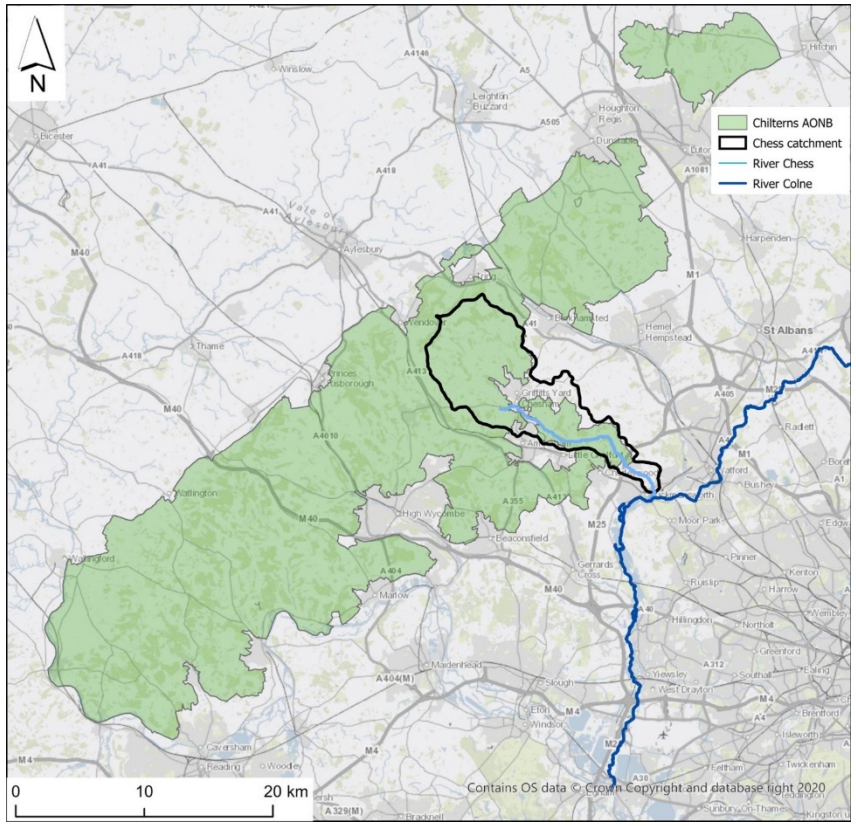
Overcoming Challenges to the Chess

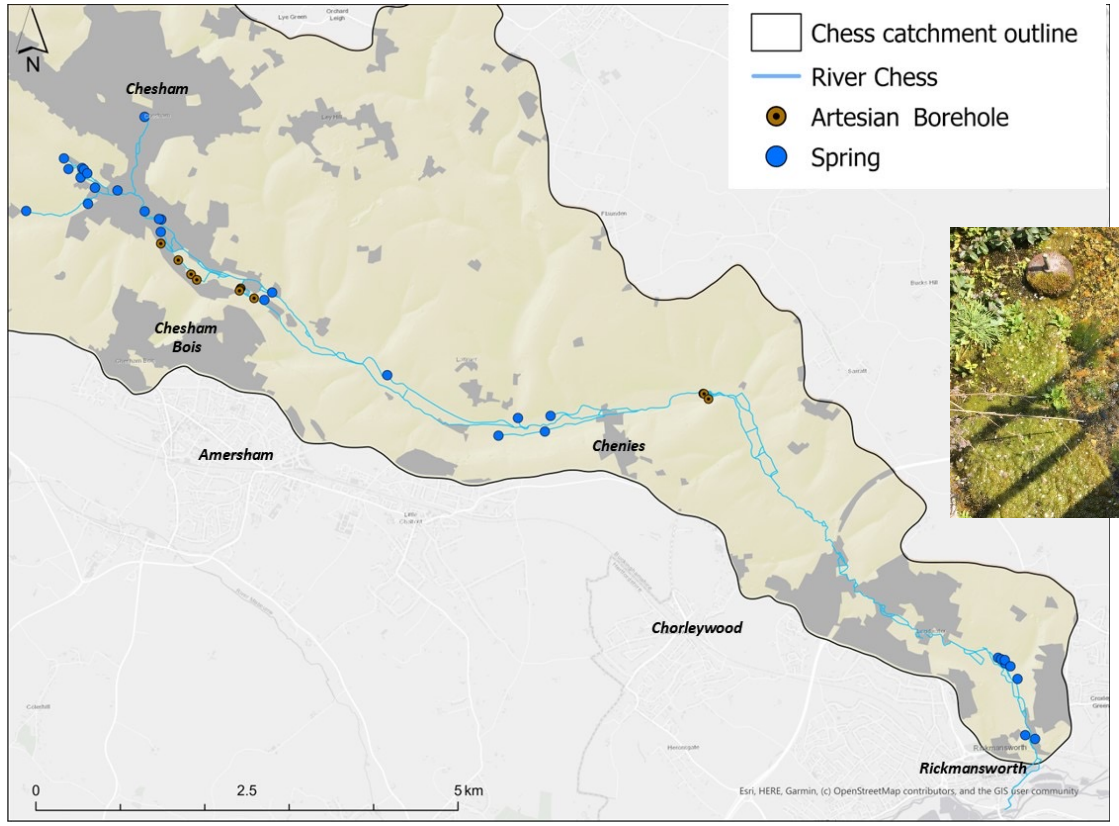
Kate Heppell

Examples in this presentation arise from the River Chess Smarter Water Catchment project, with thanks to the following organisations:

Working in partnership

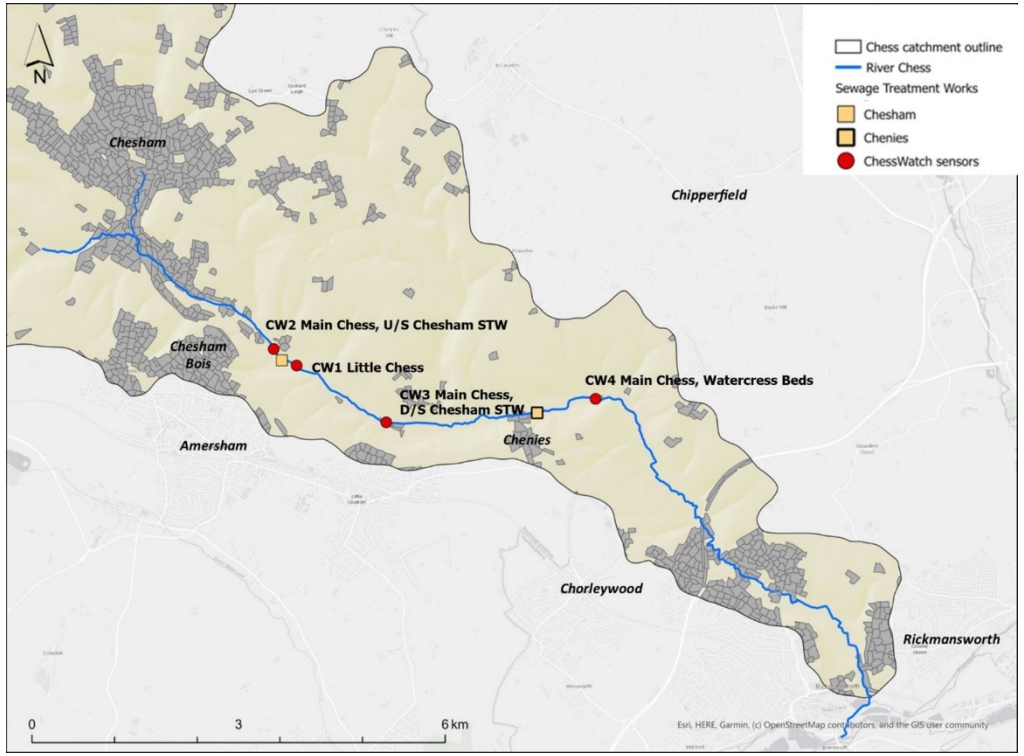
Where is the River Chess?

