Upstream Thinking

Proof of Concept

Cornwall
Westcountry Rivers Trust
South West Water
Devon Wildlife Trust
Exmoor National Park

Dr Nick Paling

Head of Evidence & Engagement
Westcountry Rivers Trust

nick@wrt.org.uk

UPSTREAM THINKING: THE CORE CHALLENGE

Upstream Thinking
Proof of Concept

Chemicals
Assets Sludge
Energy

0.0043p

RISK: treatment **failure** leaves pollutants in final water

SOURCE: Some pollutants are natural – some can be **reduced**

Soil
Algae
Pesticides
Colour

10mg

COSTS: some costs are fixed – some are **variable**

UsT2: FINDING SOURCES OF POLLUTION

Upstream Thinking
Proof of Concept

Modelling risk: *Source>Pathway>Receptor*

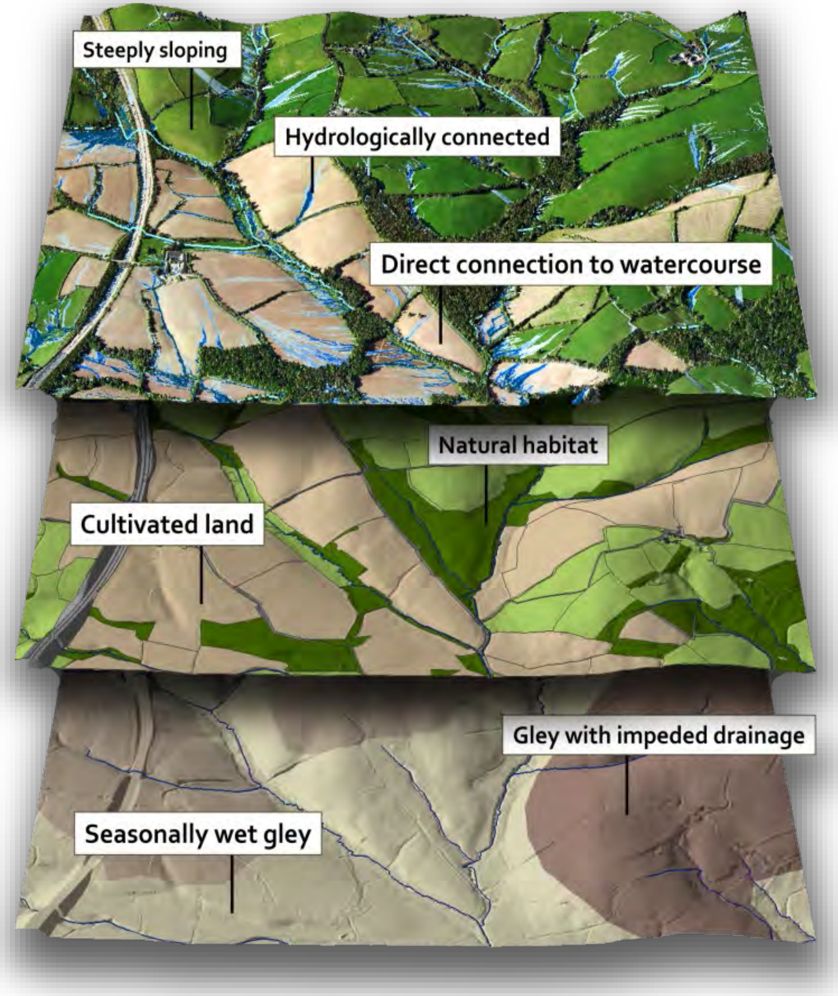
- **Robust environmental risk assessment is vital**
  We need to characterise the pressures in the system and determine where they are coming from…

- **Seeking areas with ↑ opportunity for improvement**
  Where the most risky behaviour is being undertaken in the most inherently risky places…

PRACTICE			
	3	6	9
	2	4	6
	1	2	3
	INHERENT RISK		

9 → **+++ Importance/opportunity**

- SEPP PROJECT (2011) – SWW & Defra
- SWW Catchment Investigations (2010-13)
- Tamar Pilot & WATER Project (2010-2012)
- NE WQ Risk Assessments (2013-16)
- Defra Local Action Project (2015-2018)



UsT2: FINDING SOURCES OF POLLUTION

Upstream Thinking
Proof of Concept

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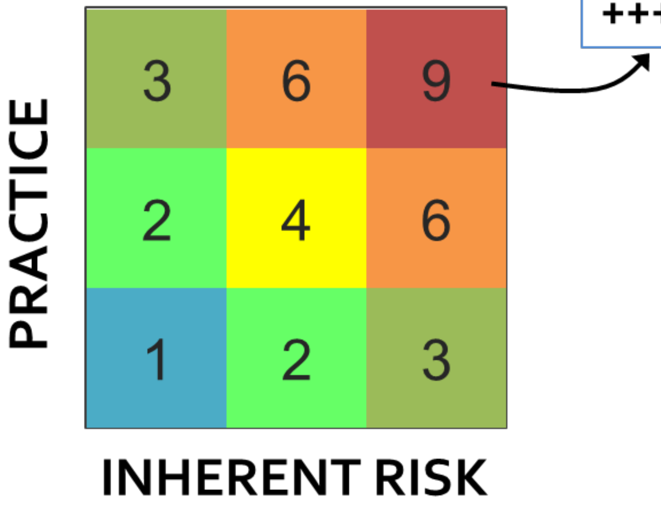

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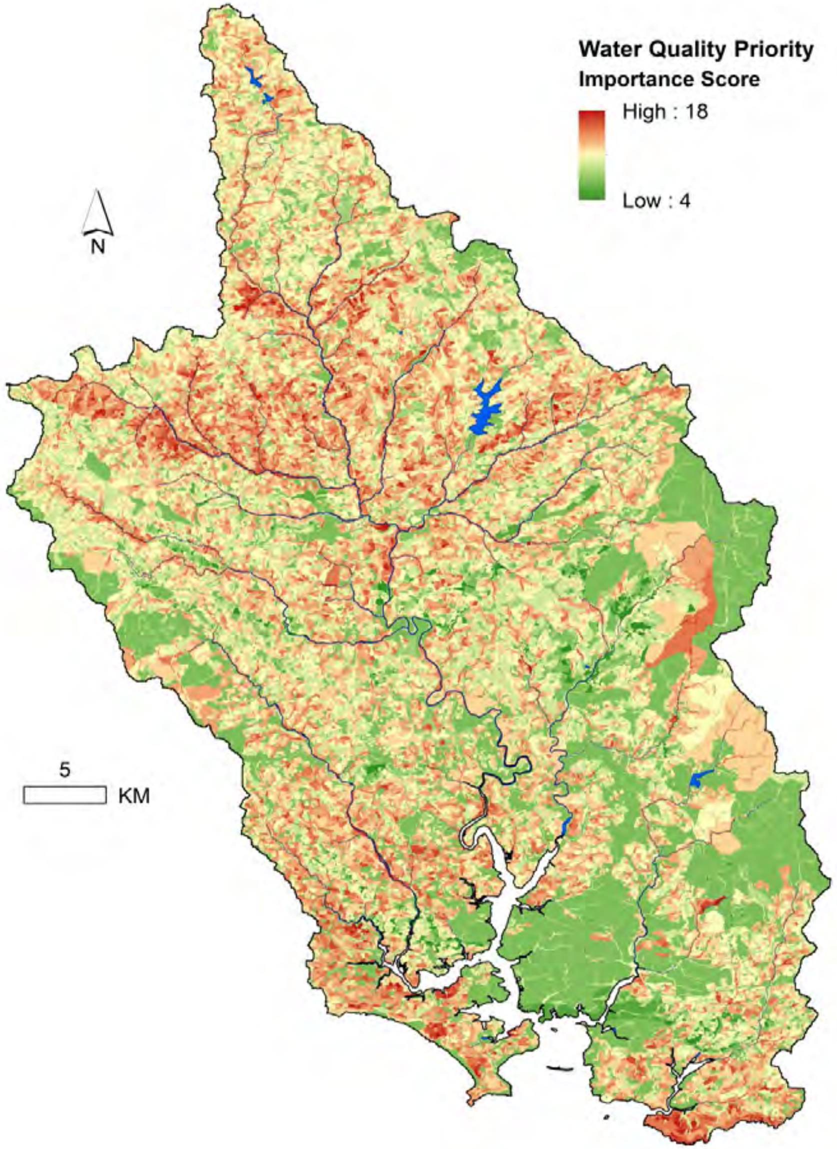
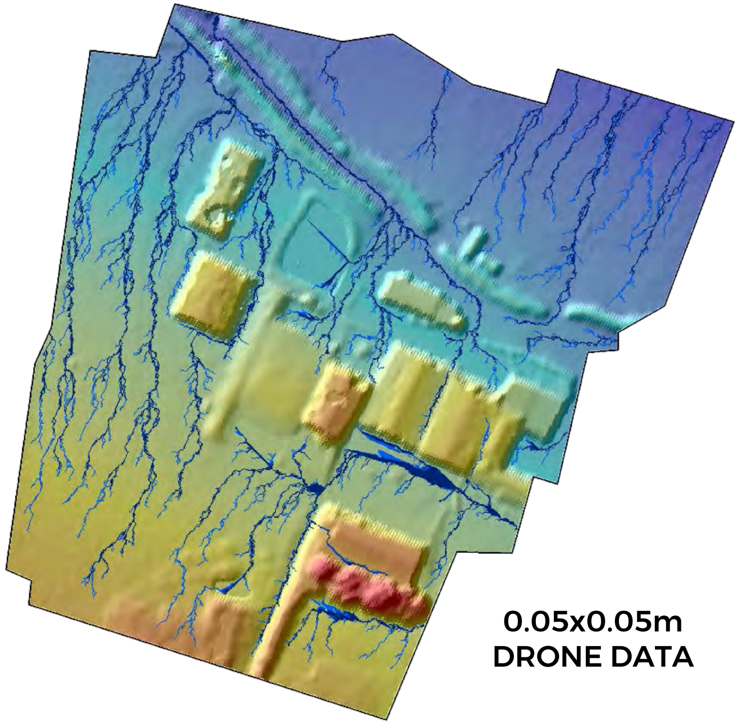


UsT2: TARGETING - SCIMAP

Modelling risk: *Source>Pathway>Receptor*

- **SCIMAP**

  A powerful visualisation & engagement tool that can be applied at a variety of spatial scales to target pollution risk areas…



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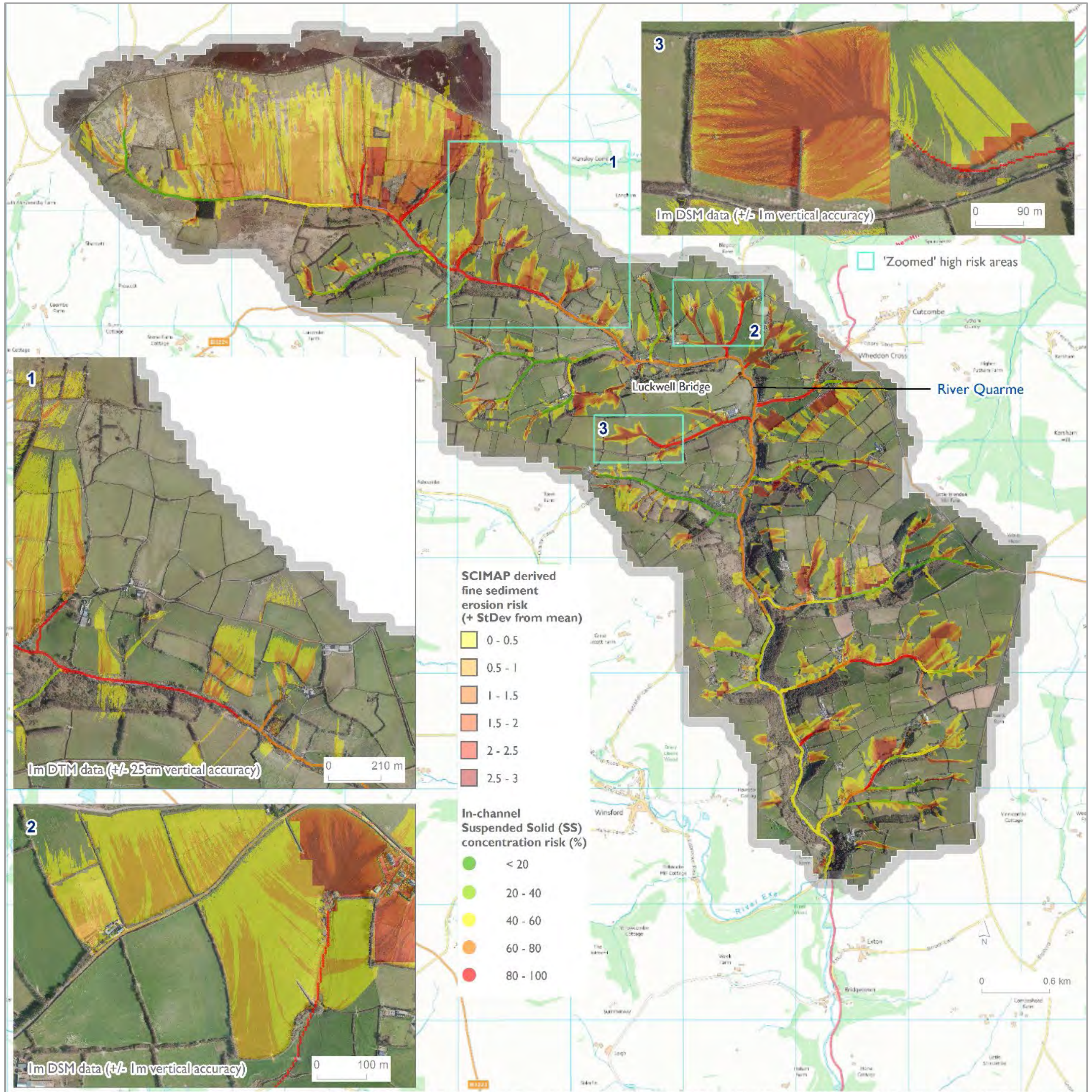


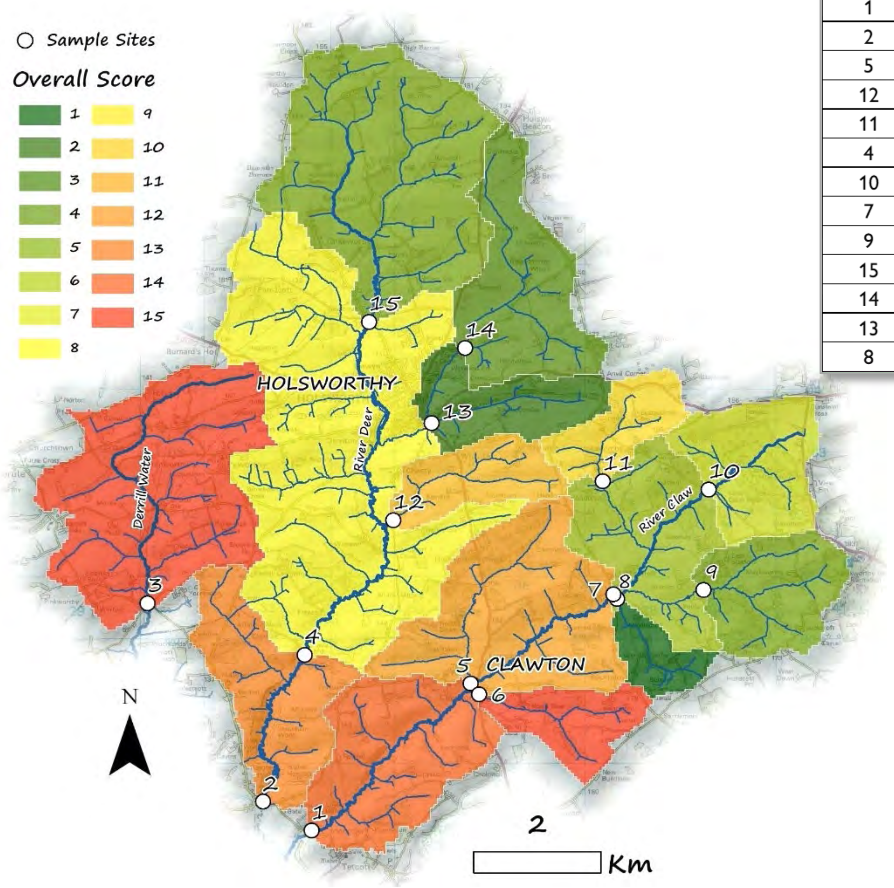
Ferraccioli, F., Gerard, F., Robinson, C., Jordan, T., Biszczuk, M., Ireland, L., Beasley, M., Vidamour, A., Barker, A., Arnold, R., Dinn, M., Fox, A., Howard, A. (2014). LiDAR based Digital Terrain Model (DTM) data for South West England. NERC Environmental

UsT2: FINDING SOURCES OF POLLUTION

Upstream Thinking
Proof of Concept

Monitoring: survey & sampling for source apportionment

WQ spot sampling



Site No.	River	Site	EC	TURB	PO_4	COL	TRYP	C-DOM	OBA	OVERALL
3	Derril Water	Yeomadon	13	14	13	12	13	8	9	11.7
6	Beer Stream	Clawton	15	8	9	8	14	14	14	11.7
1	Claw	Tetcott	9	13	7	14	12	9	10	10.6
2	Deer	North Tamerton	14	12	15	11	10	3	6	10.1
5	Claw	Clawton	5	15	12	15	1	10	11	9.9
12	Chasty Stream	Ratherton	12	6	10	6	15	7	8	9.1
11	Hollacombe Stream	Hayne Barton	10	1	14	1	6	15	15	8.9
4	Deer	Forda Mill	11	11	11	13	9	1	1	8.1
10	Claw	Higher Claw Bridge	2	10	4	7	7	13	13	8.0
7	Claw	Claw Bridge	1	9	8	10	3	12	12	7.9
9	Arscott Stream	Hayford Plantation	3	7	2	9	2	11	7	5.9
15	Claw	Gulliver Bridge	6	4	6	3	11	6	5	5.9
14	Lamerton Stream	Lamerton	8	5	3	5	8	4	3	5.1
13	Southcombe Stream	Cole's Mill Bridge	7	3	1	2	5	5	4	3.9
8	Middlecroft Stream	Clawford Cross	4	2	5	4	4	2	2	3.3

Overall water quality is the **average** of the scores given for each basic water quality indicator (conductivity, phosphate, colour, sediment, tryptophan, C-DOM and OBA).

The lower Deer, lower and mid Claw and Derril Water are the worst affected overall. Subsequent surveys will help to refine any seasonal influences on water quality in these catchments.

UsT2: DELIVERY OF ADVICE & MEASURES

Upstream Thinking
Proof of Concept

Delivery: farmer engagement, advice & investment

EXE BIOBED EVENT

DART SOILS EVENT

DEFRA DART VISIT

DART PESTICIDE EVENT

RICHARD SMITH SOILS EVENT

UsT2: DELIVERY OF ADVICE & MEASURES

Upstream Thinking
Proof of Concept

Delivery: farmer engagement, advice & investment

UsT2: DELIVERY OF ADVICE & MEASURES

Upstream Thinking
Proof of Concept

Delivery: farmer engagement, advice & investment

Tamar farm visited in March 2016 where work was identified to update the dirty water system through installing a new pump to reduce the risk of overflows to the river and by redirecting it across the farm via pipework system. Works completed to value of £4,406 (50% grant).

UsT2: DELIVERY OF ADVICE & MEASURES

Upstream Thinking
Proof of Concept

Delivery: farmer engagement, advice & investment

Tamar farm visited in January 2016 where work was identified to cover an open yard area to reduce volumes of dirty water produced, diverting clean water and thereby improving slurry storage and reducing nutrient spreading on the land. Works completed to value of £21,500 (50% grant).

