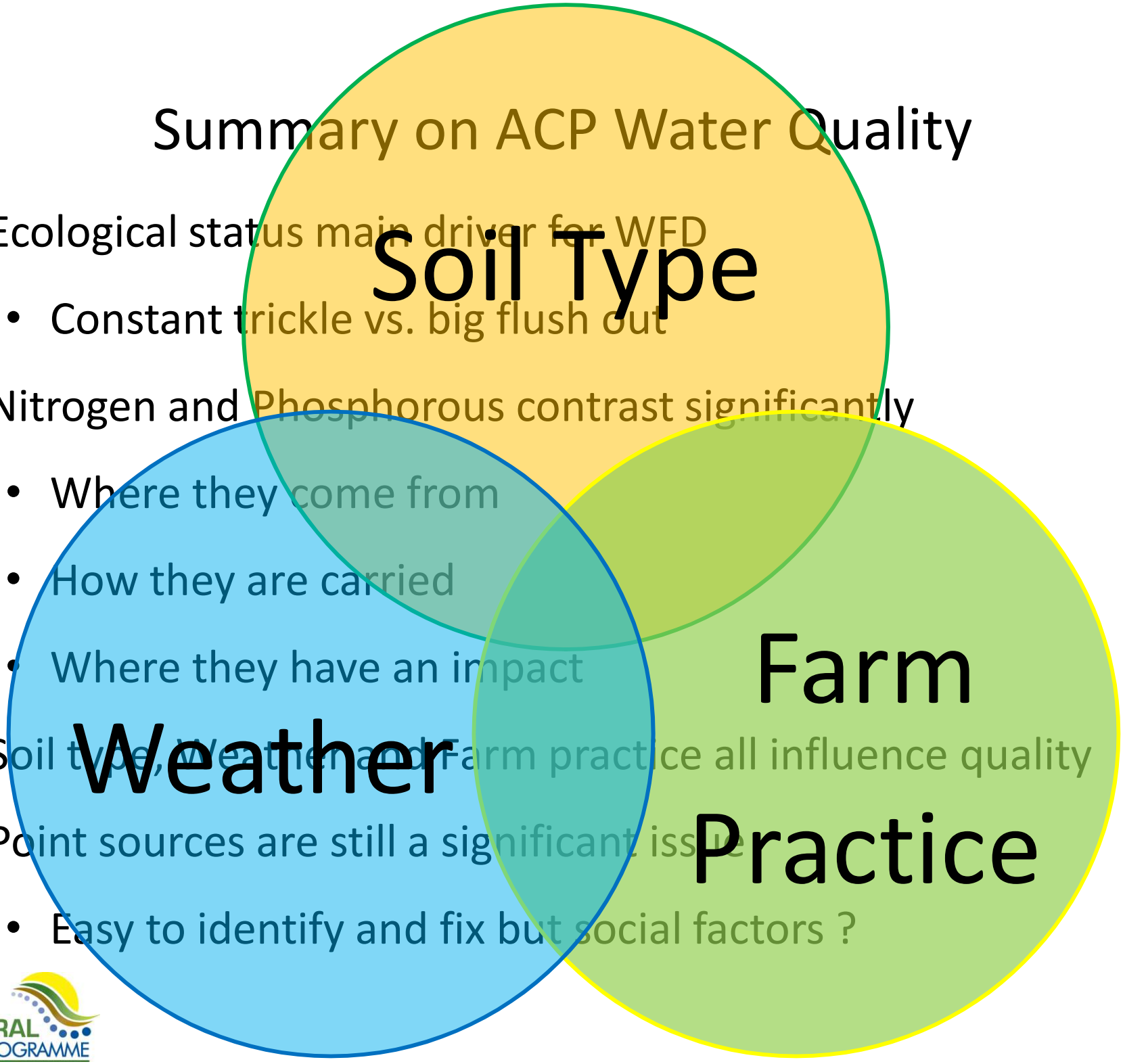
Summary on ACP Water Quality

- Ecological status main driver for WFD
  - Constant trickle vs. big flush out
- Nitrogen and Phosphorous contrast significantly
  - Where they come from
  - How they are carried
  - Where they have an impact
- Soil type, Weather and Farm practice all influence quality
- Point sources are still a significant issue
  - Easy to identify and fix but social factors ?



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