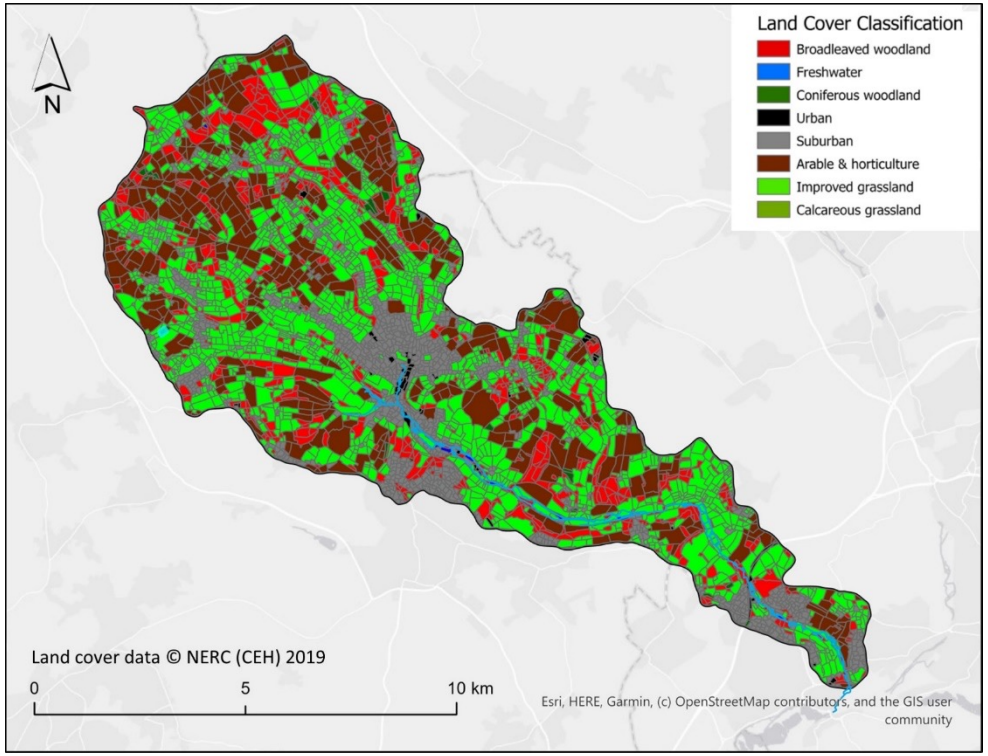




- Flows from groundwater springs in Chilterns AONB through Buckinghamshire and Hertfordshire to River Colne
- Natural springs and artesian wells along its length

What is the land use and water cycle infrastructure?

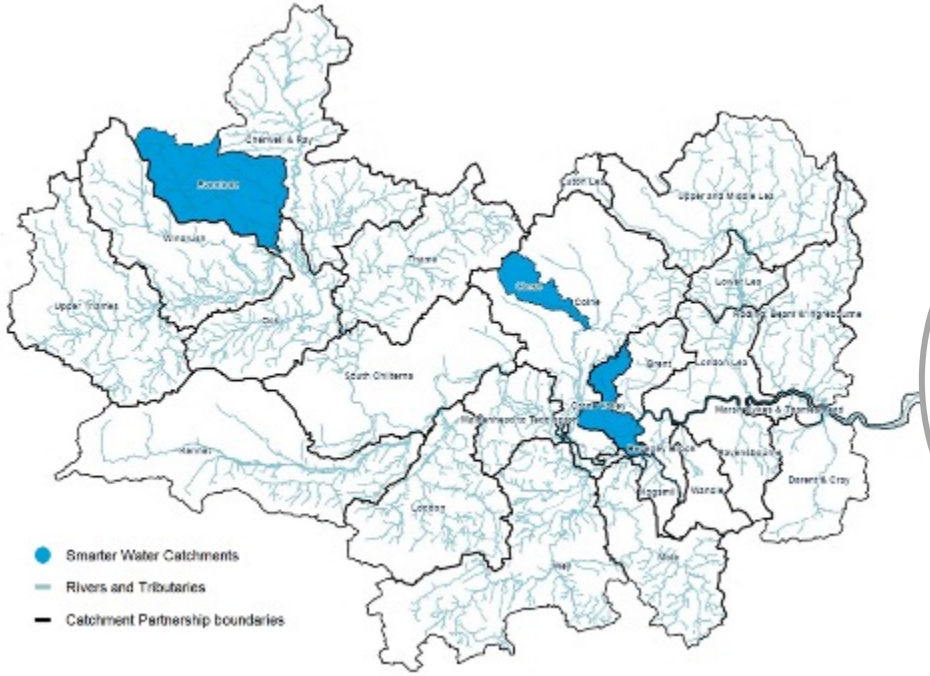




- Land cover is 12% urban, 36% arable/horticulture, 34% grassland and 18% woodland
- Chesham and Chenies STW with population equivalent of 37,300 and 150 respectively (Thames Water)
- Chesham STW has permitted dry weather flow of 14,450 m^3/d comprising 40-80% of river flow at point of entry
- Groundwater abstraction for drinking water supply (Affinity and Thames Water)

What is the ‘Smarter Water Catchment’ initiative?

A Thames Water pilot project looking at the environment as a system and working in closer partnerships to co-create & co-deliver innovative solutions to our greatest challenges