UsT2: DELIVERY OF ADVICE & MEASURES

Upstream Thinking
Proof of Concept

Delivery: farmer engagement, advice & investment

Tamar farm visited in August 2016 where work was identified for fencing to protect the watercourses, providing a wider natural buffer to intercept any soil or nutrients mobilised. The fence line incorporates gated access for stock management and one improved crossing with stone. Works completed to value of £2,033 (50% grant).

UsT2: DELIVERY OF ADVICE & MEASURES

Delivery: farmer engagement, advice & investment

An Exe farm (upscaling) visited in November 2015 where work was identified to upgrade 2 sections of the current cattle track by installing concrete sleepers to negate the poaching of soils under and reduce mobilisation and nutrient loading entering adjacent watercourses. Works completed to value of £5,614 (50% grant).

UsT2: DELIVERY OF ADVICE & MEASURES

Upstream Thinking
Proof of Concept

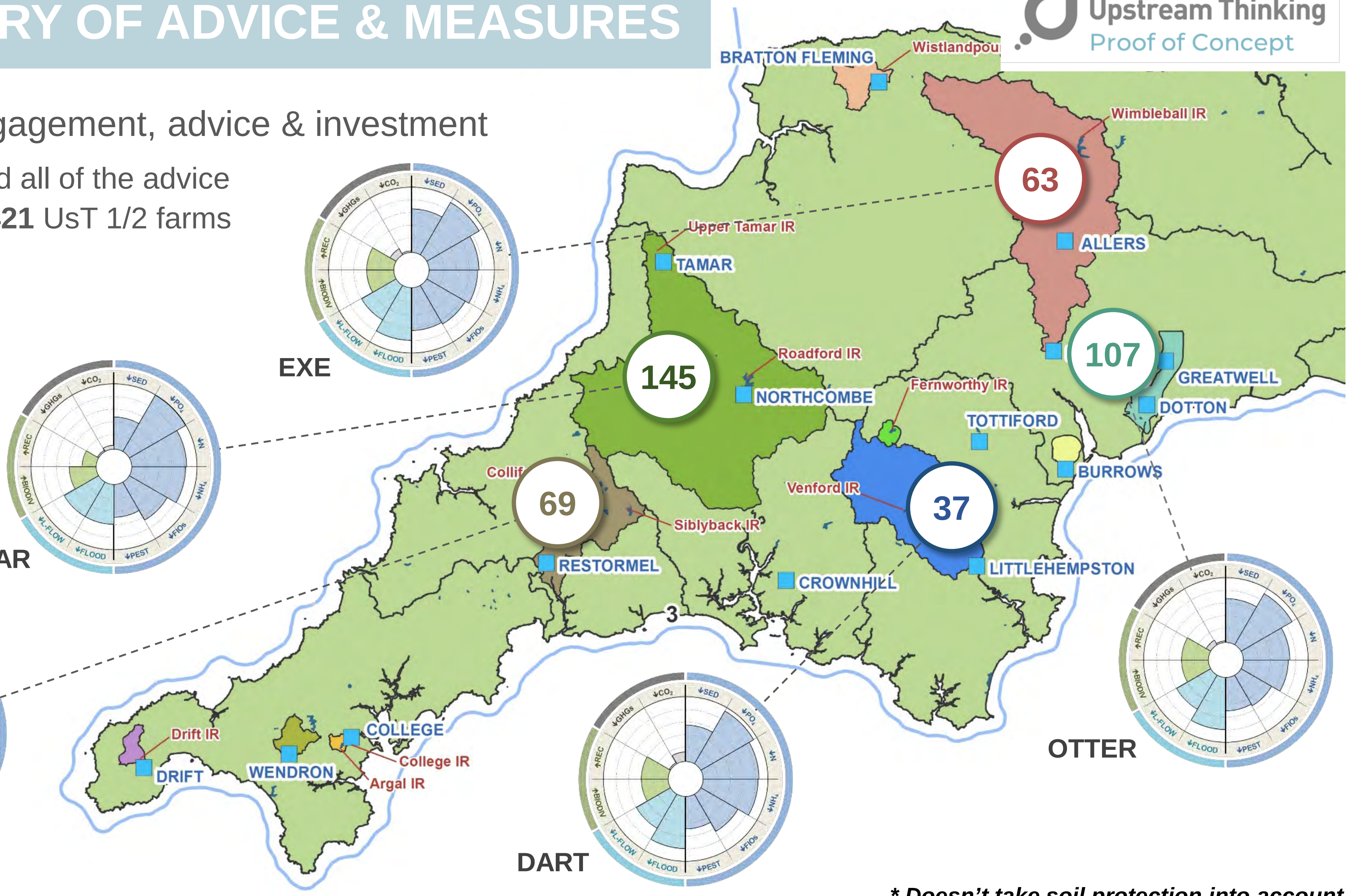
Delivery: farmer engagement, advice & investment

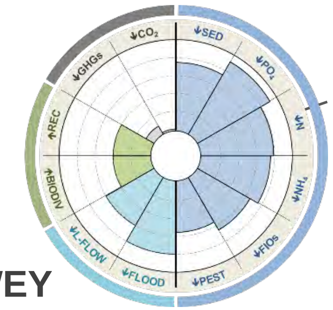
We have recently audited all of the advice & investments given to **421** UsT 1/2 farms since 2010…

UsT 1: £4.3m

UsT 2: £1.8m

so far…





**** Doesn't take soil protection into account***


Upstream Thinking
Pesticide Simulator
South West
Water
Westcountry
Rivers Trust
UNIVERSITY OF
LEICESTER


Upstream Thinking
Pesticide Simulator
South West Water
Westcountry Rivers Trust
UNIVERSITY OF LEICESTER

THE PESTICIDE CHALLENGE

- **'Pesticides'** – any chemical used to kill or control 'pest' organisms – typically in agriculture or horticulture
- When used correctly, they can deliver substantial **benefits for society**:
  - Increase availability of good quality, reasonably priced food
  - Help maintain urban environments & infrastructure
- Can pose a **significant threat** to ecosystem health, biodiversity and human health if lost to environment
- **Risks of contamination** need to be assessed and measures taken to minimise

Upstream Thinking
Pesticide Simulator

THE WATER COMPANY VIEW

- **UK water companies are required by law to –**
  1. Assess the risk that pesticides pose to raw water sources
  2. Monitor sources for the presence of pesticides
- **EU Drinking Water Directive**
  "...must be no individual pesticide detected in drinking water over 0.1 µg per litre..."
- Increasing levels of pesticides found in raw water has driven huge increases in treatment processes...**and costs...**

WTWs processes for mitigating pesticide contamination include:

Dilution – Adsorption – Biological – Destruction – Physical Removal

- **Switching sources** or blending raw water to **dilute** contaminants
- **Adsorption** onto granular or powdered **activated carbon**
- Destruction using **ozone**, **ultraviolet irradiation** or **advanced oxidation**
- **Physical removal** (size exclusion) using **nano-filtration reverse osmosis**

Expensive
High energy demand
May not be possible

Upstream Thinking
Pesticide Simulator

THE WATER COMPANY VIEW

There is always some **residual level of risk**…

- Some pesticides, such as **metaldehyde** (slug pellets) and the herbicide **chlopyralid**, can still **‘break through’** these processes…
- The **performance of treatment processes**, such as activated carbon filters, **can be degraded if raw water quality is poor.**

3x MECHANISMS OF PESTICIDE POLLUTION

Upstream Thinking
Pesticide Simulator

- Pesticide pollution typically occurs via **3 mechanisms** –
  1. **Wash-off from land** following application
  2. **Spills** during **preparation** and **equipment washing**
  3. **Leaks** from current and/or old **storage** facilities

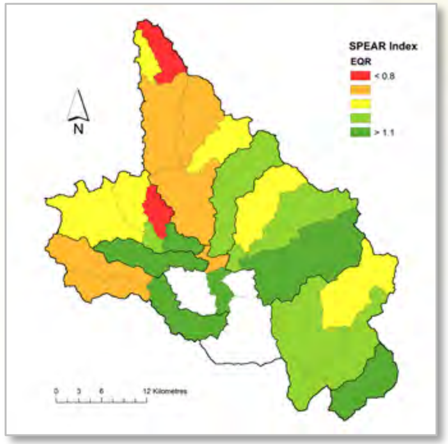
- **The risk of pollution can be reduced (but never to zero) by increasing the adoption of good/best practices for each of these process…**

SPATIAL ASSESSMENT OF PESTICIDE POLLUTION SOURCES

- **2x approaches** for identifying pesticide sources in a landscape –

    1. **Monitoring** (biological or chemical)

SPEcies **A**t **R**isk: **Pesticides**
(*SPEAR-PESTICIDES Index*)
Assesses how invertebrates in a river are being affected by pesticides (esp. insecticides)



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Pesticide Simulator

SPATIAL ASSESSMENT OF PESTICIDE POLLUTION SOURCES

Upstream Thinking
Pesticide Simulator

- **2x approaches for identifying pesticide sources in a landscape –**

  1. **Monitoring** (biological or chemical)

     Passive sampling

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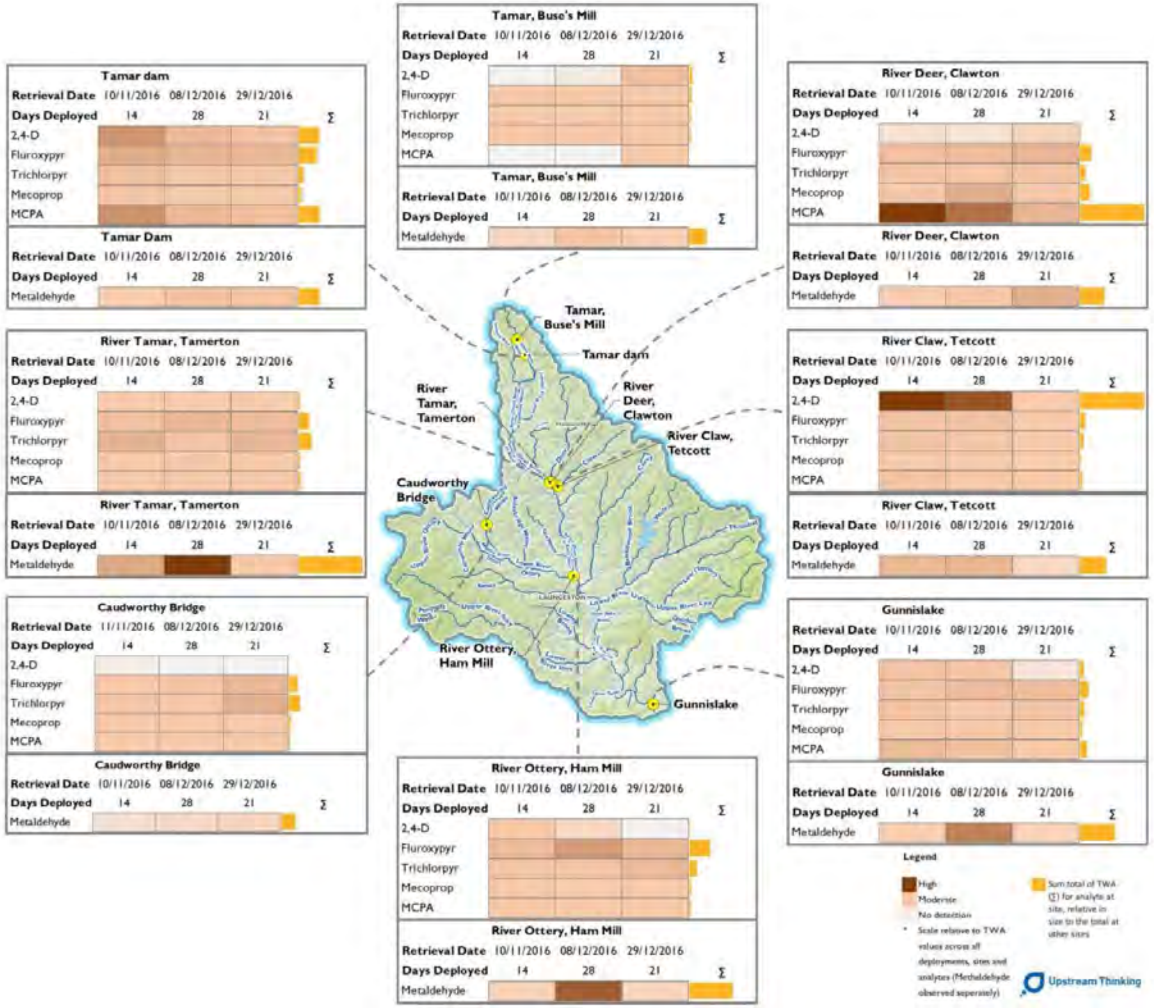


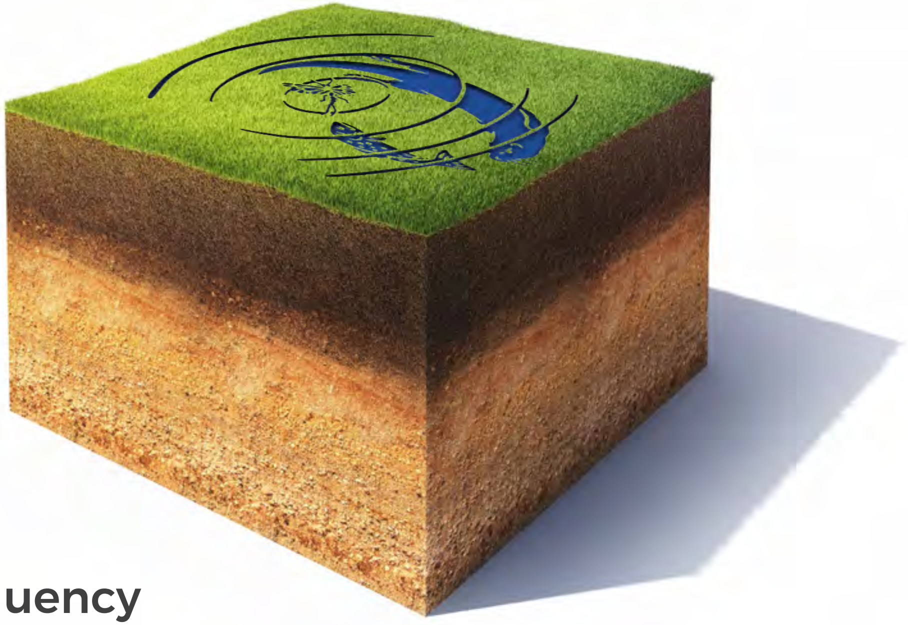
THE UPSTREAM THINKING PESTICIDE POLLUTION SIMULATOR

Upstream Thinking
Pesticide Simulator

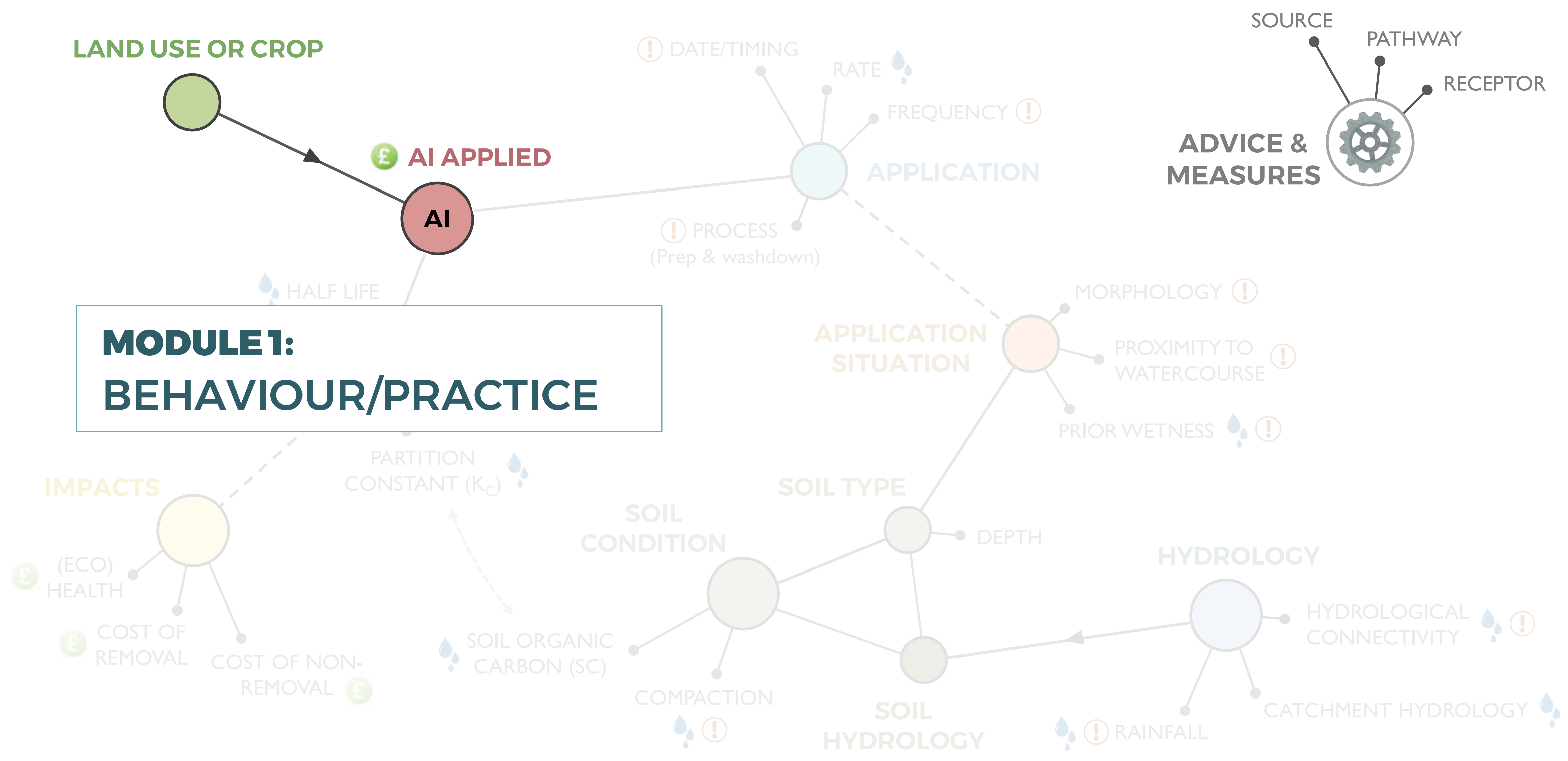
WRT have undertaken a comprehensive review of existing pesticide models

We identified the need for a **pesticide simulator** that:

- Assesses risk at **fine spatial** (sub-field) & **temporal** (day) **scale**
- Incorporates **local data**
- Helps **target/design advice** & **measures**
- Simulates **stochastic pesticide pollution events**
- Works for **grassland dominated catchments**
- Demonstrates **changes in pesticide pollution events** (frequency and magnitude) resulting from **land management advice and measures**