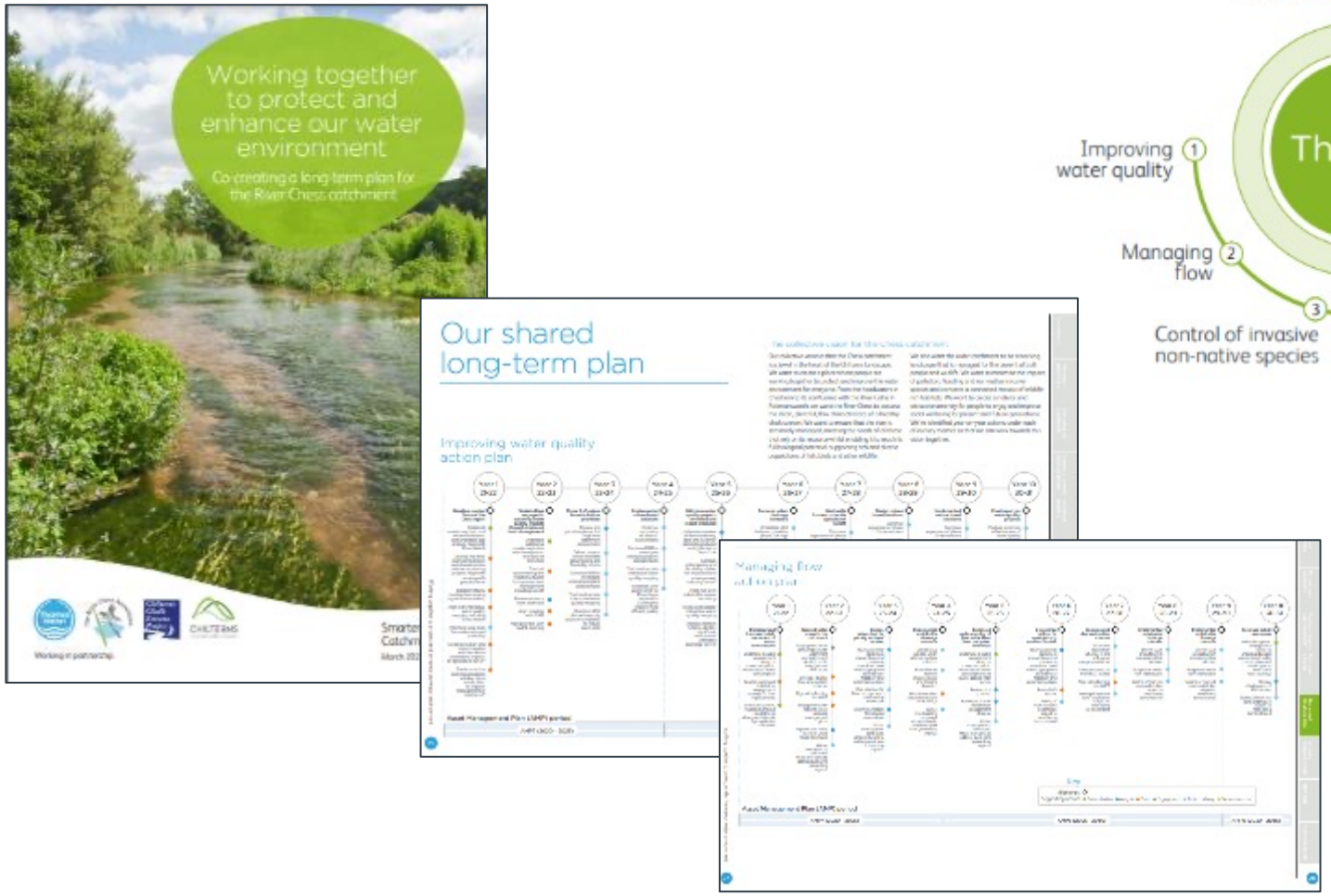


Additional **£9m** investment from 2020-2025 to trial new ways of working to improve the health of our river catchments

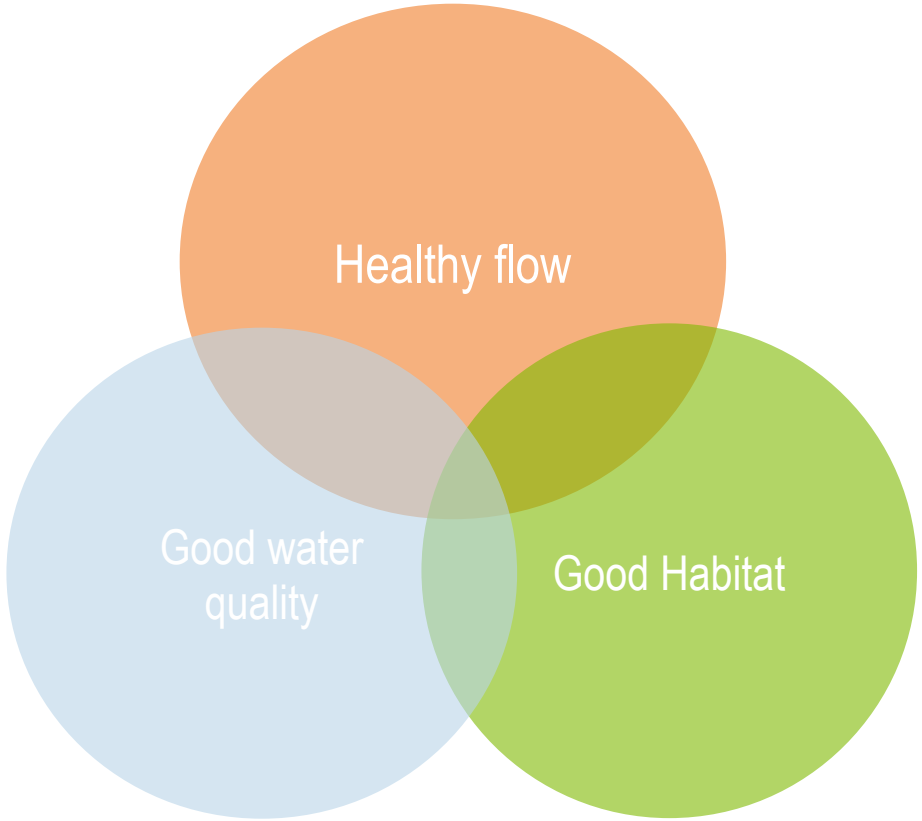
- Develop deeper understanding of the challenges
- Determine requirements to facilitate co-delivery
- Explore co-funding opportunities
- Set a precedent for future ways of working across the water industry
- Inform better decision making & future investment

What does this mean in practice?

The partners – led by Chilterns Chalk Streams Project and River Chess Association - have co-created a shared 10-year plan which aims to restore the health of the River Chess



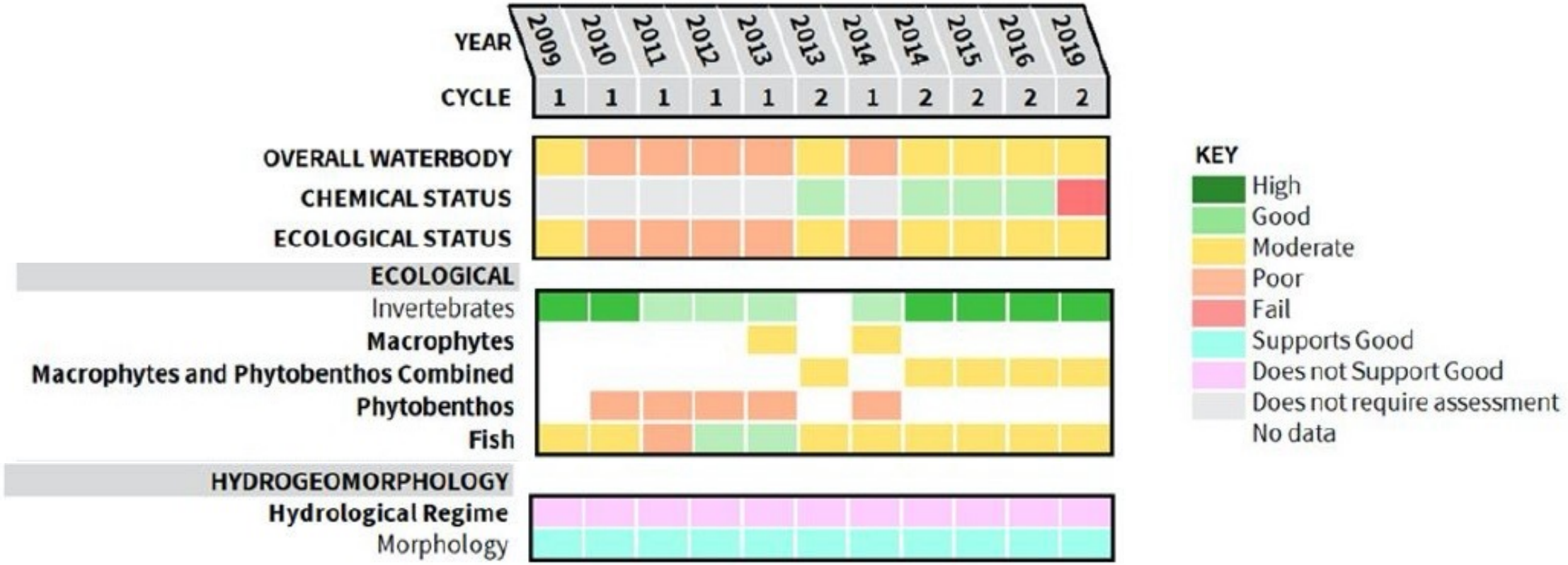
What are the challenges to the Chess?



Catchment Based Approach

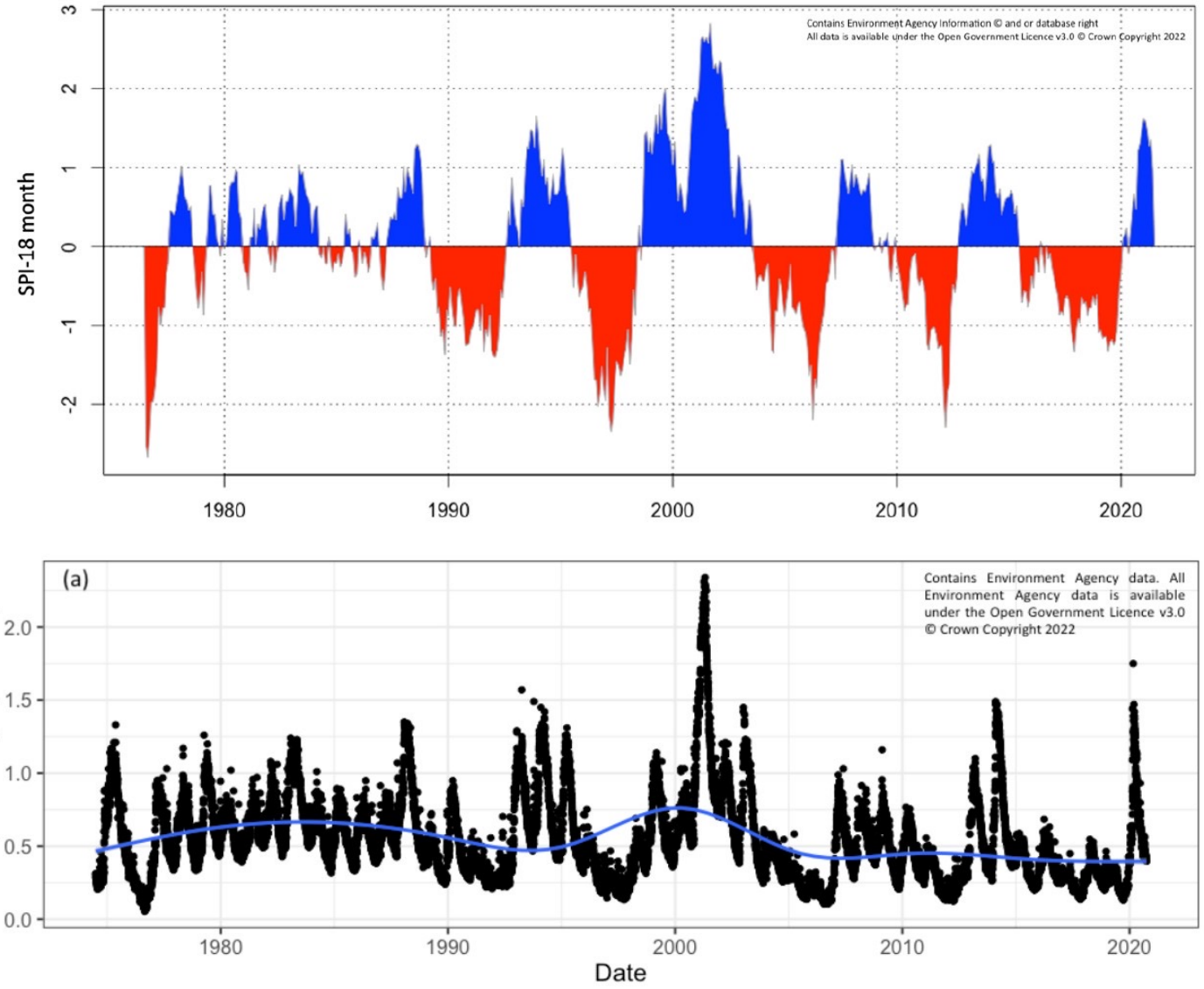
WFD Status

As of 2019, Moderate Overall and Ecological Status, Failed Chemical Status



Hydrological regime does not support good status

River flows reflecting rainfall and abstraction….



Challenge:

Over-abstraction for drinking water

Decreased groundwater recharge due to climate change

40 to 80% of flow in R Chess is treated effluent

Opportunity:

AMP7 Sustainable abstraction reduction

Chalk Streams First initiative

River flows reflecting rainfall and abstraction….

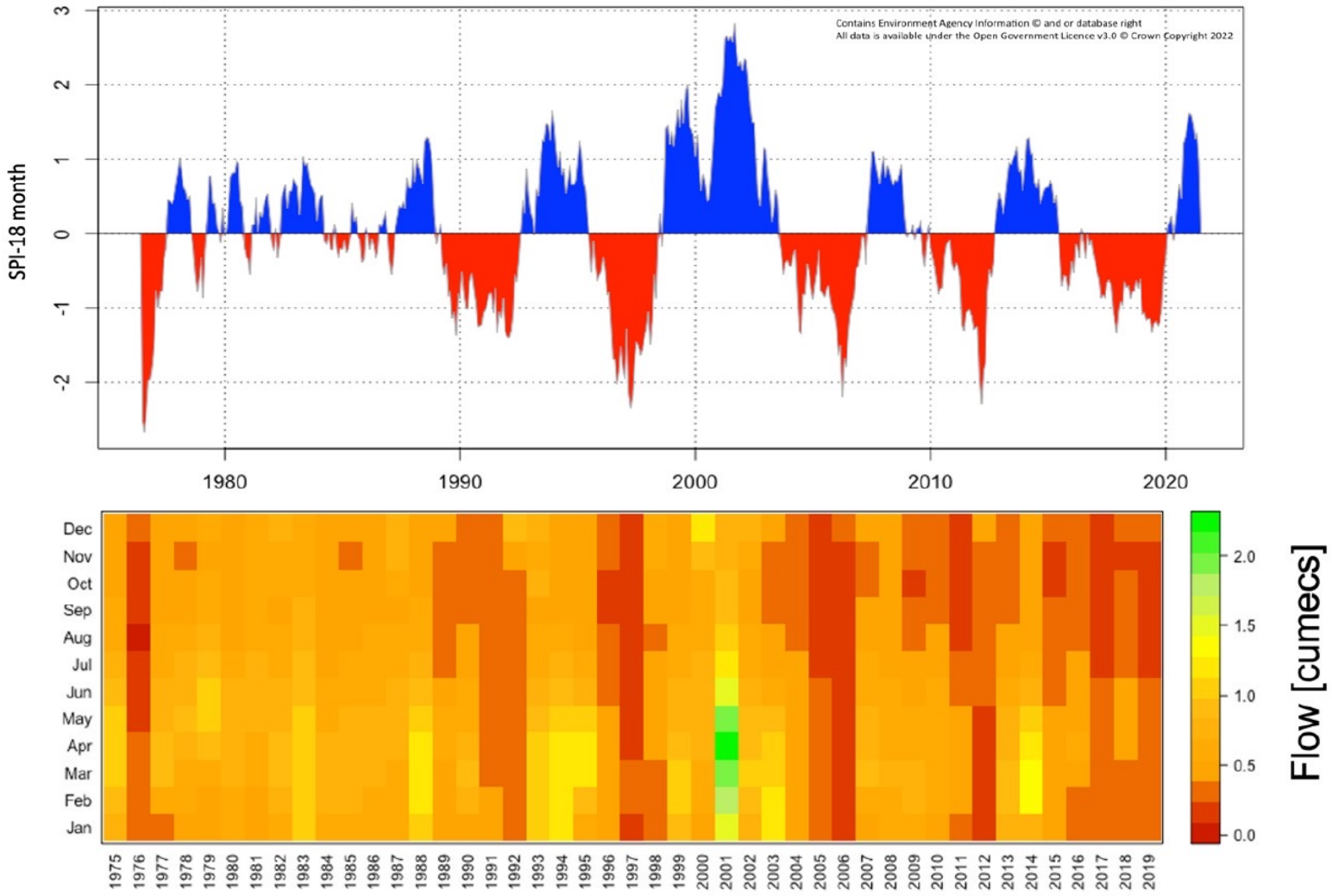


Figure 21 Heat map of mean monthly discharge (m3/s) at Rickmansworth gauging station. SOURCE: Environment Agency data.