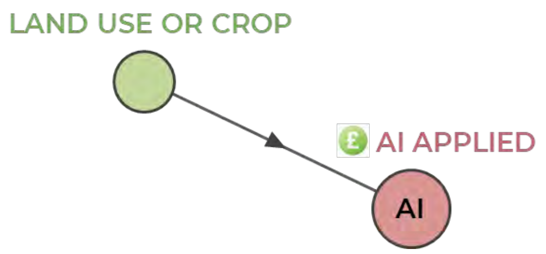
MODULE 1:
BEHAVIOUR/PRACTICE



(!) = RISK FACTOR – LIKELIHOOD OF CONTAMINATION

= FACTOR EFFECTING LEVEL OF CONTAMINATION

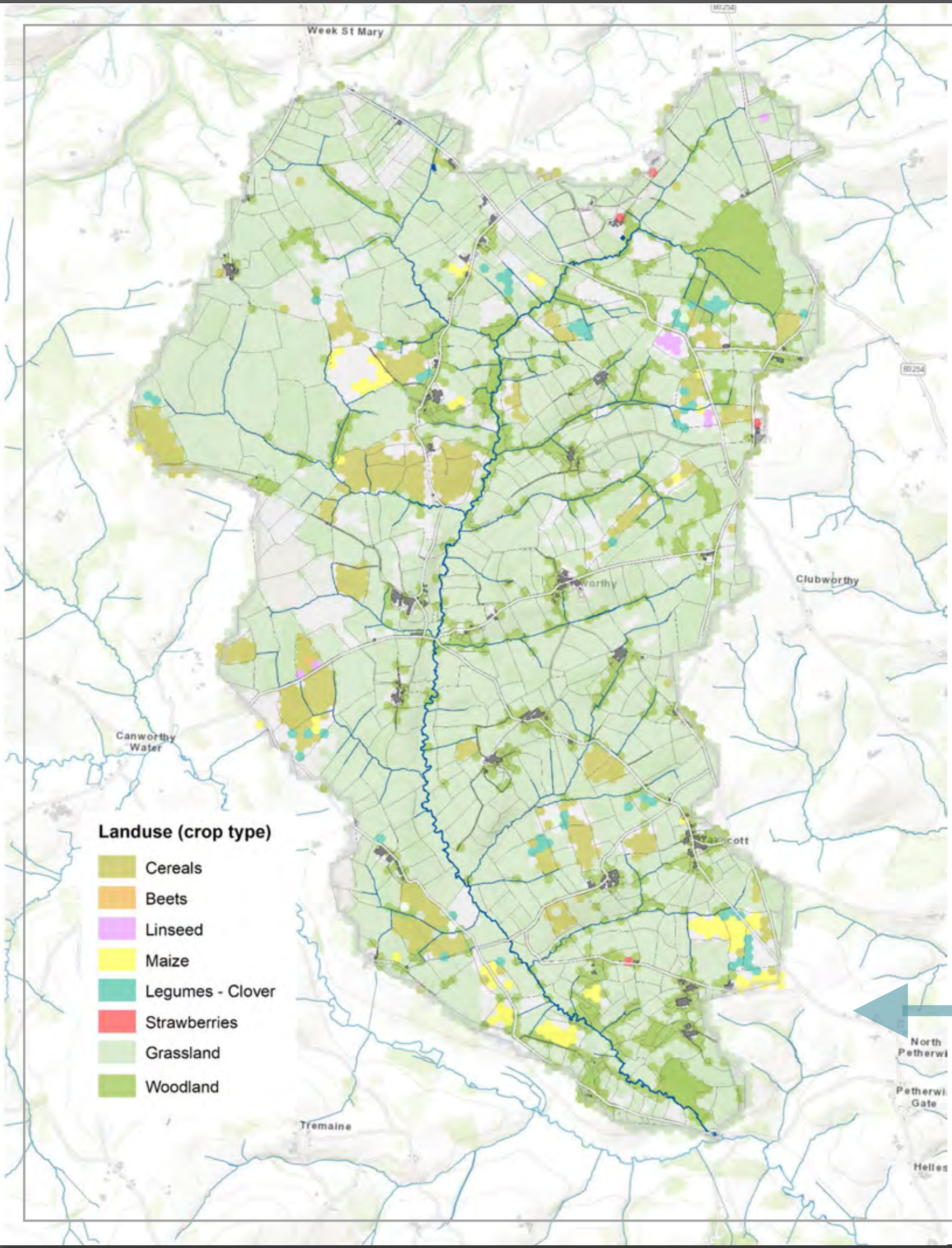
£ = ECONOMIC CONSIDERATION - COSTS

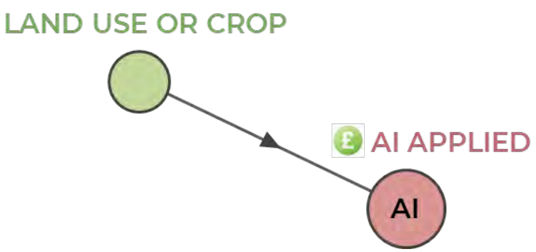


MODULE 1:
BEHAVIOUR/PRACTICE

Undertook comprehensive review of :

- Pesticide formulations on the market, their usage guidelines & their cost
- Current agronomic advice provided to farmers of different types in the South West
- Latest regulatory framework relating to integrated pest management (IPM)
- Farmer (& spray contractor) perceptions of IPM & typical behaviour





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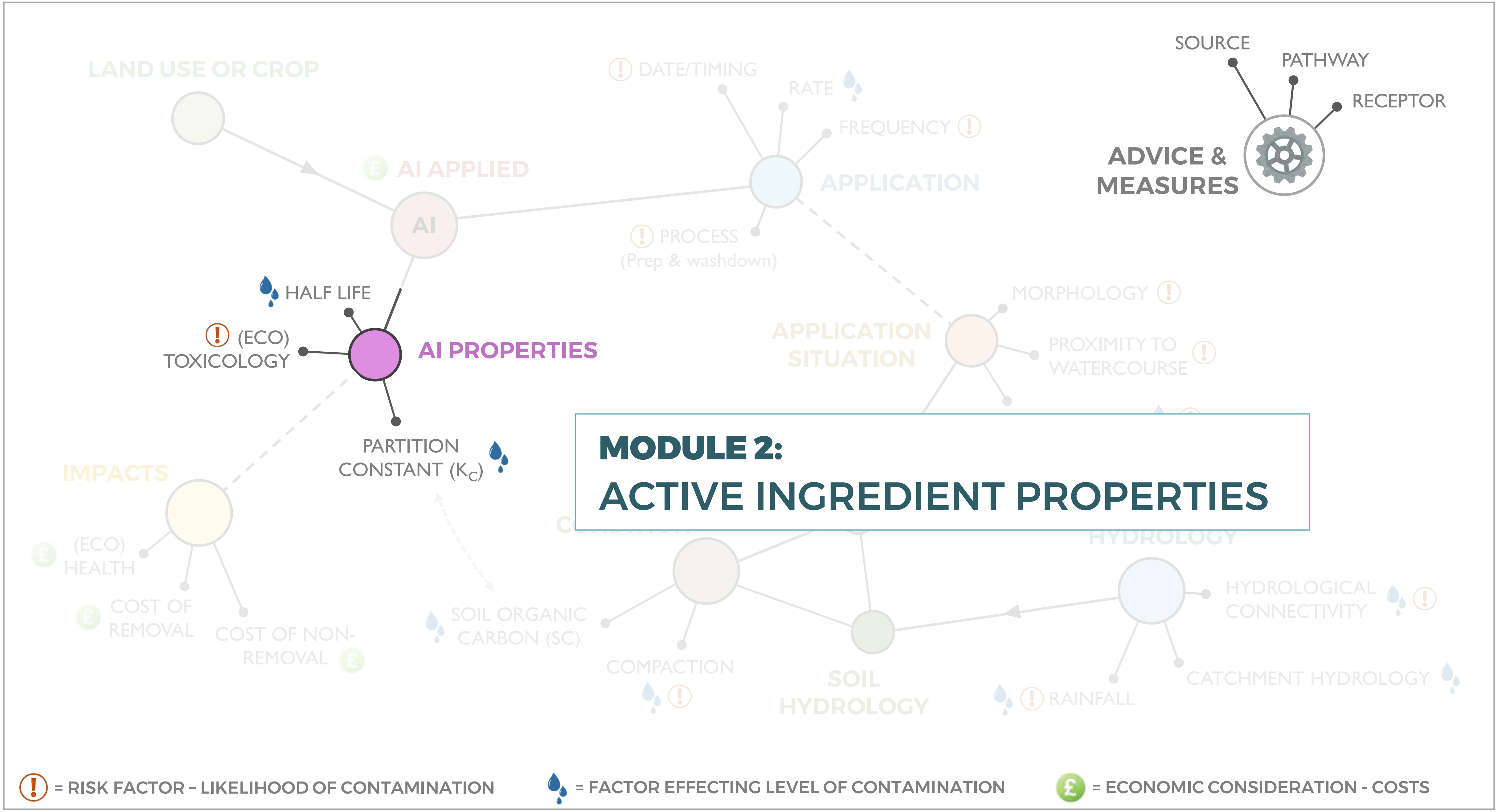
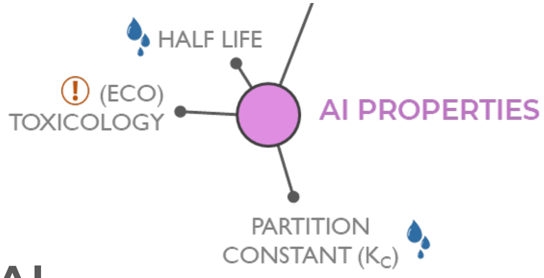
Active ingredient choice & application method is determined by land use / crop type / pest type

The most critical factor is the 'decision-to-spray'



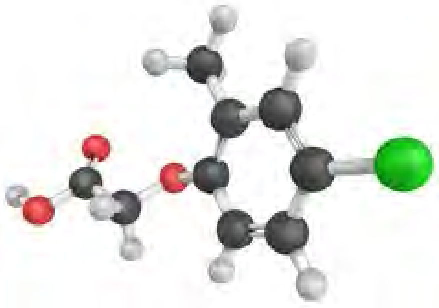
LAND USE OR CROP
AI APPLIED
AI
DATE/TIMING
RATE
FREQUENCY
APPLICATION
PROCESS (Prep & washdown)
SOURCE
PATHWAY
RECEPTOR
ADVICE & MEASURES
HALF LIFE
(ECO) TOXICOLOGY
AI PROPERTIES
PARTITION CONSTANT (K_C)
MORPHOLOGY
APPLICATION SITUATION
PROXIMITY TO WATERCOURSE
MODULE 2:
ACTIVE INGREDIENT PROPERTIES
IMPACTS
(ECO) HEALTH
COST OF REMOVAL
COST OF NON-REMOVAL
SOIL ORGANIC CARBON (SC)
COMPACTION
SOIL HYDROLOGY
HYDROLOGICAL CONNECTIVITY
CATCHMENT HYDROLOGY
RAINFALL
= RISK FACTOR – LIKELIHOOD OF CONTAMINATION
= FACTOR EFFECTING LEVEL OF CONTAMINATION
= ECONOMIC CONSIDERATION - COSTS

MODULE 2:
AI PROPERTIES



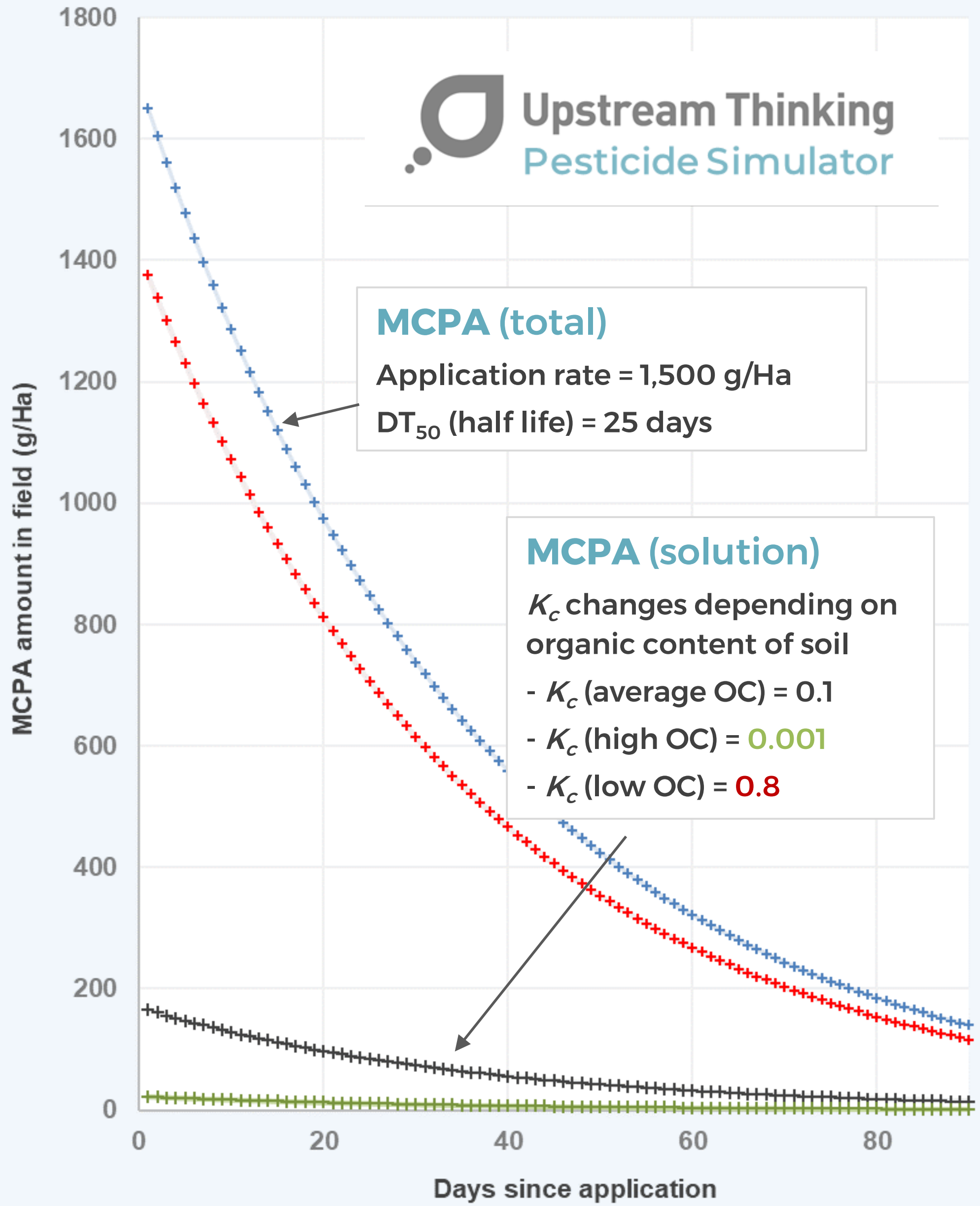
Key characteristics of each AI –

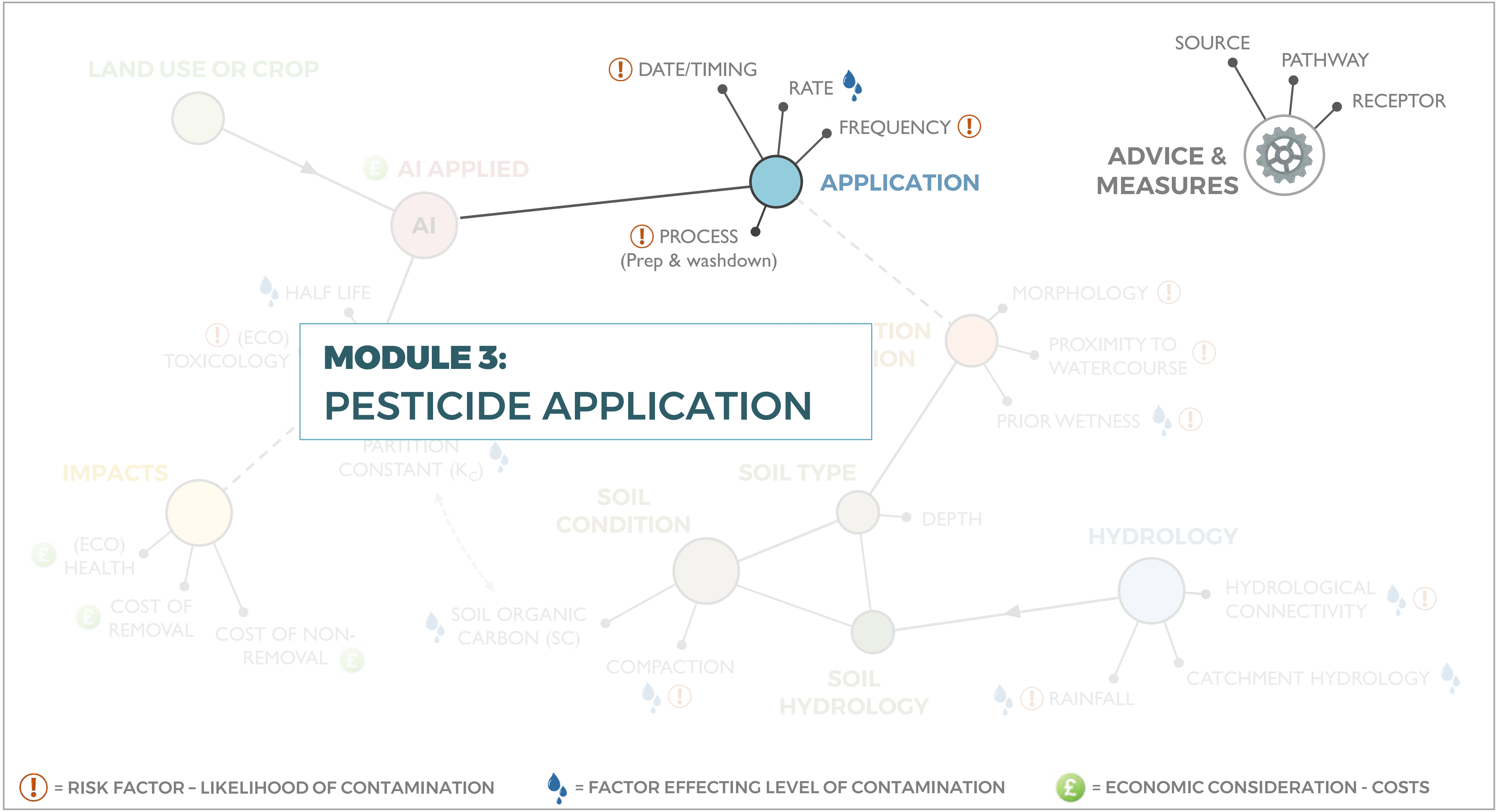
- **Half life** – rate of AI breakdown
- **Partition Constant (*K_c*)** – proportion of AI applied that enters solution in soil pore water
- **Mobility** & **persistence** in the environment
- **Ecotoxicology** & potential **human toxicology**



MCPA

2-methyl-4-chlorophenoxyacetic acid is a selective herbicide used to control broadleaf weeds, such as thistle and dock, in cereal crops and pasture.