Challenge:

Over-abstraction for drinking water

Decreased groundwater recharge due to climate change

Opportunity:

AMP7 abstraction reduction (7.27 ML/d from Chesham area)

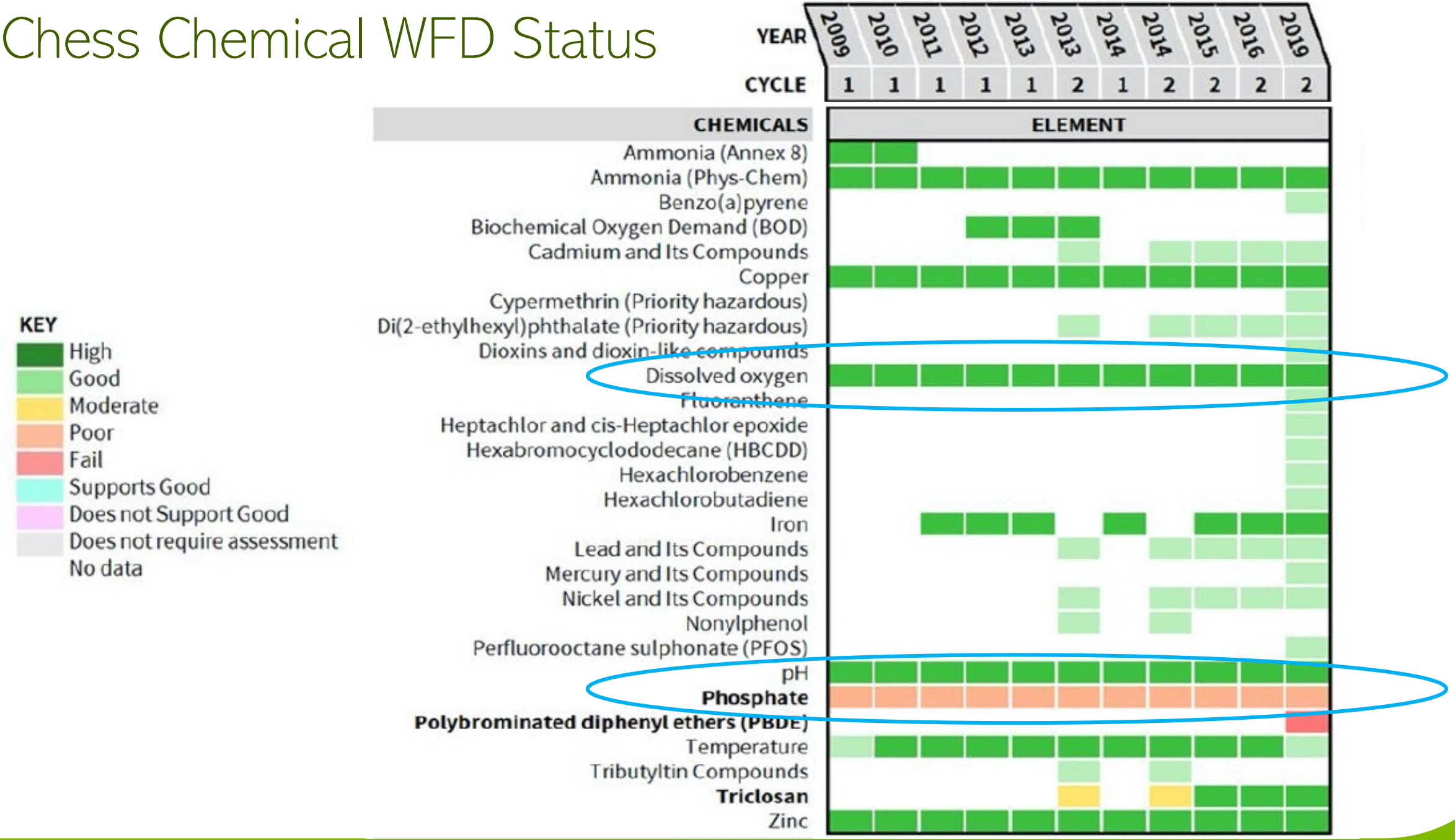
Chalk Streams First initiative

Ephemeral sections of the River Chess

Challenge:
Migration of winterbourne sections downstream

Opportunity:
Understanding value of winterbourne sections of chalk streams

Chess Chemical WFD Status



Real-time sensor technology

'Basic' water quality parameters	
Water temperature	
Electrical conductivity	
pH	
'Well established' water quality parameters	
Dissolved Oxygen	Optical optodes
Turbidity	Light scattering
Ammonium	Ion selective electrodes
'Newer' water quality parameters	
Coloured dissolved organic matter, CDOM	UV sensor
Nitrate	UV sensor
Tryptophan	Fluorescence sensor
'Derived' water quality parameters	
Biological and Chemical Oxygen Demand	Tryptophan, temperature, turbidity
Total coliform / Faecal coliform / E. Coli	Tryptophan, temperature, turbidity, CDOM & ?

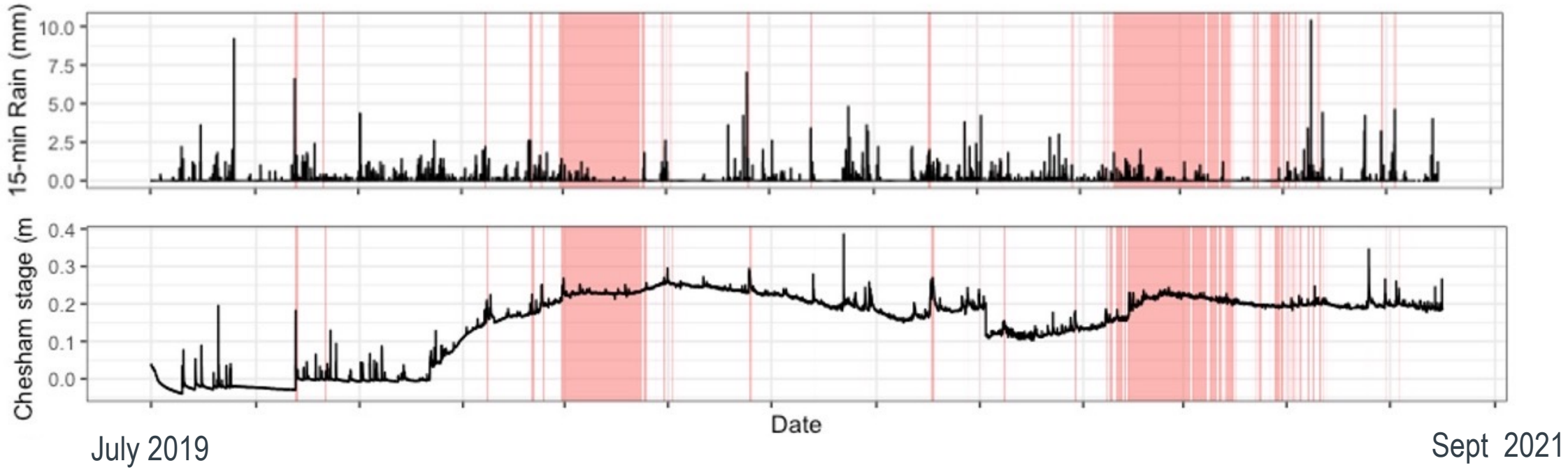
Note the wipers – these are vital

River Chess Smarter Water Catchment

Thames Water

Storm tank overflows from Chesham sewage treatment works

Peach panels show periods of storm tank overflow



Storm tanks at Chesham STW can overflow when capacity of treatment works is exceeded, to prevent water backing up into homes.

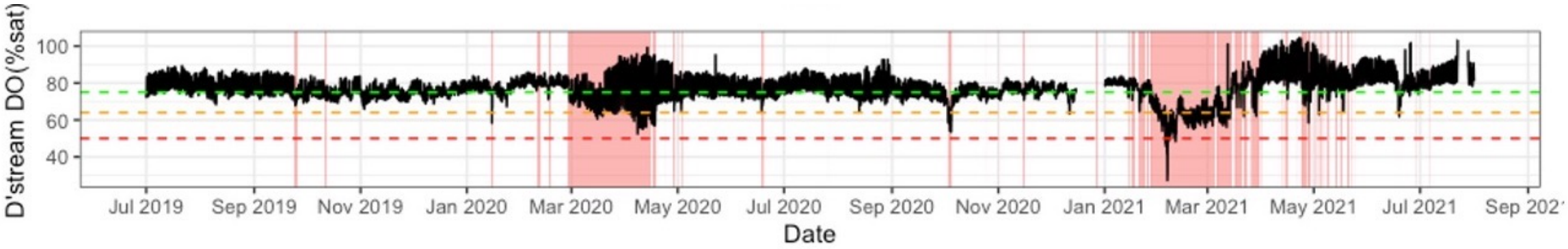
In 2020 and 2021 storm tank overflows occurred from Chesham STW due to:

(i) intense rainfall;

(ii) groundwater ingress to sewer network when groundwater levels were high

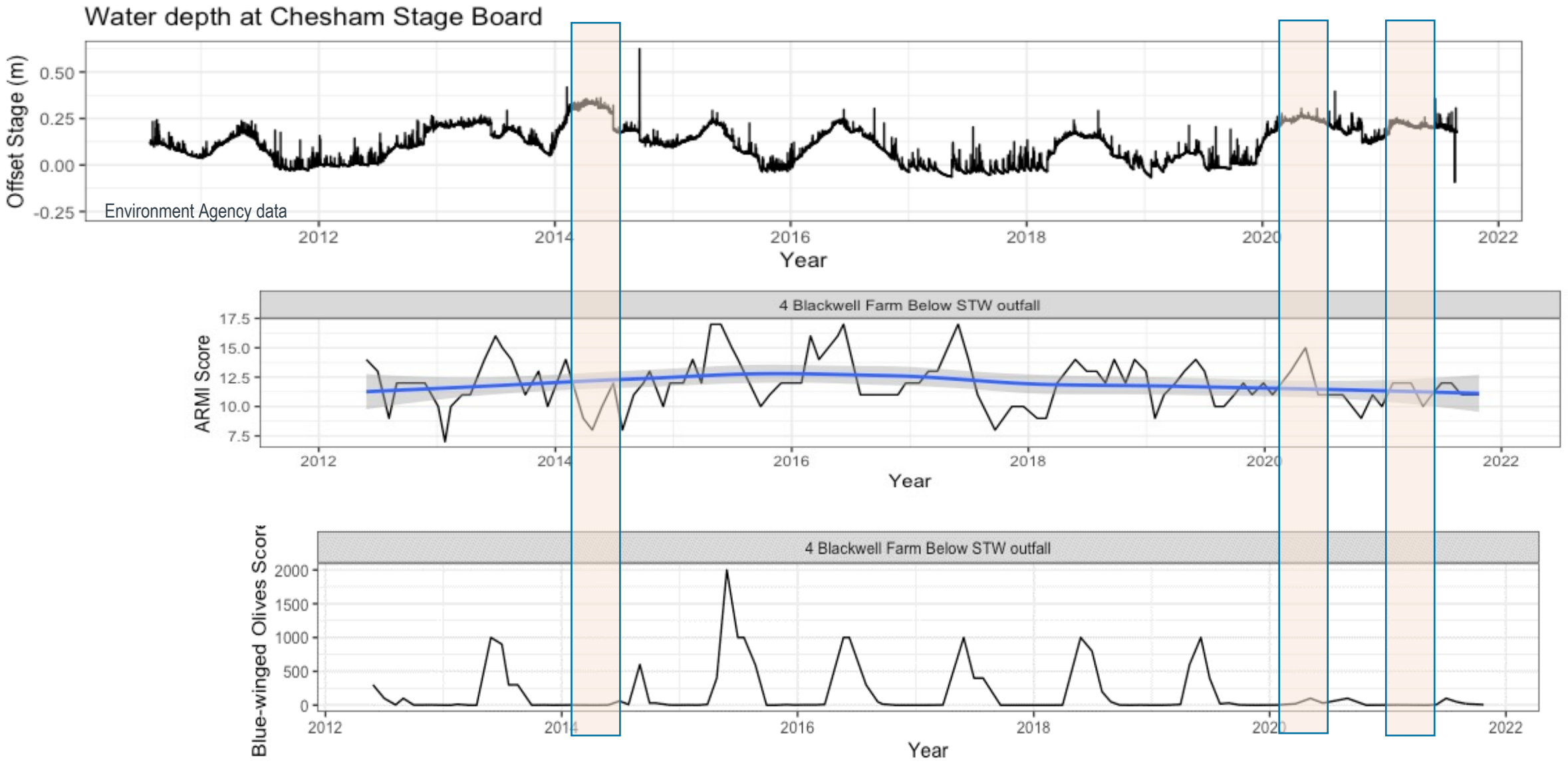
Tracking dissolved oxygen

Peach panels show periods of storm tank overflow from Chesham sewage treatment works

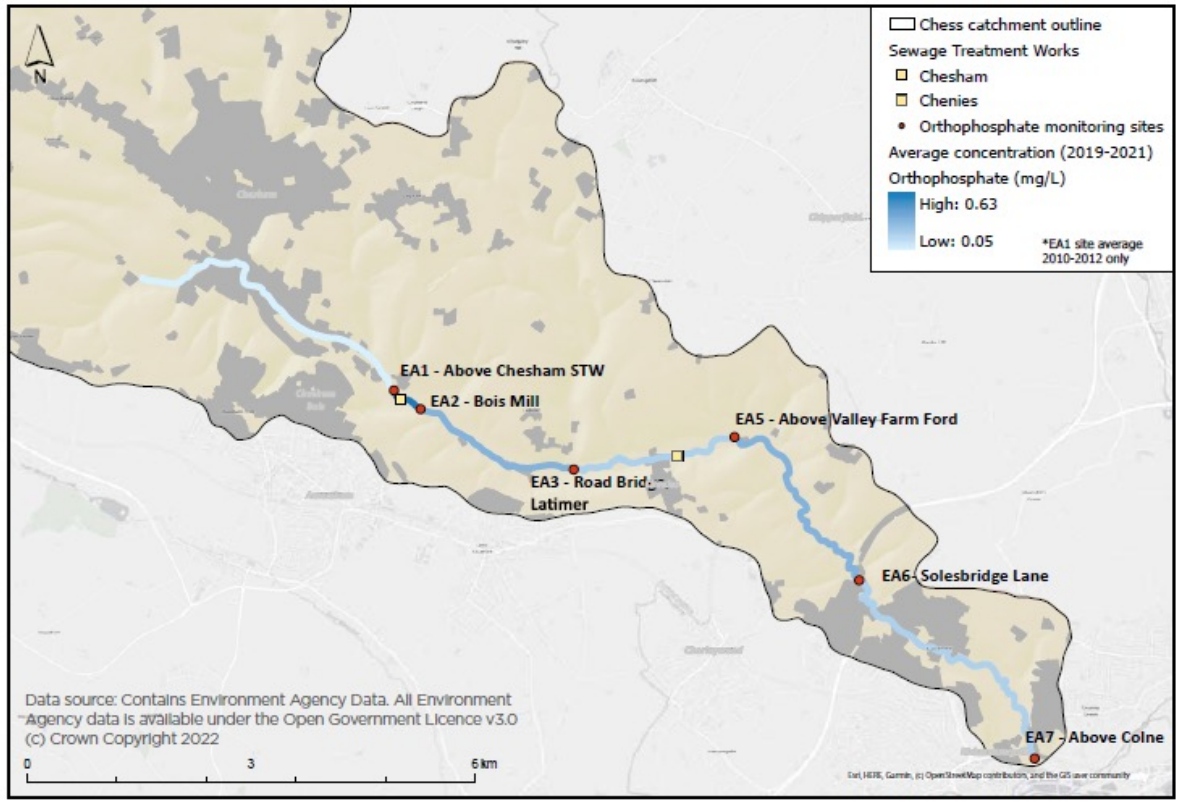


- Groundwater ingress causes dissolved oxygen levels in the water to drop downstream of Chesham STW for prolonged periods (days to months)
- Intense rainfall can cause transient drops in dissolved oxygen levels (hours)
- Dissolved oxygen levels further downstream (e.g. at Sarratt) remain high
- Levels of e.g. phosphate, bacteria and viruses in the water due to storm tank discharges are not known