MODULE 3:
PESTICIDE APPLICATION
LAND USE OR CROP
AI APPLIED
AI
APPLICATION
DATE/TIMING
RATE
FREQUENCY
PROCESS
(Prep & washdown)
ADVICE &
MEASURES
SOURCE
PATHWAY
RECEPTOR
HALF LIFE
(ECO)
TOXICOLOGY
PARTITION
CONSTANT (K_C)
MORPHOLOGY
PROXIMITY TO
WATERCOURSE
PRIOR WETNESS
IMPACTS
(ECO)
HEALTH
COST OF
REMOVAL
COST OF NON-
REMOVAL
SOIL ORGANIC
CARBON (SC)
SOIL TYPE
DEPTH
SOIL
CONDITION
COMPACTION
SOIL
HYDROLOGY
HYDROLOGY
HYDROLOGICAL
CONNECTIVITY
CATCHMENT HYDROLOGY
RAINFALL
= RISK FACTOR – LIKELIHOOD OF CONTAMINATION
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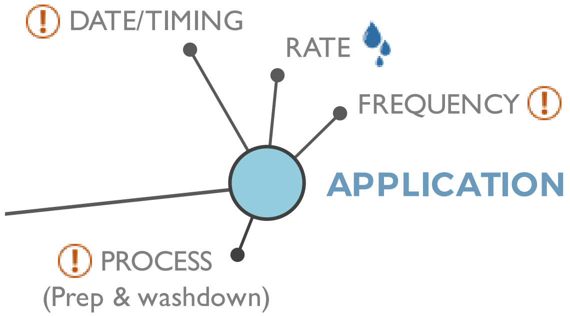
MODULE 3:

PESTICIDE APPLICATION



Key parameters relating to pesticide application processes –

- **Process risk** – spray accuracy, preparation & washdown (biobed use)
- **Date (timing) of application** – when is spraying done (earliest/latest)
- **Application rate** – at what rate is an AI applied (usually in g/Ha)
- **Number of applications** – trade-offs between 1 big hit or multiple

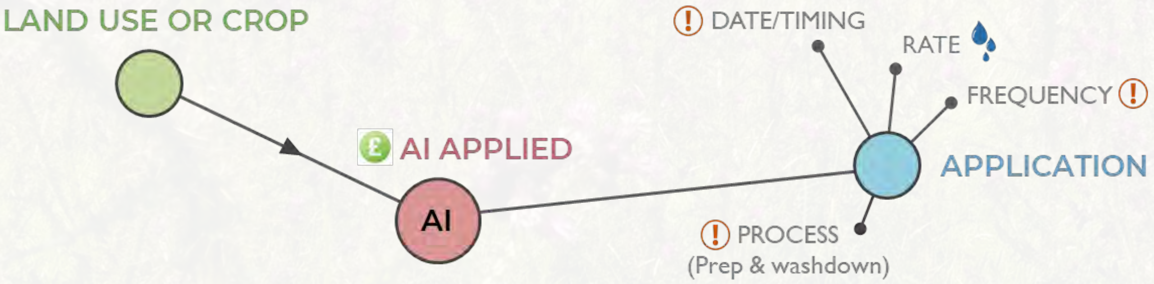
Upstream Thinking
Pesticide Simulator

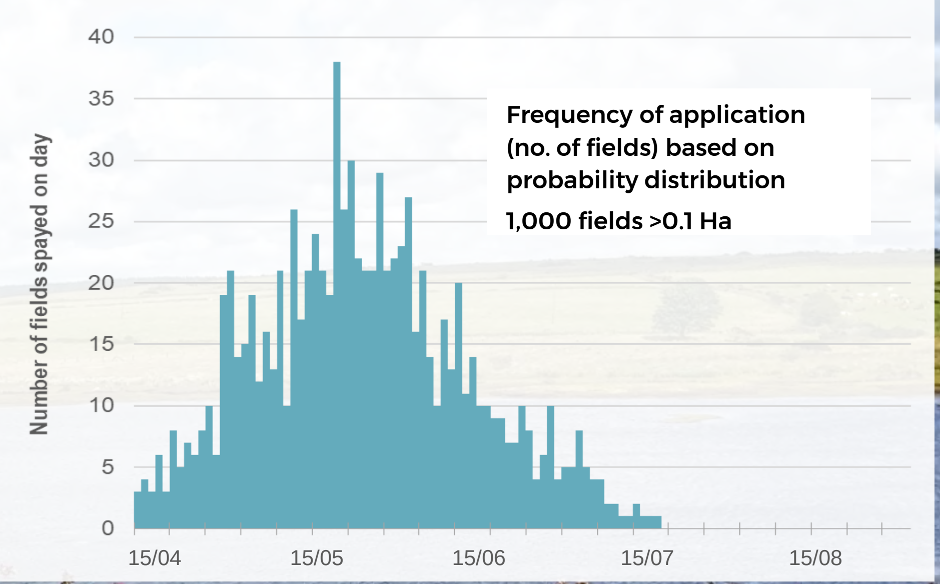
CASE STUDY:

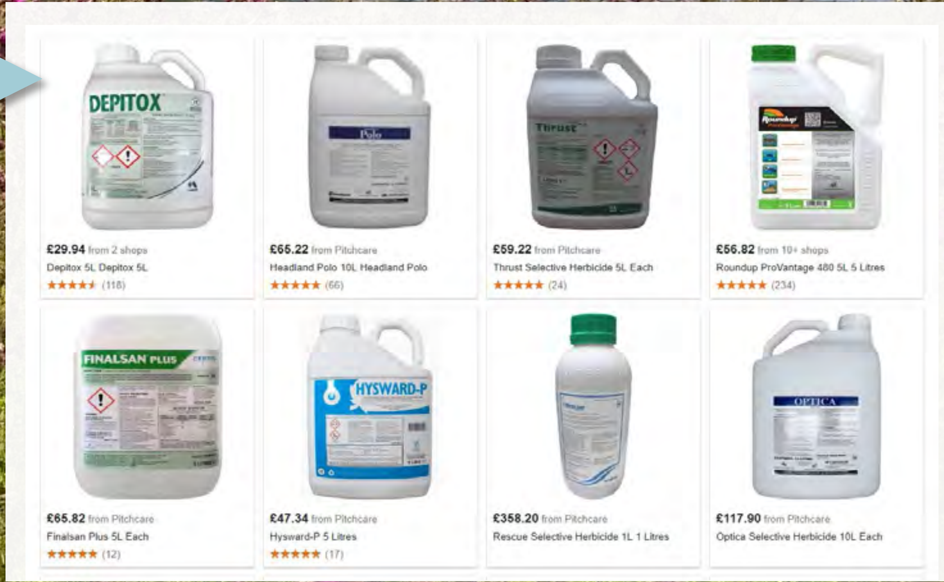
IPM FOR GRASSLAND

Farmers need to selectively control grassland weeds (thistles, docks, rushes, nettles, etc)

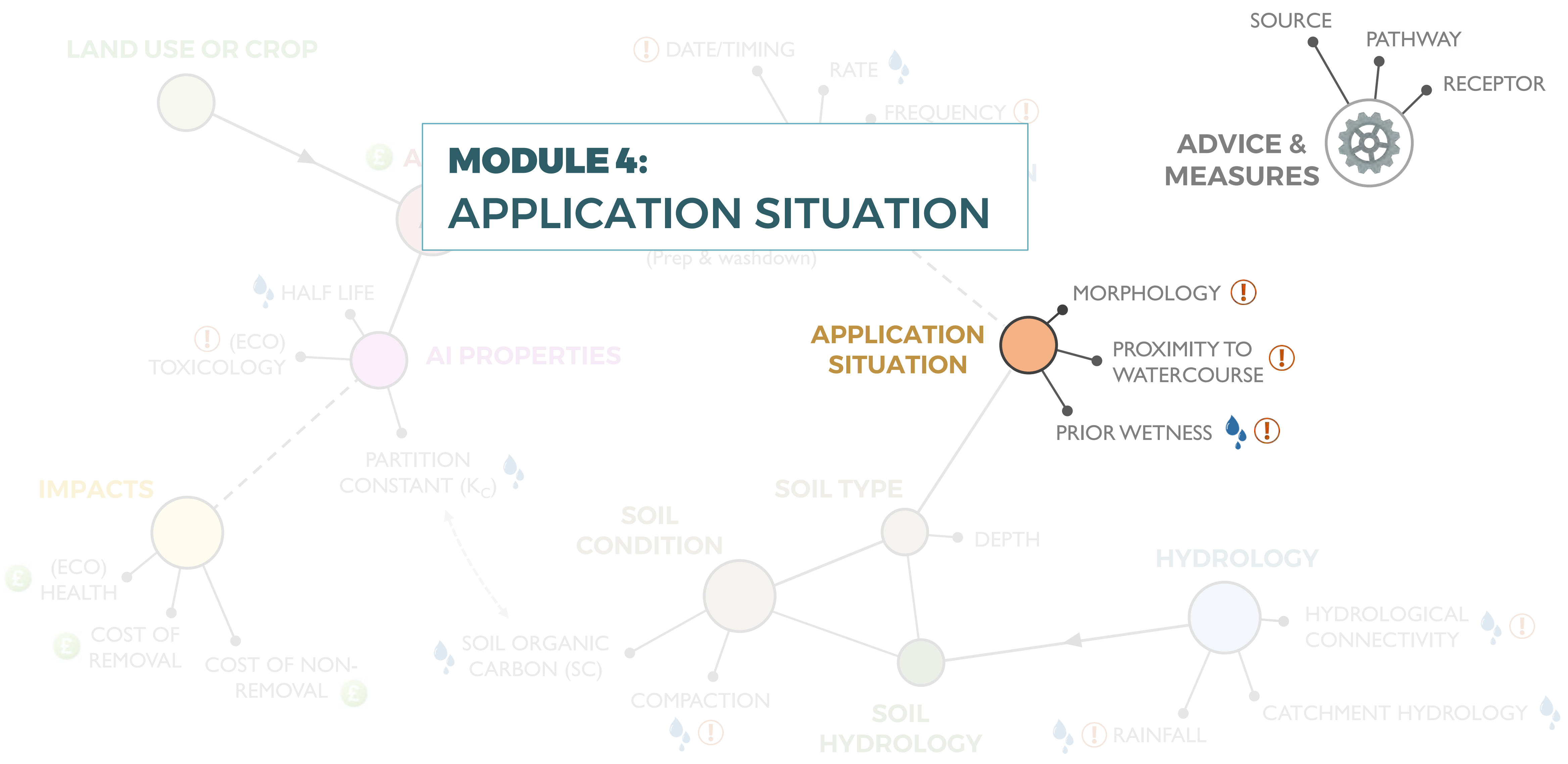
- **‘Decision to spray’** – judgment/advice — Probably most critical factor
- **2x application windows** – spring & autumn
- **AI selection** – based on **target**, **advice** & **cost**
- **Application rate** – according to label/advice







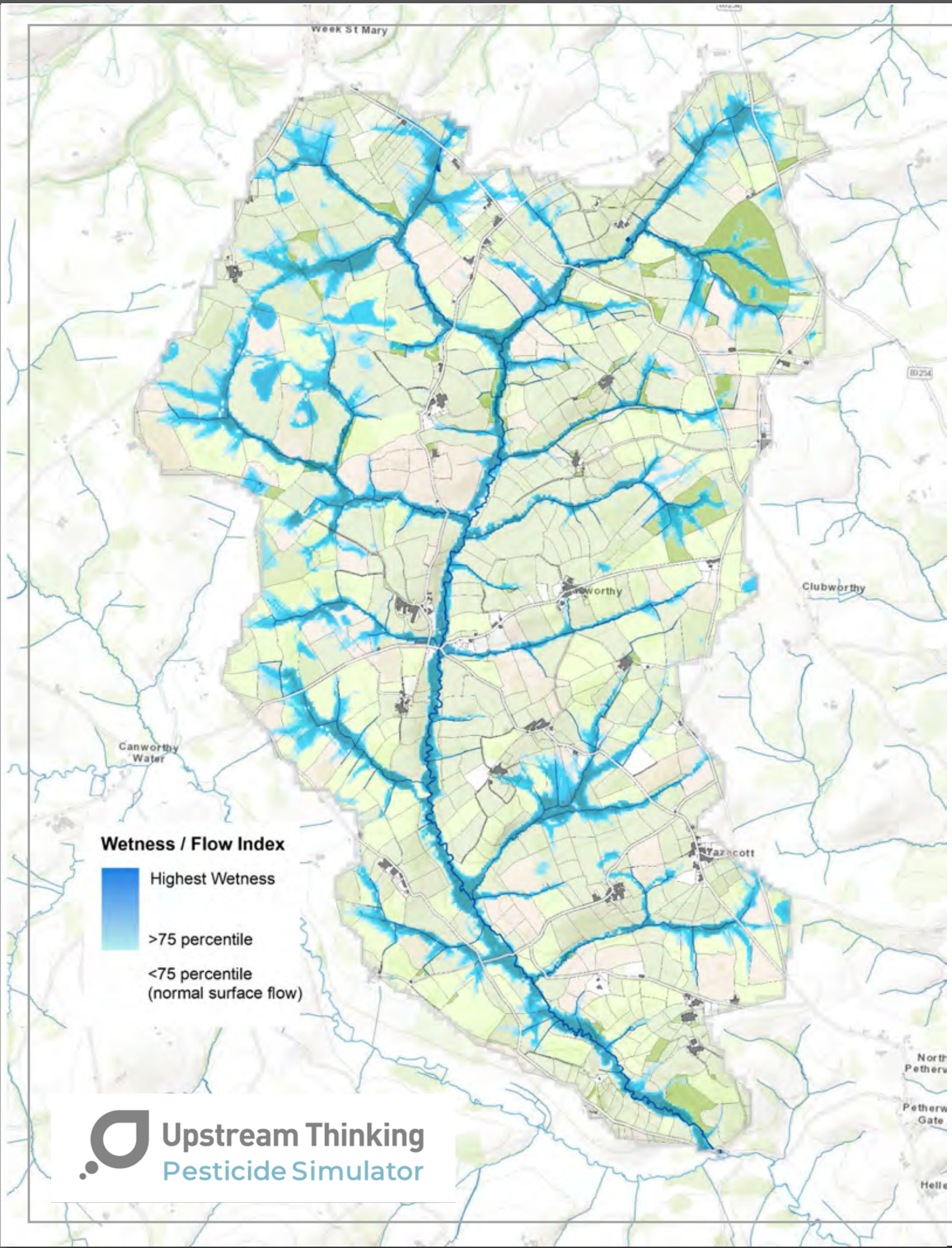
MODULE 4:
APPLICATION SITUATION

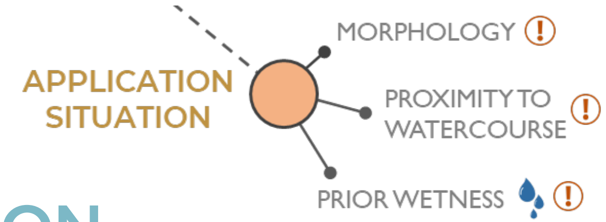


(!) = RISK FACTOR – LIKELIHOOD OF CONTAMINATION

(drops) = FACTOR EFFECTING LEVEL OF CONTAMINATION

(£) = ECONOMIC CONSIDERATION - COSTS

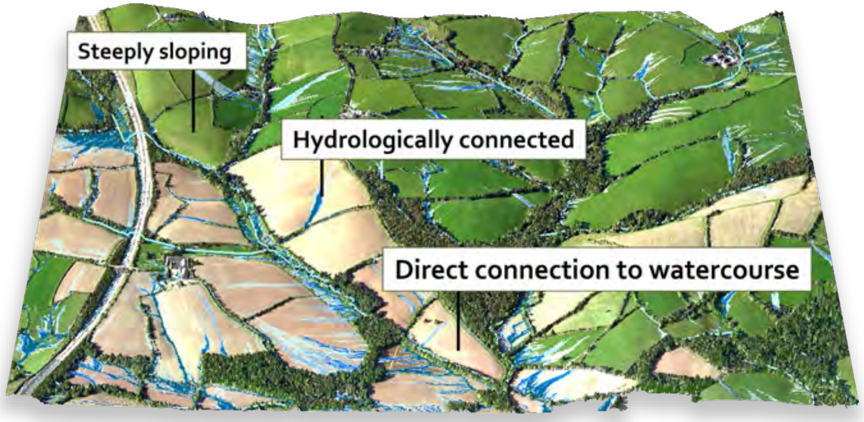




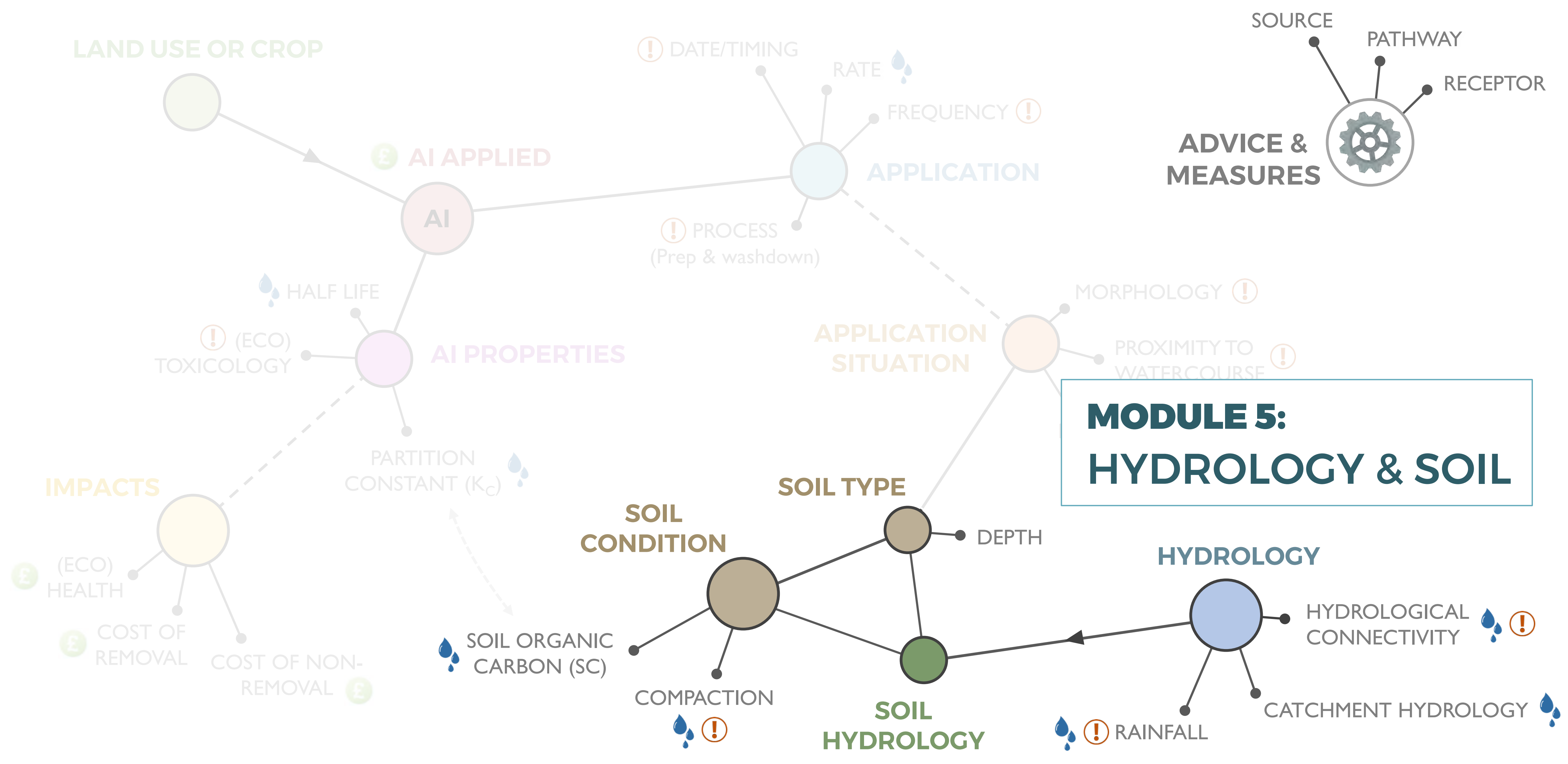
MODULE 4:
APPLICATION SITUATION

Several key characteristics of the application situation significantly effect pollution risk:

- **Morphology** – slope increases run-off potential
- **Hydrological connectivity** & **prior wetness**
  ↑ % of AI entering solution & ↑ mobilisation risk
- **Proximity to watercourse** – ↓ pathway attenuation