Blue-Winged Olives c. 300 m below WWTW outfall



Phosphate is ‘poor status’ due to Chesham STW



Challenge: 96 % of the total reactive phosphorus currently originates from treated effluent entering river from Chesham STW (EA, SAGIS)

Opportunity: AMP7 permit change will reduce effluent from 2 to 0.25 mg P/L by 2024

Investment in Chesham STW by Thames Water

Upgrades to Thames Water assets

Sewage Treatment Works Capacity Upgrade

- Optimised existing assets since April 2021 to reduce volumes discharged from storm tanks
- Upgrade the site to increase the capacity that can be treated by ~40% (end of 2023)

Sewage Treatment Works Quality Upgrade

- Upgrade the site to reduce the Phosphorus permit from 2mg/l to 0.25mg/l (end of 2024)

Reducing infiltration & improving the resilience of their network

- Undertaken CCTV on 4.6km of sewer to identify hotspots & priorities for repair
- Re-lined large sections & repaired defects
- Finding and correcting surface water to foul misconnections; sealed and replaced ~750 manholes

Phosphate

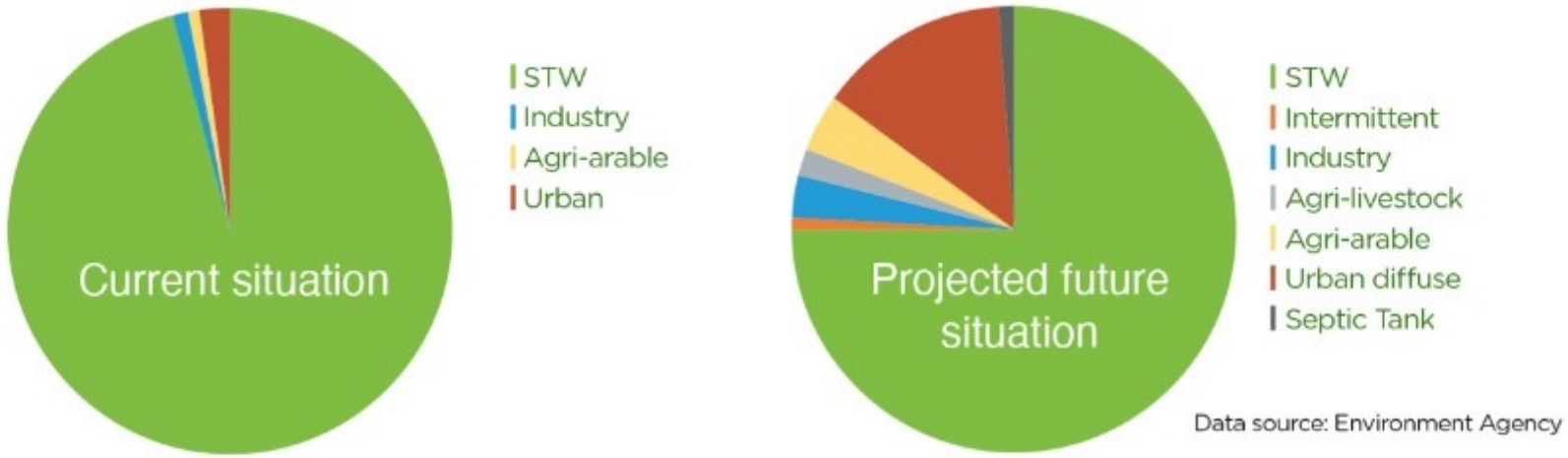


Figure 47 Percentage contribution of different sources of reactive P to the River Chess (a) SAGIS analysis for PR2014; (b) contribution of different sources of P following 2024 permit change (SAGIS modelled prediction).

Challenge:

- 75 % of total reactive phosphorus load will be from Chesham STW after P-stripping (EA, SAGIS)
- River Chess predicted to reach 'moderate' P status. Not below ecologically-relevant threshold concentrations.
- Climate change scenarios of reduced groundwater recharge and higher temperatures mean less dilution and greater algal growth?

Fine sediment….

Challenges:

Not a measured parameter for WFD

Proportion of different sources not known:

- Urban runoff
- Agricultural runoff
- Banks (crayfish, poaching)

Analysis revealed PAHs in sediments exceed USEPA predicted effect concentrations

Opportunities:

Partnership working allowing us to monitor through:

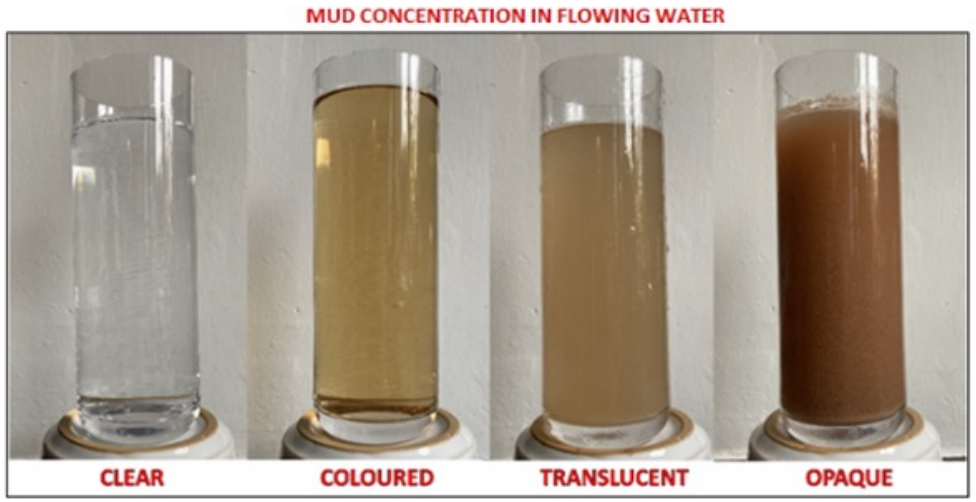
- Sensors
- Sediment source apportionment
- Citizen Science
- Spatial mapping of risk (SCIMAP)