MODULE 5: HYDROLOGY & SOIL



(!) = RISK FACTOR – LIKELIHOOD OF CONTAMINATION

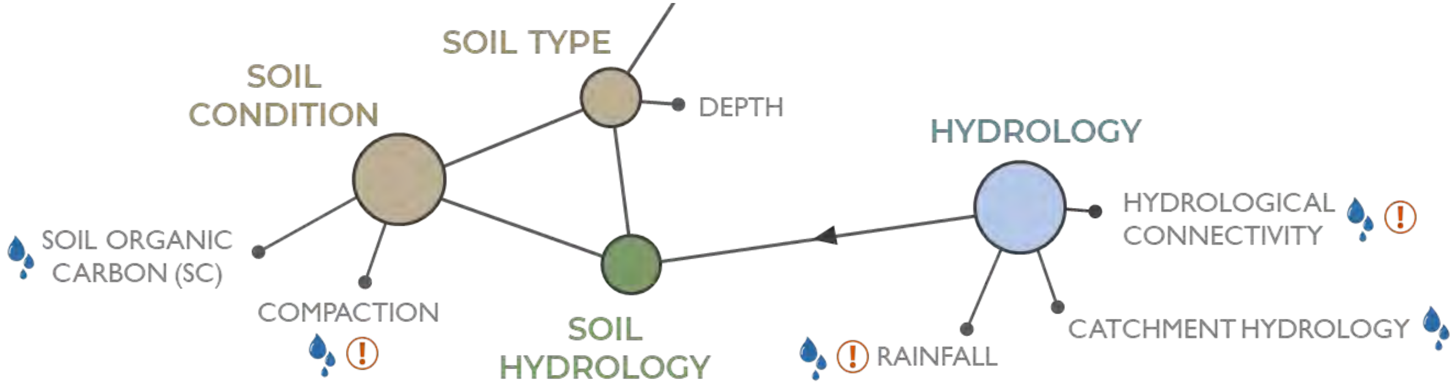
(droplet) = FACTOR EFFECTING LEVEL OF CONTAMINATION

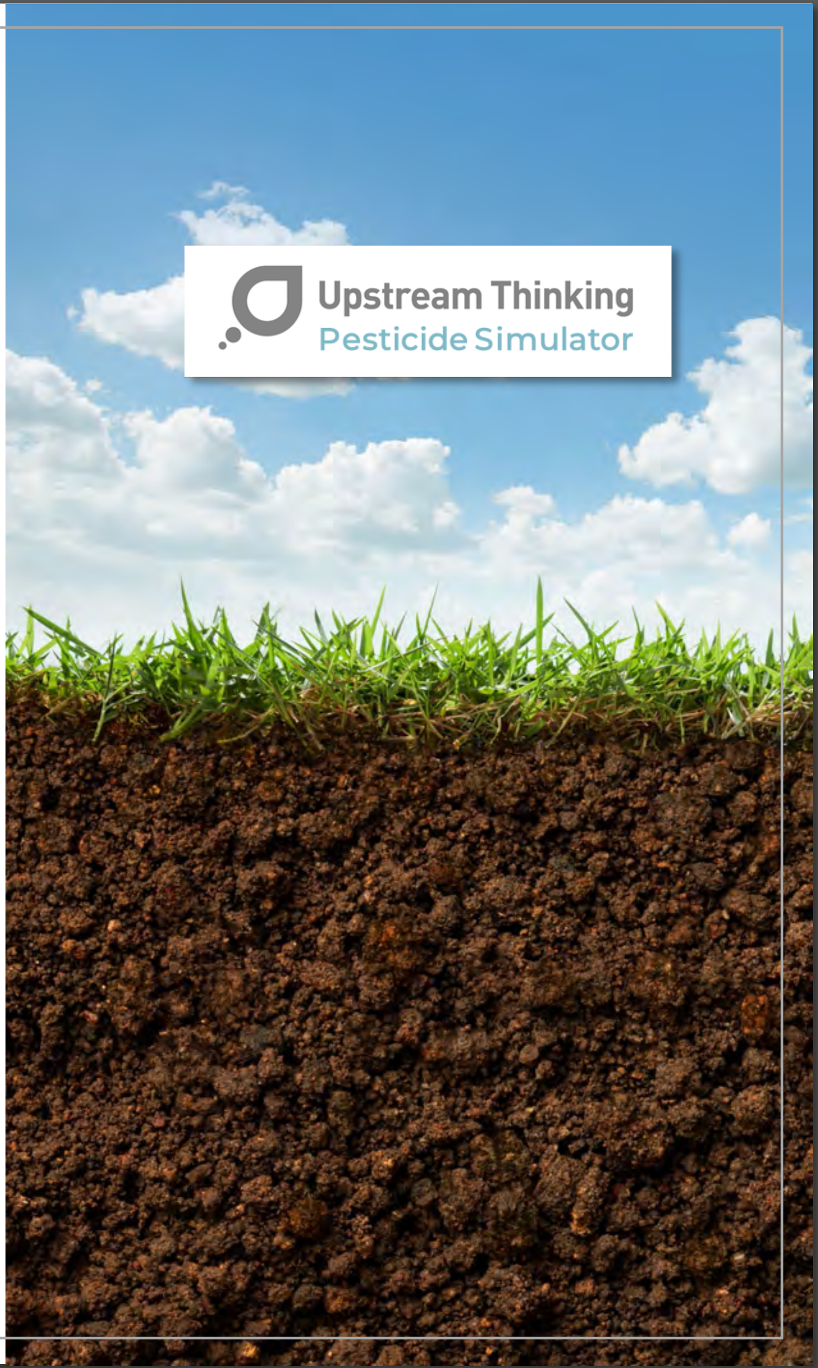
(£) = ECONOMIC CONSIDERATION - COSTS

MODULE 5:
HYDROLOGY & SOIL

Factors that determine the hydrological response of a catchment landscape :

- **Rainfall** – input of water to the system
- **Catchment size** & **morphology**
  – determines volume of water & rate of run-off
- **Soil type (character)** & **condition** – determine soil hydrology





Upstream Thinking
Pesticide Simulator

MODULE 5:

HYDROLOGY & SOIL

UNIVERSITY OF LEICESTER

Soil hydrology model (based on TOPMODEL):

Developed by Mick Whelan at Uni of Leicester...

SOIL – 0712d – HALLSWORTH 1 – 49% of catchment area

- Seasonally waterlogged slowly permeable **stagnogley (clay) soils**
- **Low** hydraulic conductivity and **high** run-off risk
- **High** initial water content & **low** storage capacity

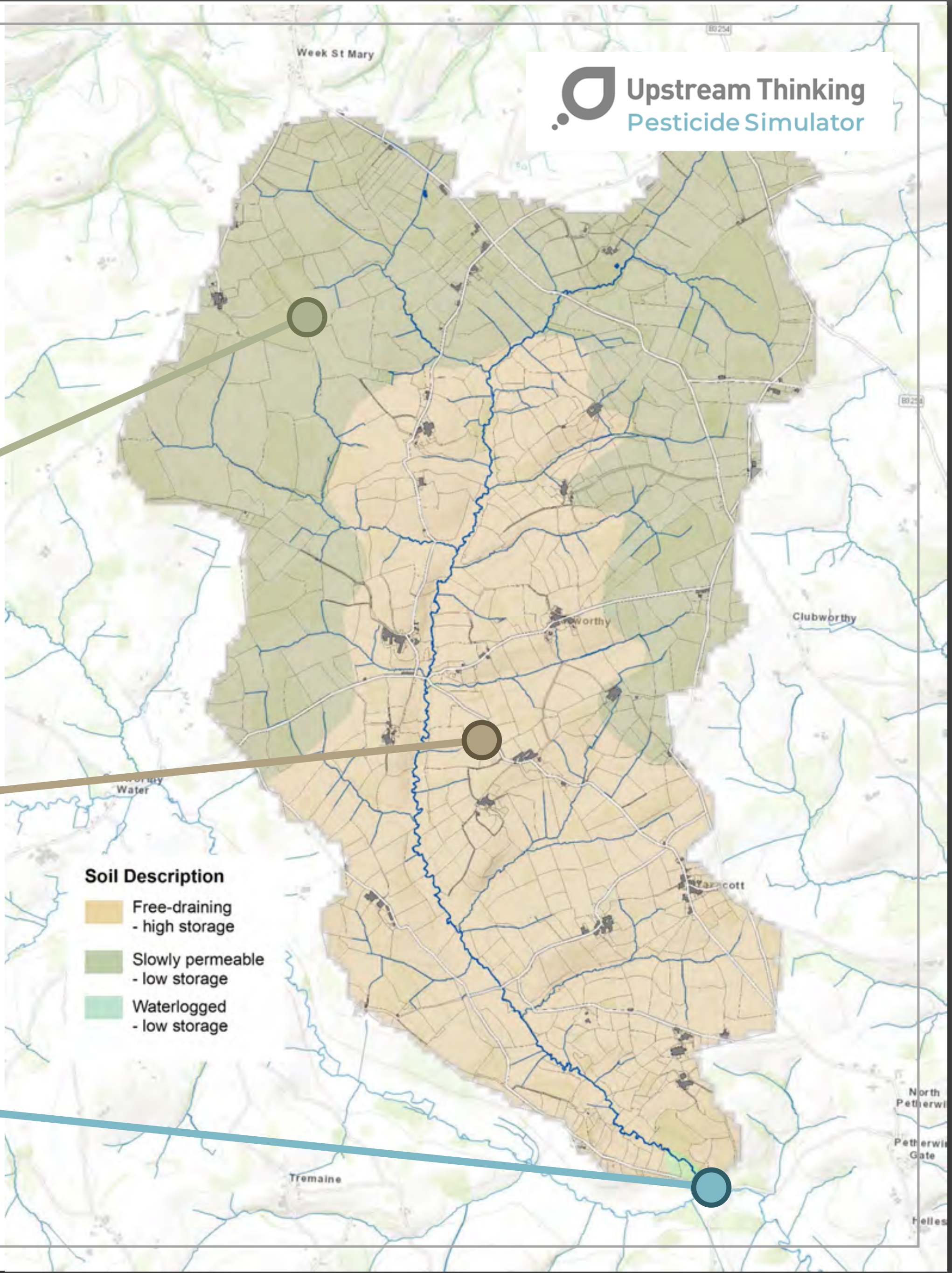
SOIL – 0541h – NEATH – 51% of catchment area

- **Brown earth (loamy) soils** – permeable and well drained
- **High** hydraulic conductivity and **low** run-off risk
- **Low** initial water content & **high** storage capacity

FLOW – Hydrological Monitoring (DTC)

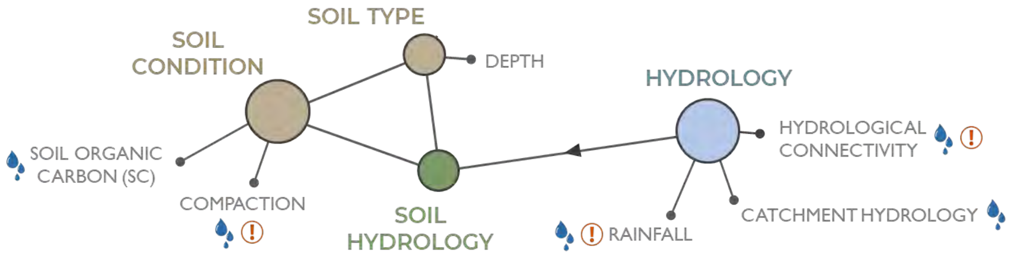
- **Caudworthy Ford** – outflow of 26 sq km catchment
- **Flow** (Q in m^3/s) measures at 15 min intervals 2012-2016
- Mean Daily Flows (MDF) calculated

Upstream Thinking
Pesticide Simulator



MODULE 5:

HYDROLOGY & SOIL



Soil hydrology model (based on TOPMODEL):

Developed by Mick Whelan at Uni of Leicester…

Innate soil character

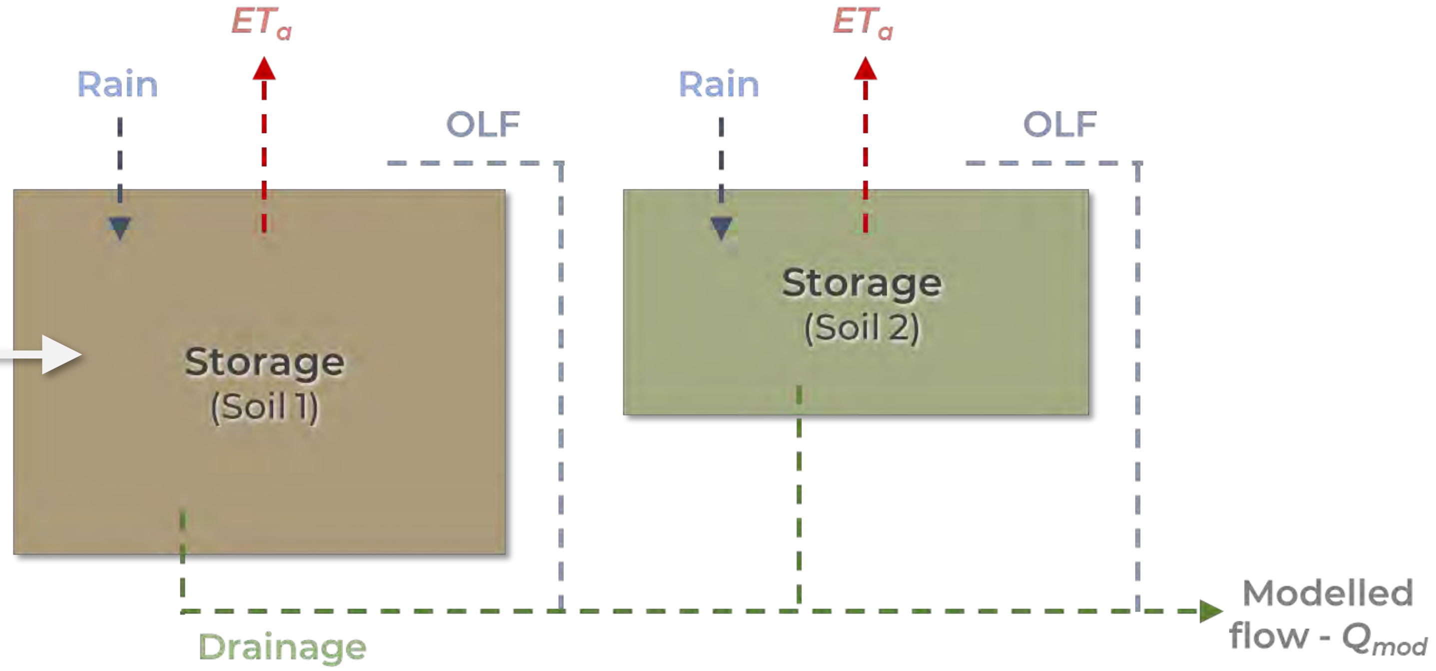
- Soil depth
- Hydraulic conductivity (k_n)
- Saturated soil conductivity (K_{sat})
- Saturated Water Content
- Permanent Wilting Point

Soil / antecedent conditions

- Initial water content
- Organic carbon content of soil
- Evapotranspiration rate

Landscape factors

- % of soil type in catchment



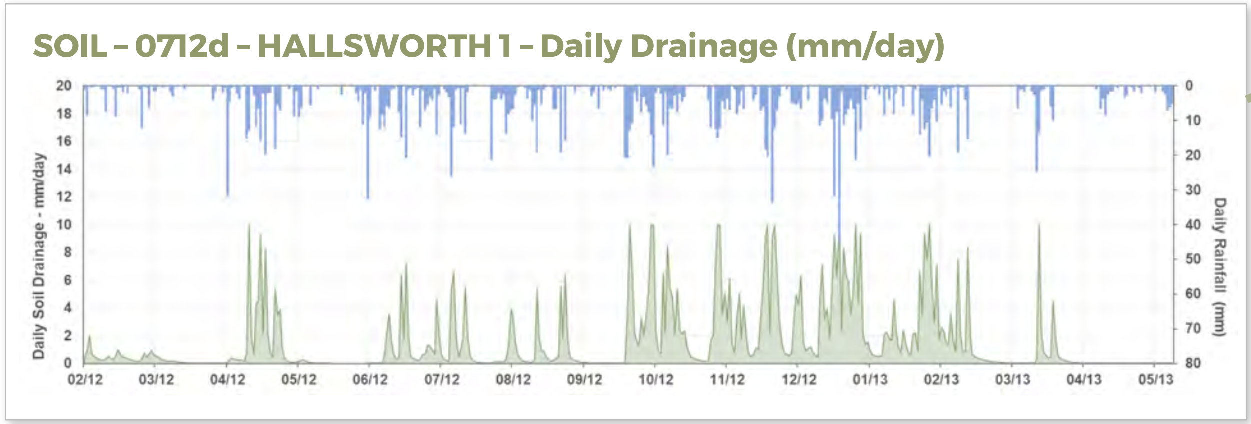
Rain = Rainfall OLF = Over Land Flow

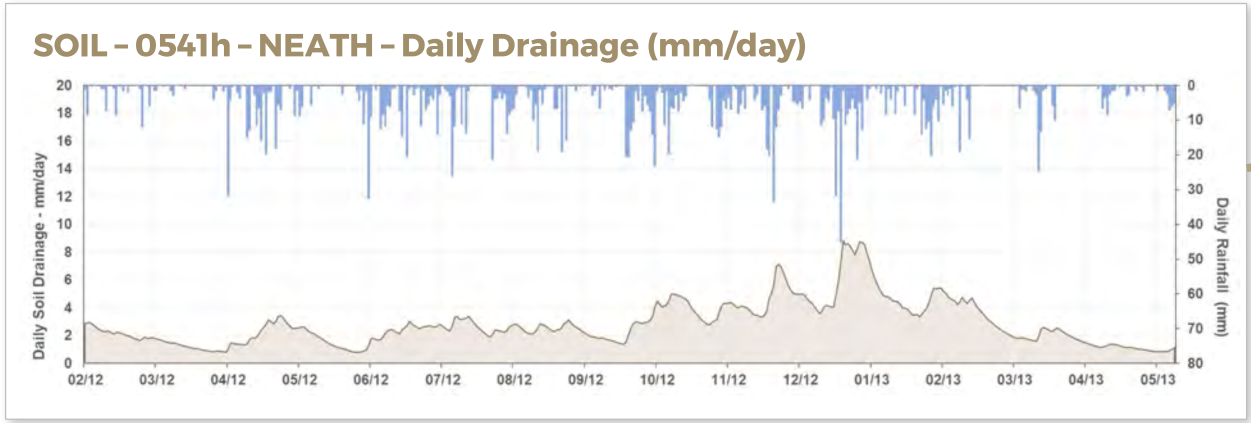
ET_a = Actual Evapotranspiration

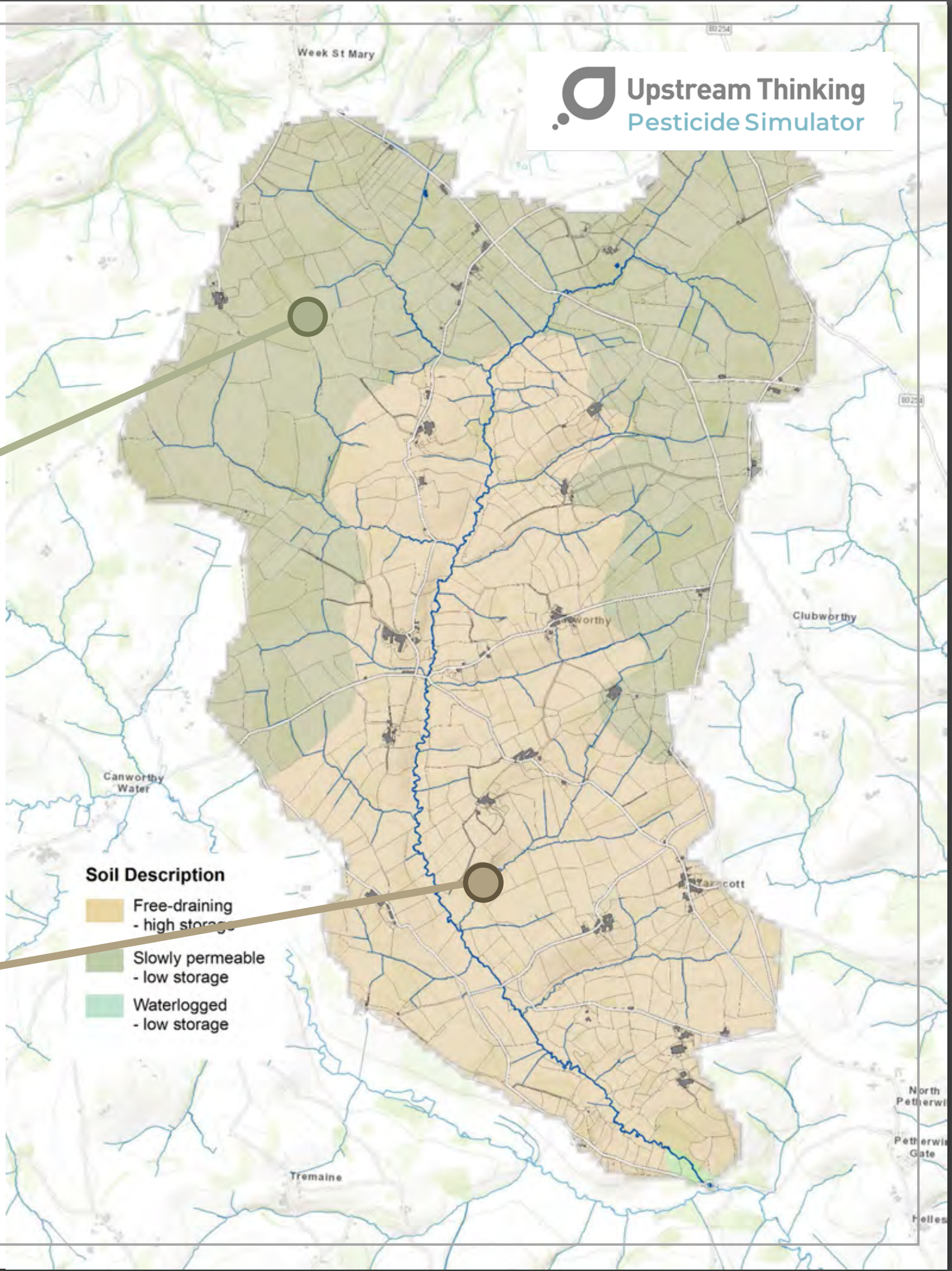
MODULE 5:
HYDROLOGY & SOIL

UNIVERSITY OF LEICESTER

Soil hydrology model (based on TOPMODEL):
Developed by Mick Whelan at Uni of Leicester...

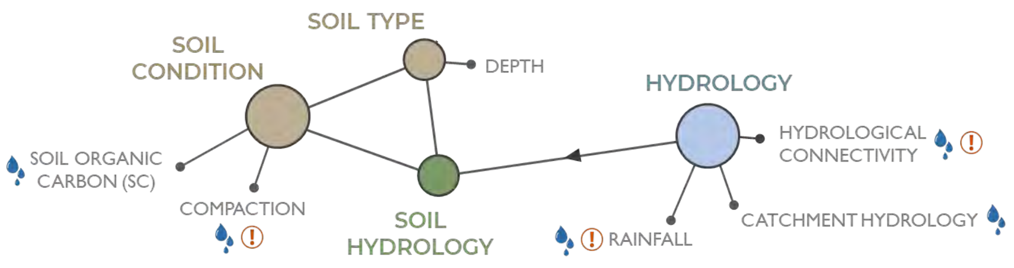






MODULE 5:

HYDROLOGY & SOIL



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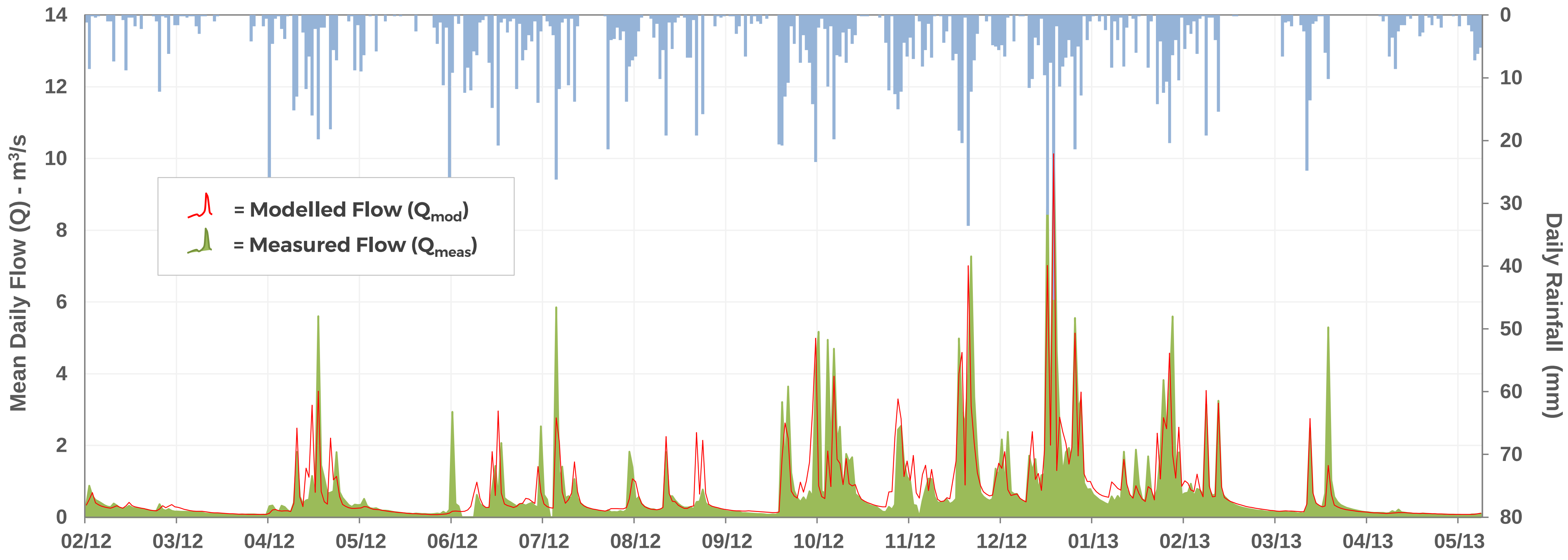
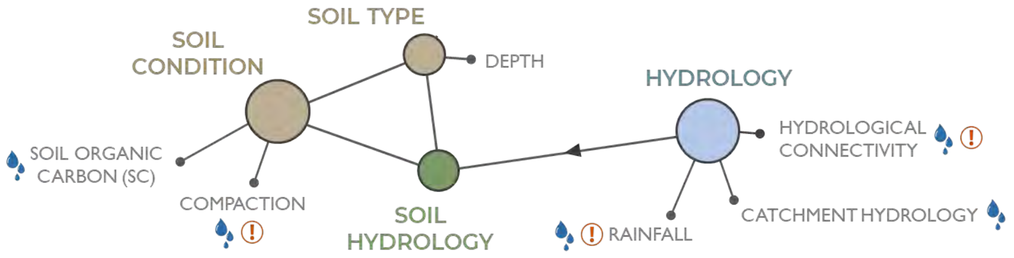


MODULE 5:
HYDROLOGY & SOIL



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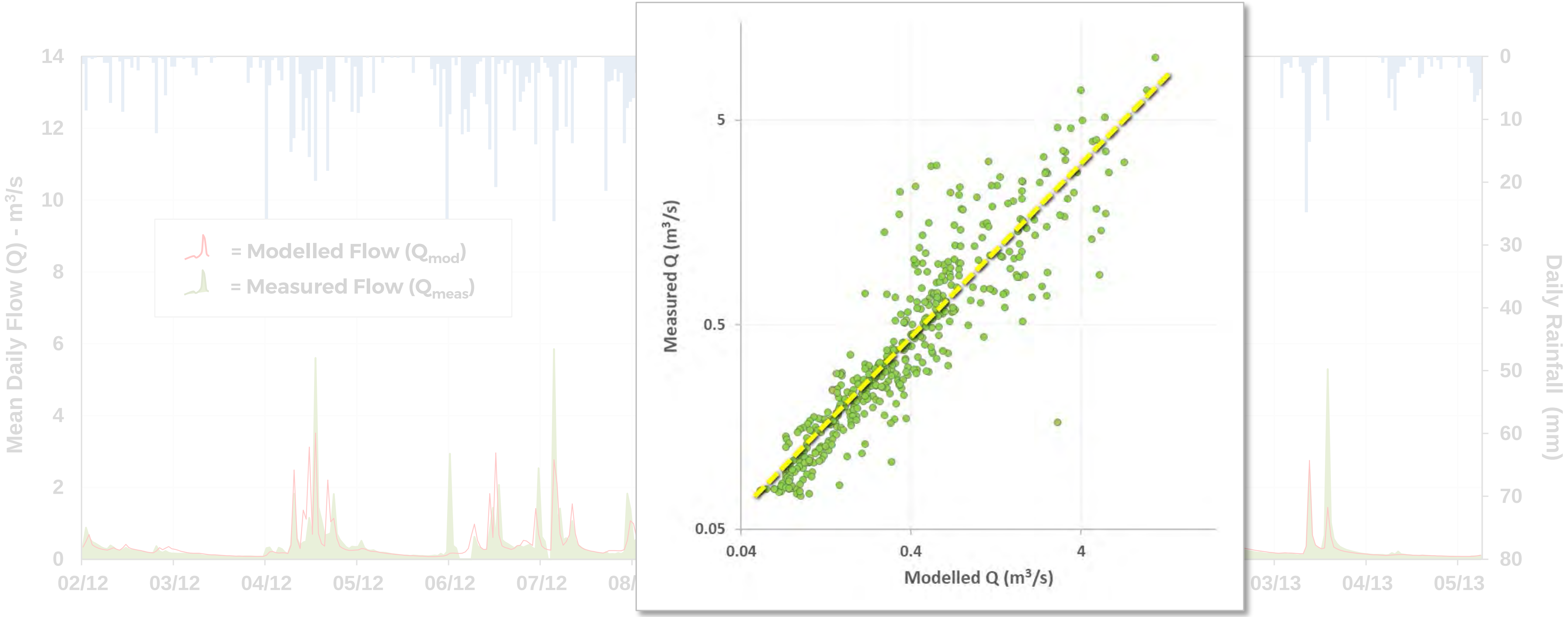
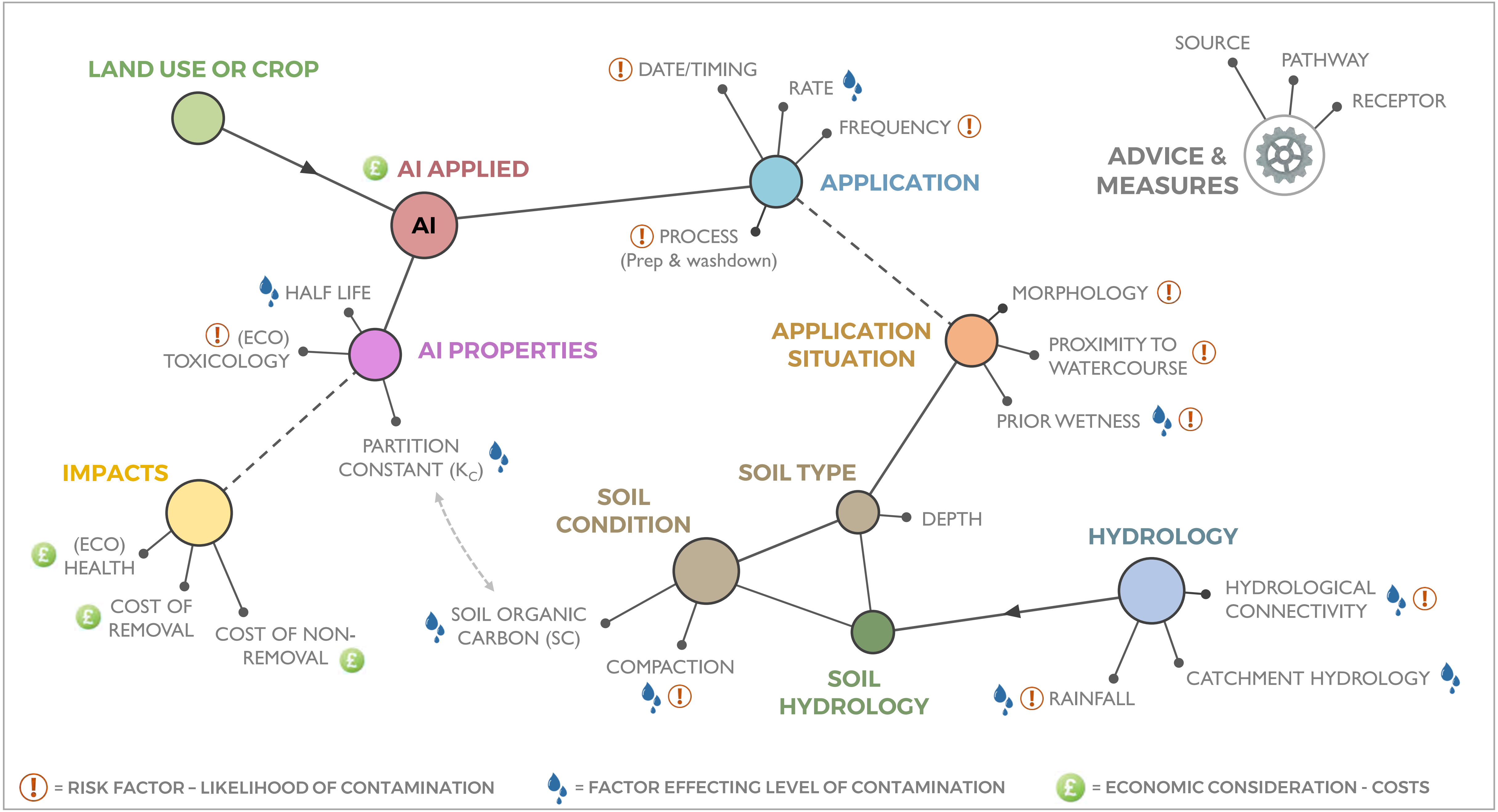




LAND USE OR CROP
AI APPLIED
AI
DATE/TIMING
RATE
FREQUENCY
APPLICATION
PROCESS
(Prep & washdown)
SOURCE
PATHWAY
RECEPTOR
ADVICE &
MEASURES
HALF LIFE
(ECO)
TOXICOLOGY
AI PROPERTIES
PARTITION
CONSTANT (K_C)
MORPHOLOGY
APPLICATION
SITUATION
PROXIMITY TO
WATERCOURSE
PRIOR WETNESS
IMPACTS
(ECO)
HEALTH
COST OF
REMOVAL
COST OF NON-
REMOVAL
SOIL TYPE
SOIL
CONDITION
DEPTH
HYDROLOGY
SOIL ORGANIC
CARBON (SC)
COMPACTION
SOIL
HYDROLOGY
HYDROLOGICAL
CONNECTIVITY
CATCHMENT HYDROLOGY
RAINFALL
= RISK FACTOR – LIKELIHOOD OF CONTAMINATION
= FACTOR EFFECTING LEVEL OF CONTAMINATION
= ECONOMIC CONSIDERATION - COSTS

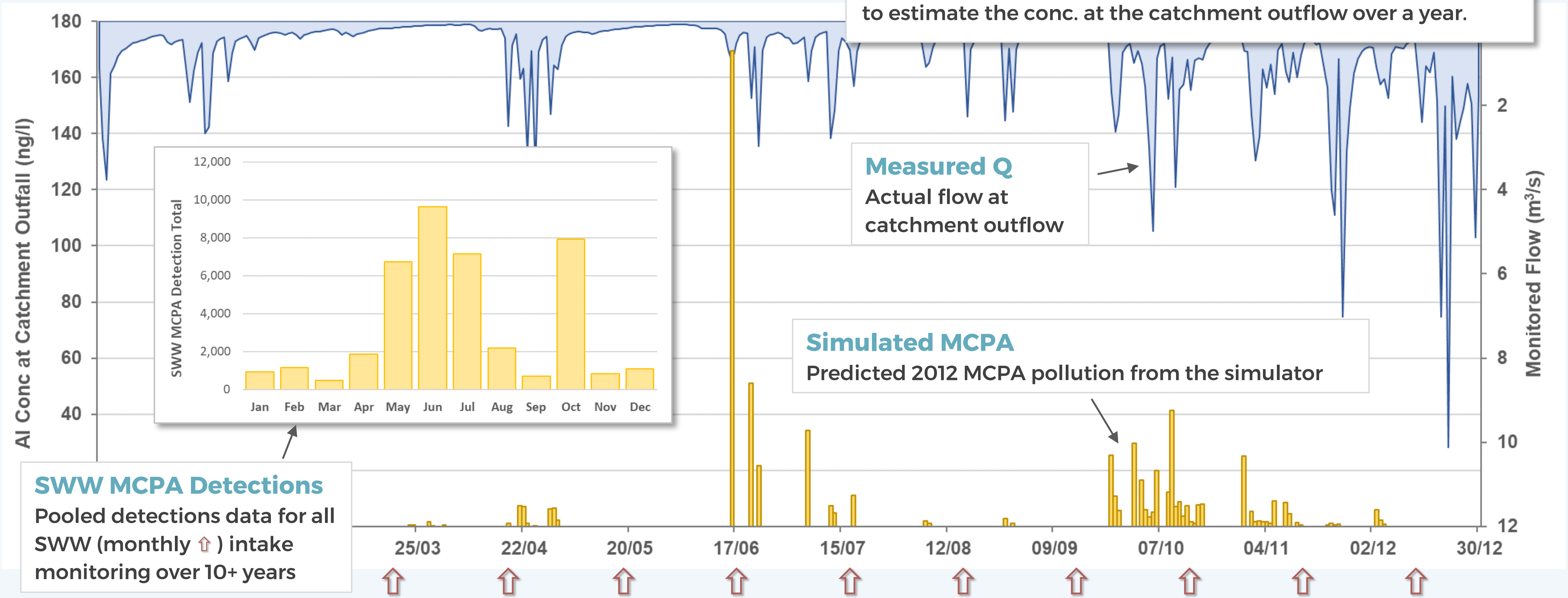
Upstream Thinking
Pesticide Simulator

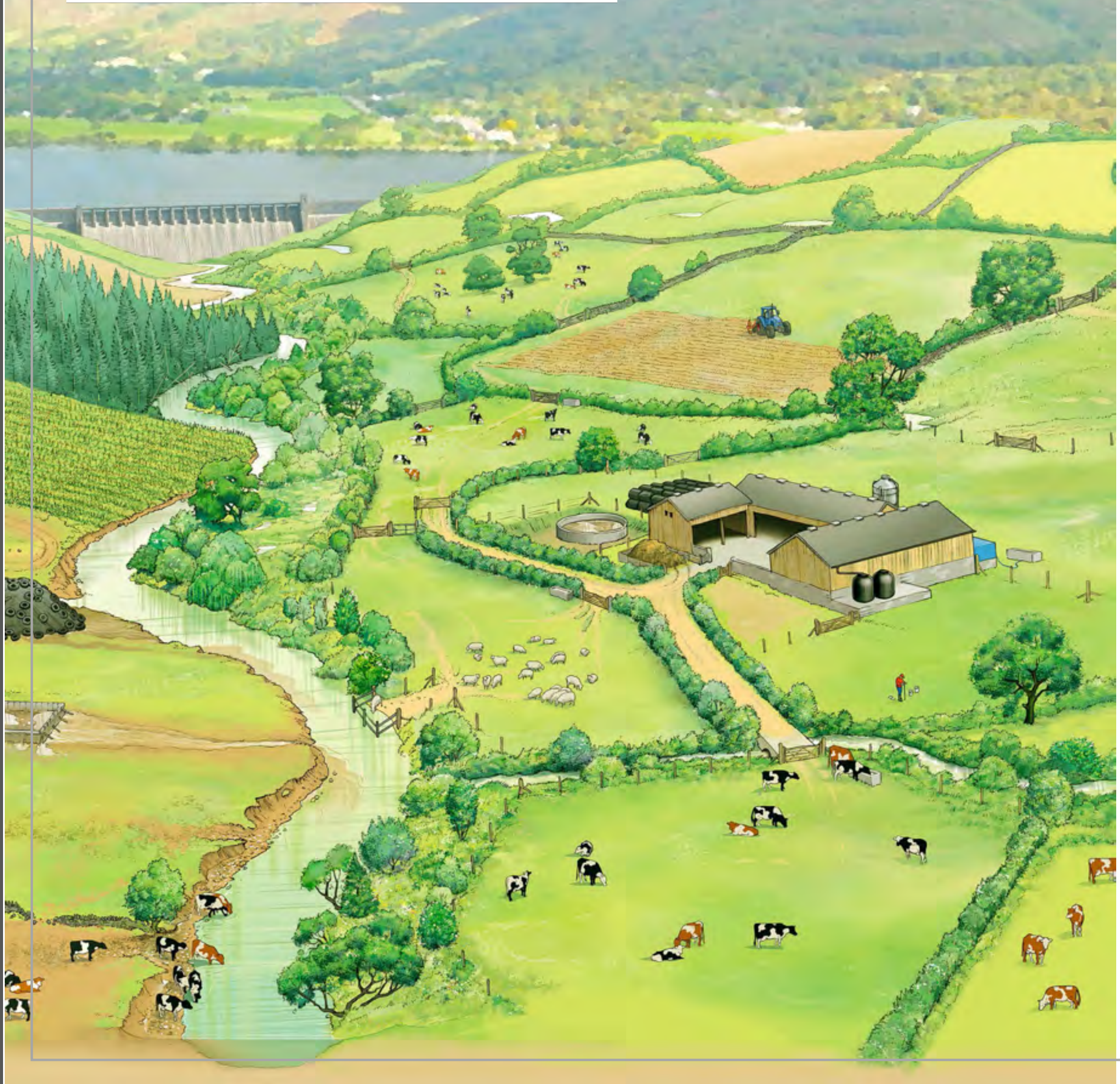
UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Simulator built to include all modules:

Initial build for MCPA usage in the Caudworthy Water in the Otter

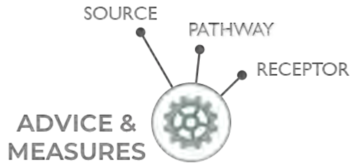
PESTICIDE SIMULATION
The AI losses from all fields are then accumulated and diluted to estimate the conc. at the catchment outflow over a year.





Upstream Thinking
Pesticide Simulator

MODULE 6:
ADVICE & MEASURES



A number of Best Farming Practices serve to reduce the risk of pesticide pollution –

↓ Process risk
Spray accuracy, preparation & washdown (biobed use)

Δ Date (timing) of application
When in the year or in relation to weather

↓ Application rate
What rate is AI applied at (usually in g/Ha)

↑ Soil carbon content
Increase adsorption & reduce soluble fraction

Δ Active ingredient
To one with reduced mobility or less risk to receptors

≠ Pollution pathways
Create features that slow/store contaminated water

UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Upstream Thinking
Pesticide Simulator

BASELINE (~MCPA)
DT_{50} = 25
K_d = 1.2 K_{oc} = 5 (74)
App Rate = 1,650 g/Ha

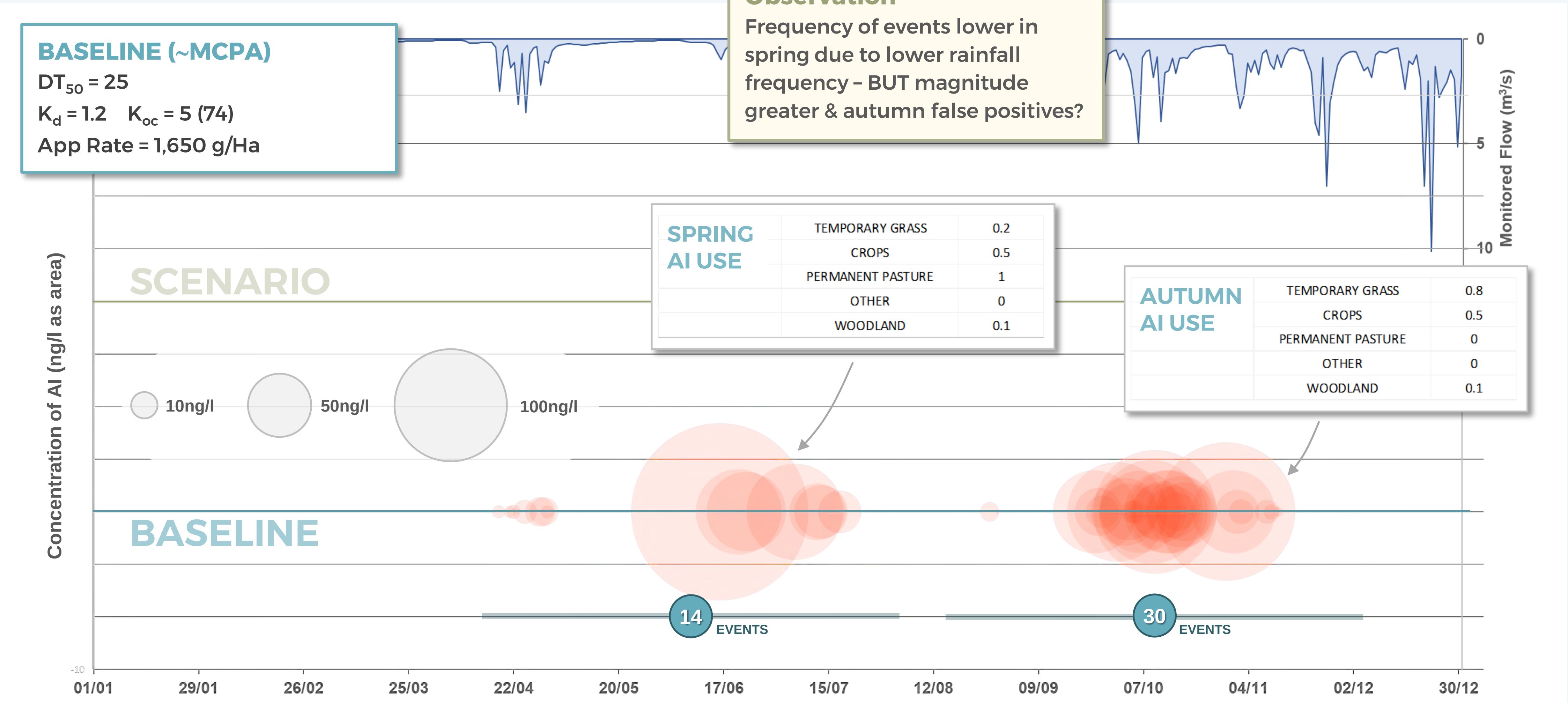
Observation
Frequency of events lower in spring due to lower rainfall frequency – BUT magnitude greater & autumn false positives?

SPRING AI USE

TEMPORARY GRASS	0.2
CROPS	0.5
PERMANENT PASTURE	1
OTHER	0
WOODLAND	0.1

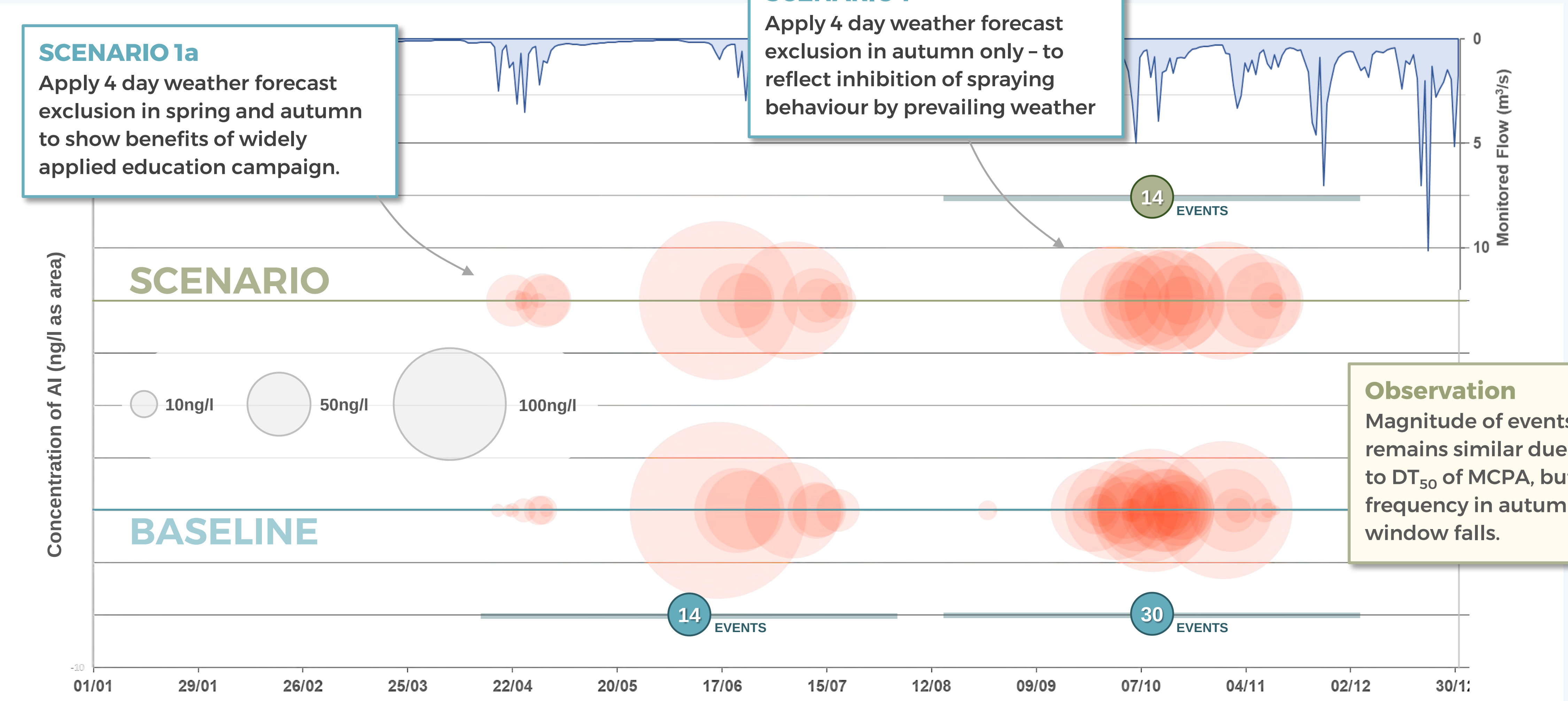
AUTUMN AI USE

TEMPORARY GRASS	0.8
CROPS	0.5
PERMANENT PASTURE	0
OTHER	0
WOODLAND	0.1



UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Upstream Thinking
Pesticide Simulator



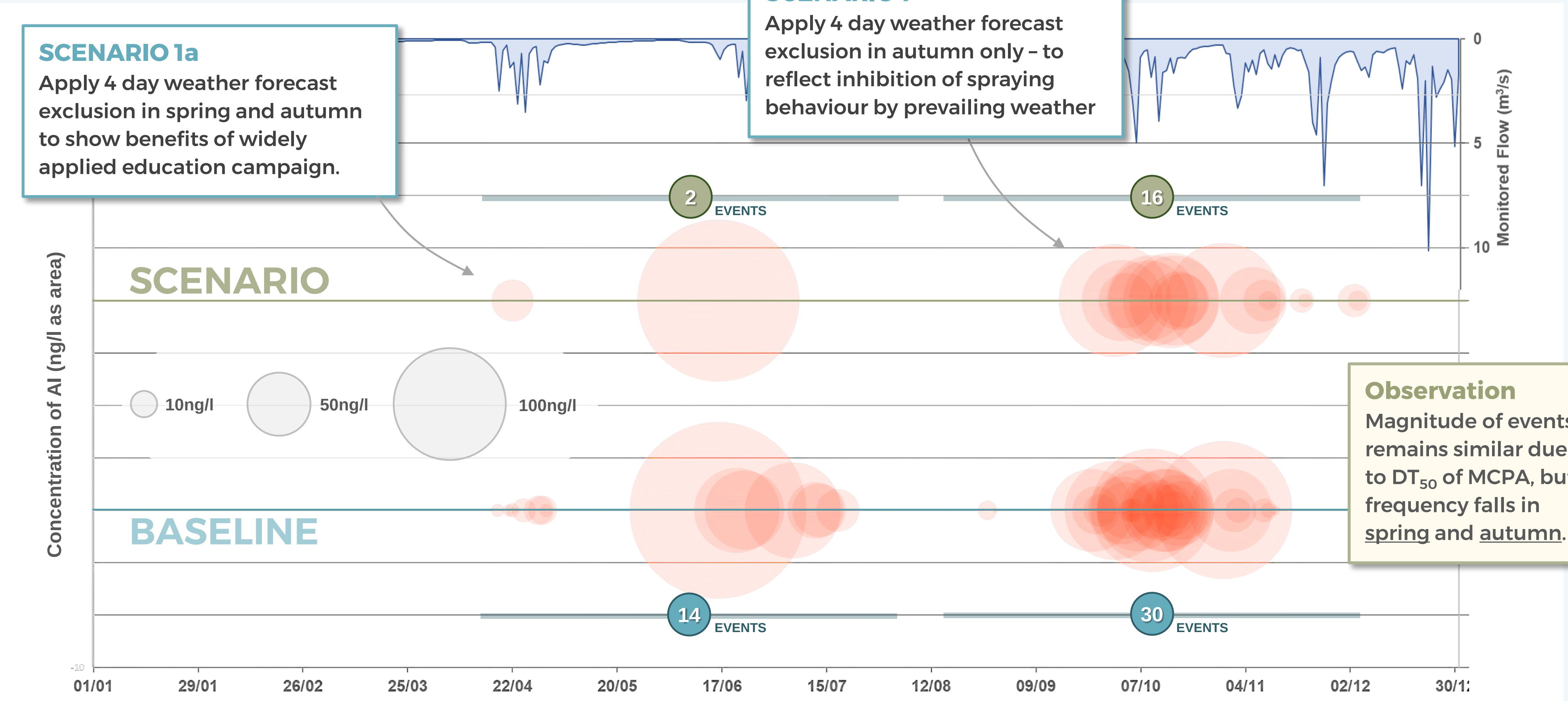
Observation
Magnitude of events remains similar due to DT_{50} of MCPA, but frequency in autumn window falls.

UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Upstream Thinking
Pesticide Simulator

SCENARIO 1a
Apply 4 day weather forecast exclusion in spring and autumn to show benefits of widely applied education campaign.

SCENARIO 1
Apply 4 day weather forecast exclusion in autumn only – to reflect inhibition of spraying behaviour by prevailing weather



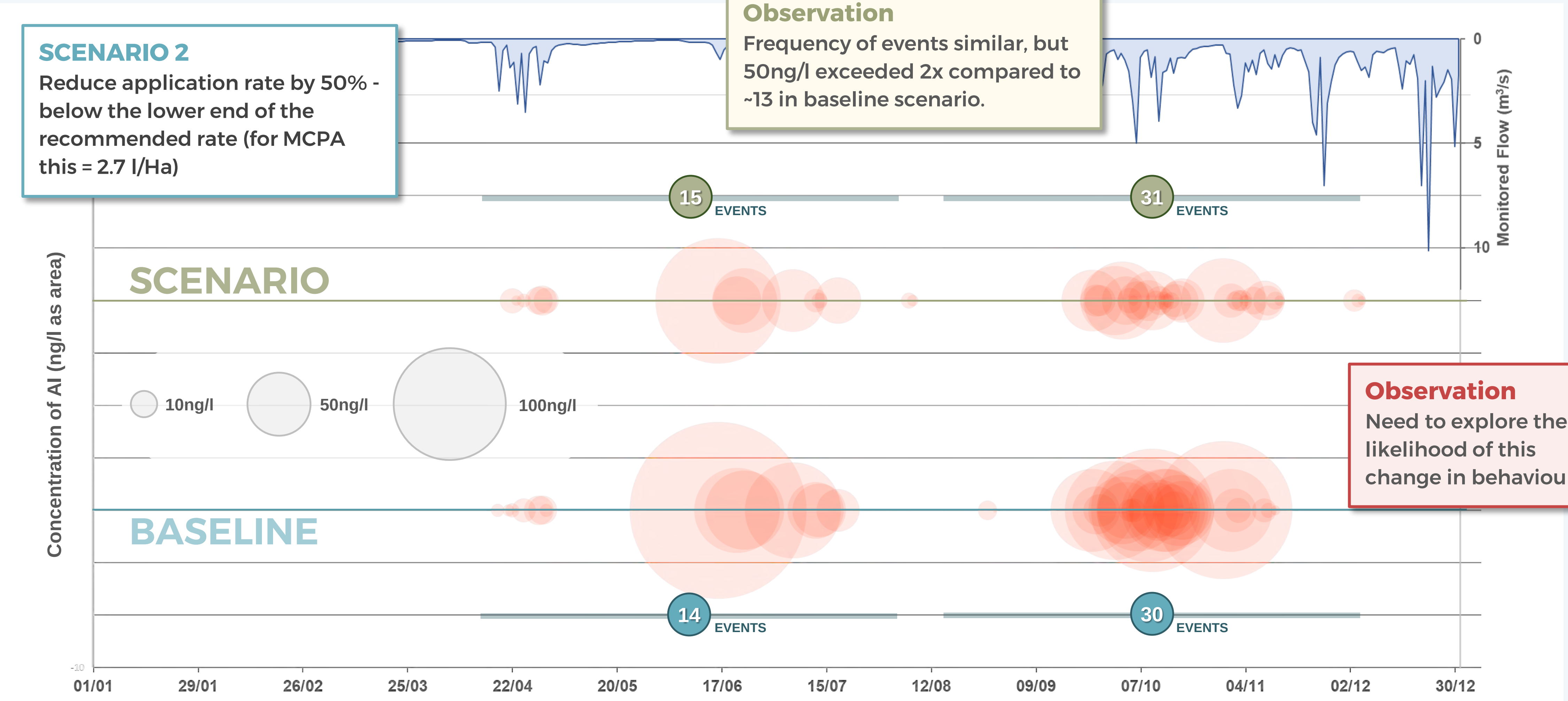
Observation
Magnitude of events remains similar due to DT_{50} of MCPA, but frequency falls in <u>spring</u> and <u>autumn</u>.

UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Upstream Thinking
Pesticide Simulator

SCENARIO 2
Reduce application rate by 50% - below the lower end of the recommended rate (for MCPA this = 2.7 l/Ha)

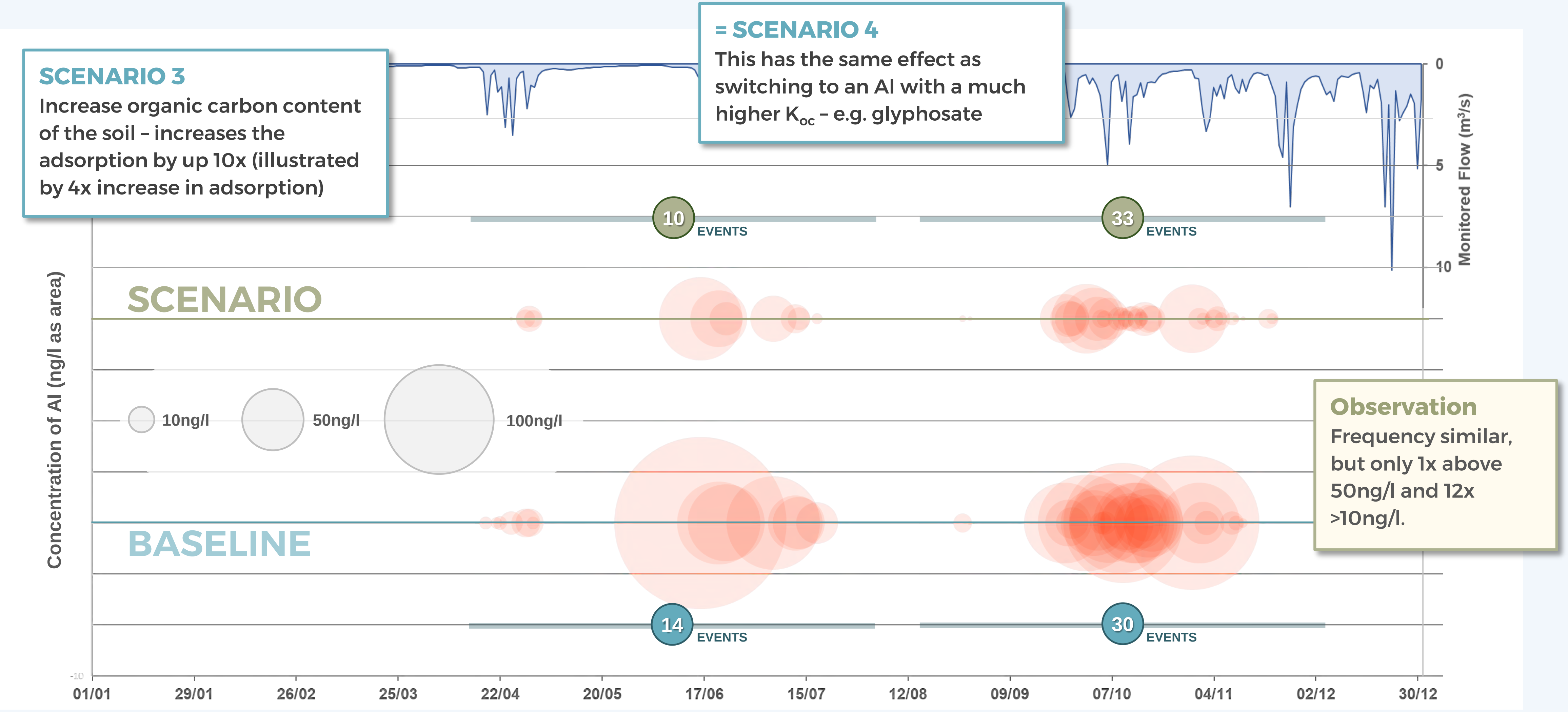
Observation
Frequency of events similar, but 50ng/l exceeded 2x compared to ~13 in baseline scenario.



Observation
Need to explore the likelihood of this change in behaviour.

UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Upstream Thinking
Pesticide Simulator

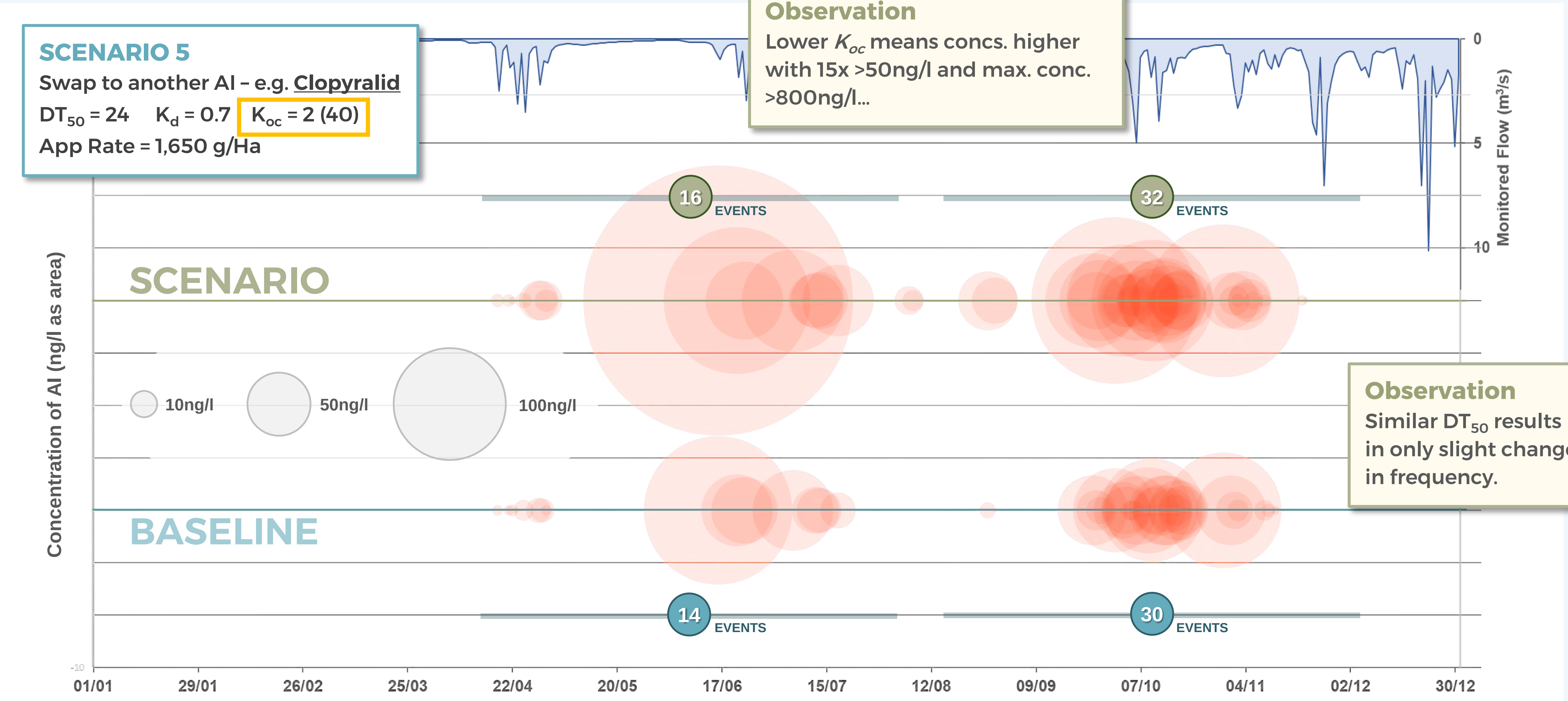


UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Upstream Thinking
Pesticide Simulator

SCENARIO 5
Swap to another AI – e.g. Clopyralid
DT_{50} = 24 K_d = 0.7 K_{oc} = 2 (40)
App Rate = 1,650 g/Ha

Observation
Lower K_{oc} means concs. higher with 15x >50ng/l and max. conc. >800ng/l...



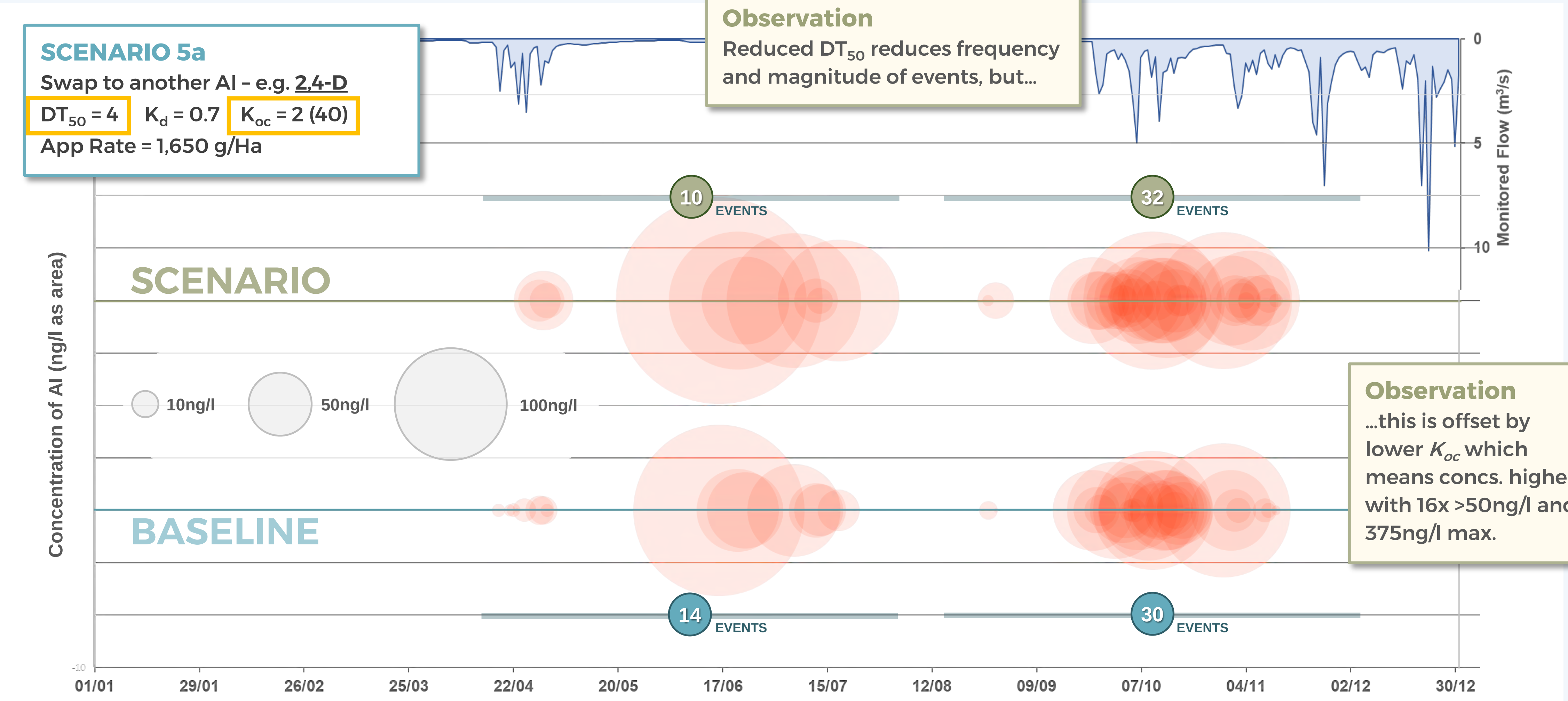
Observation
Similar DT_{50} results in only slight change in frequency.

UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Upstream Thinking
Pesticide Simulator

SCENARIO 5a
Swap to another AI – e.g. 2,4-D
DT_{50} = 4 K_d = 0.7 K_{oc} = 2 (40)
App Rate = 1,650 g/Ha

Observation
Reduced DT_{50} reduces frequency and magnitude of events, but...



Observation
...this is offset by lower K_{oc} which means concs. higher with 16x >50ng/l and 375ng/l max.

UsT PESTICIDE SIMULATOR:
OUTPUTS & SCENARIOS

Upstream Thinking
Pesticide Simulator

SCENARIO 6

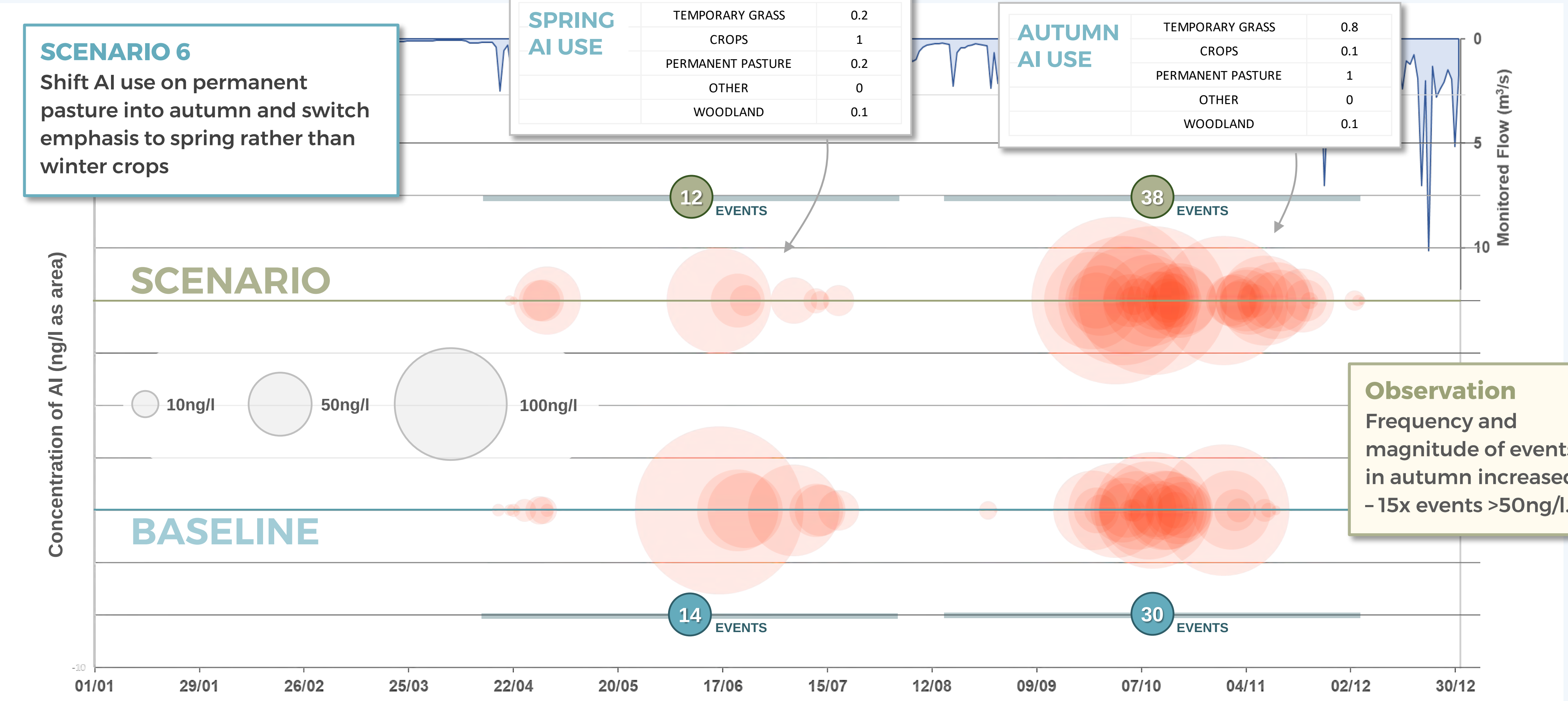
Shift AI use on permanent pasture into autumn and switch emphasis to spring rather than winter crops

SPRING AI USE

TEMPORARY GRASS	0.2
CROPS	1
PERMANENT PASTURE	0.2
OTHER	0
WOODLAND	0.1

AUTUMN AI USE

TEMPORARY GRASS	0.8
CROPS	0.1
PERMANENT PASTURE	1
OTHER	0
WOODLAND	0.1



Observation

Frequency and magnitude of events in autumn increased – 15x events >50ng/l.

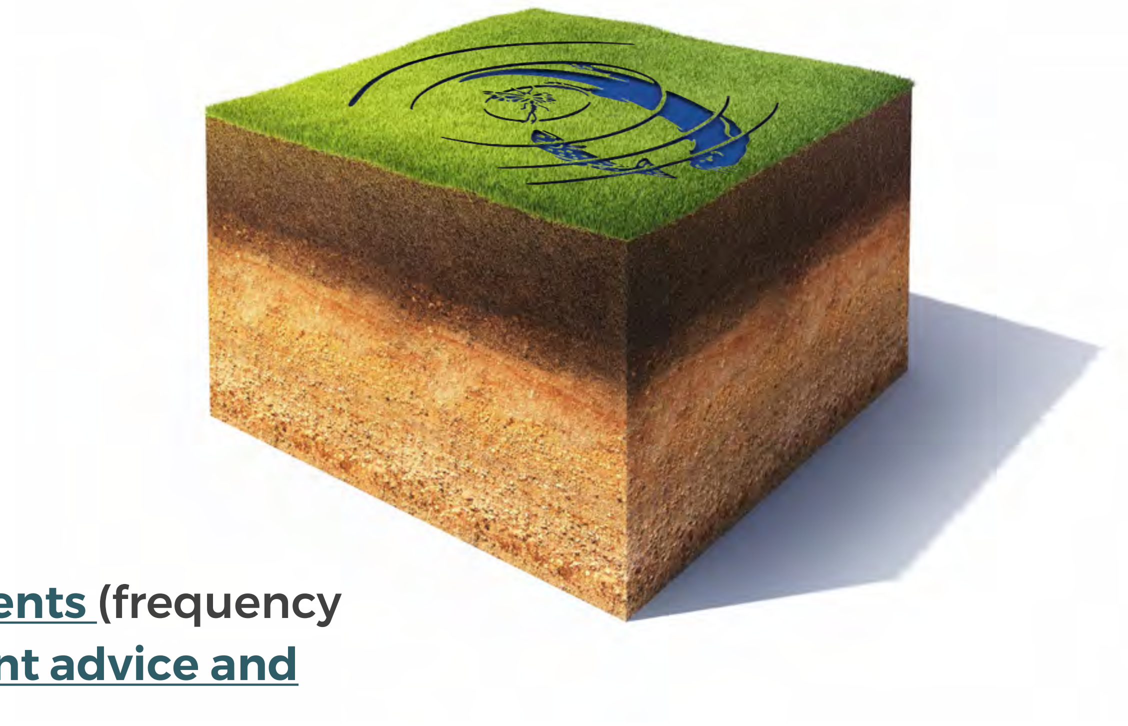
THE UPSTREAM THINKING PESTICIDE POLLUTION SIMULATOR

Upstream Thinking
Pesticide Simulator

WRT have undertaken a comprehensive review of existing pesticide models

...and have then developed a **pesticide simulator** that:

- Assesses risk at fine spatial (sub-field) & temporal (day) scale
- Incorporates local data
- Helps target/design advice & measures
- Simulates stochastic pesticide pollution events
- Works for grassland dominated catchments
- Demonstrates changes in pesticide pollution events (frequency and magnitude) resulting from land management advice and measures



UsT2 & 3: FUTURE DIRECTIONS & PLANS

Upstream Thinking
Proof of Concept

The successful realisation of UST2/3 outcomes will require us to become more expert in –

1. SOIL STEWARDSHIP
2. PSYCHOLOGICAL, SOCIAL & ECONOMIC PRESSURES ACTING ON FARMERS

Interreg Atlantic Area European Regional Development Fund
Interreg 2 Seas Mers Zeeën USAR European Regional Development Fund
Interreg 2 Seas Mers Zeeën PROWATER European Regional Development Fund
Interreg France (Channel Manche) England CPES
WaterLIFE
WWF
The Rivers Trust
Westcountry Rivers Trust
Life

Upstream Thinking
Proof of Concept
Cornwall
Westcountry Rivers Trust
South West Water
Devon Wildlife Trust
EXMOOR NATIONAL PARK
Dr Nick Paling
Head of Evidence & Engagement
Westcountry Rivers Trust
nick@wrt.org.uk