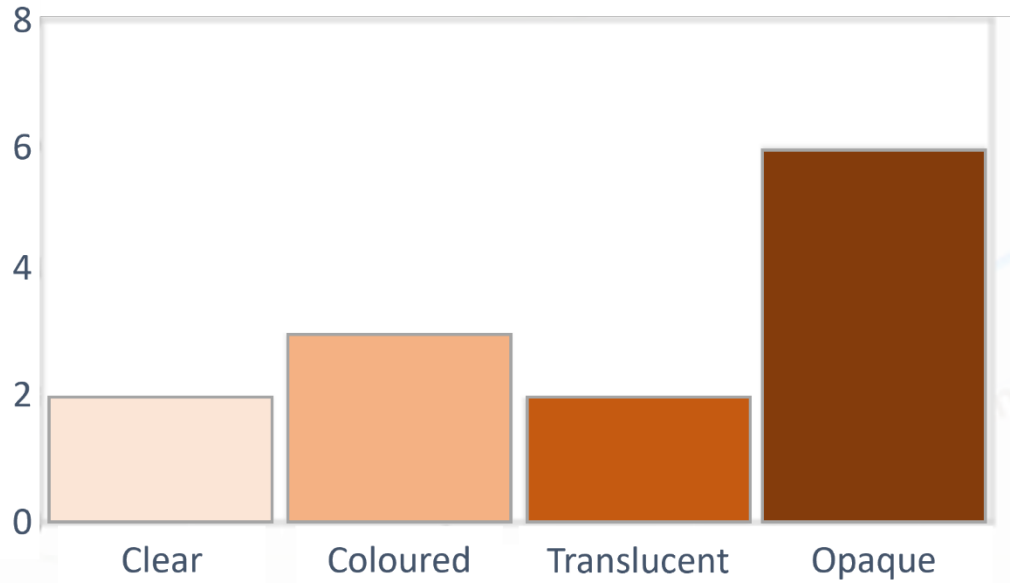
MudSpotter Pilot

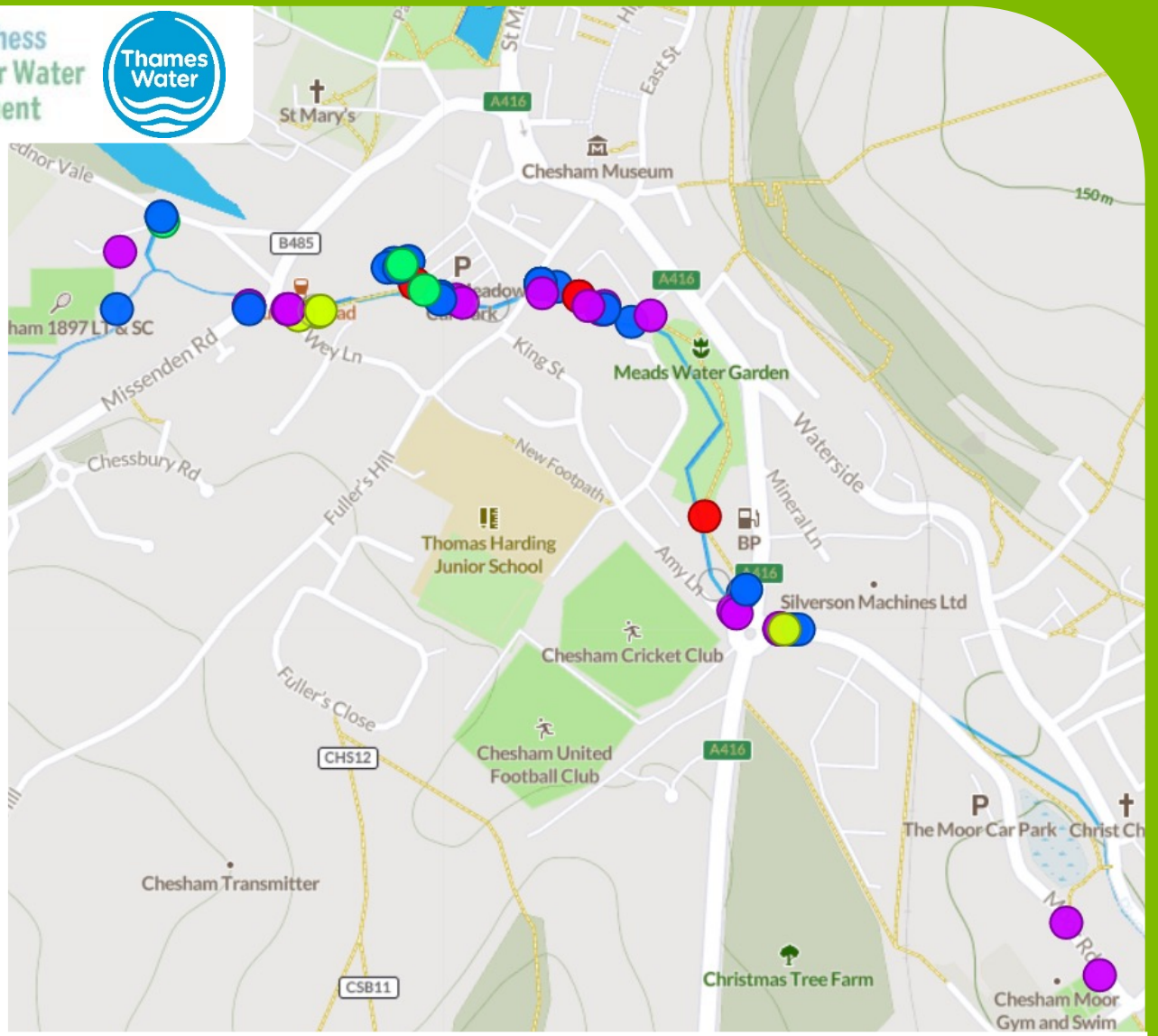
River Chess Smarter Water Catchment

Thames Water

Chesham



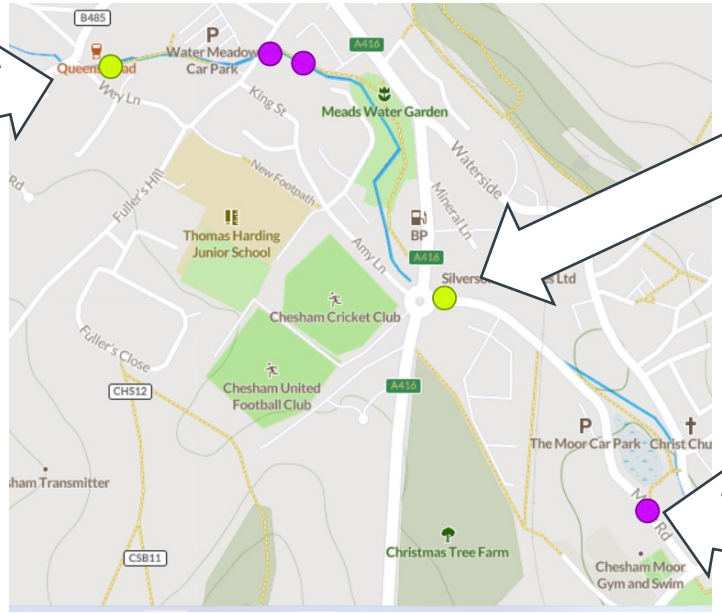


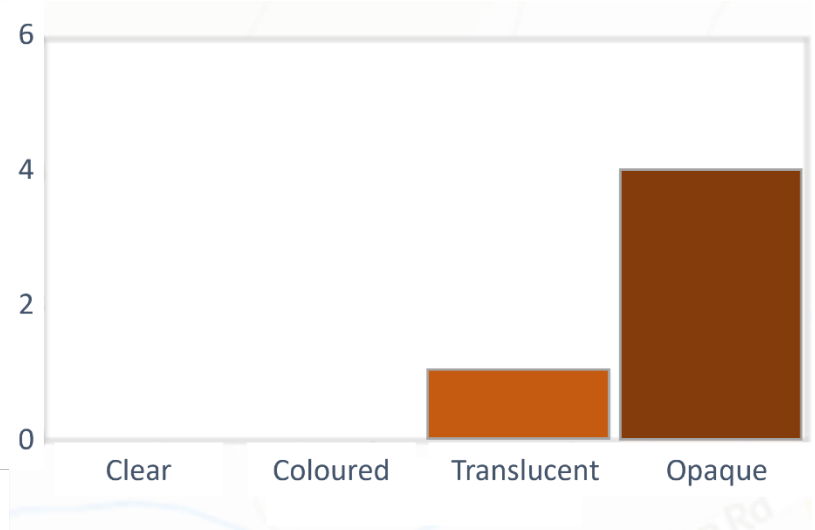


MudSpotter Survey

15th November 2022: Holly & Hannah

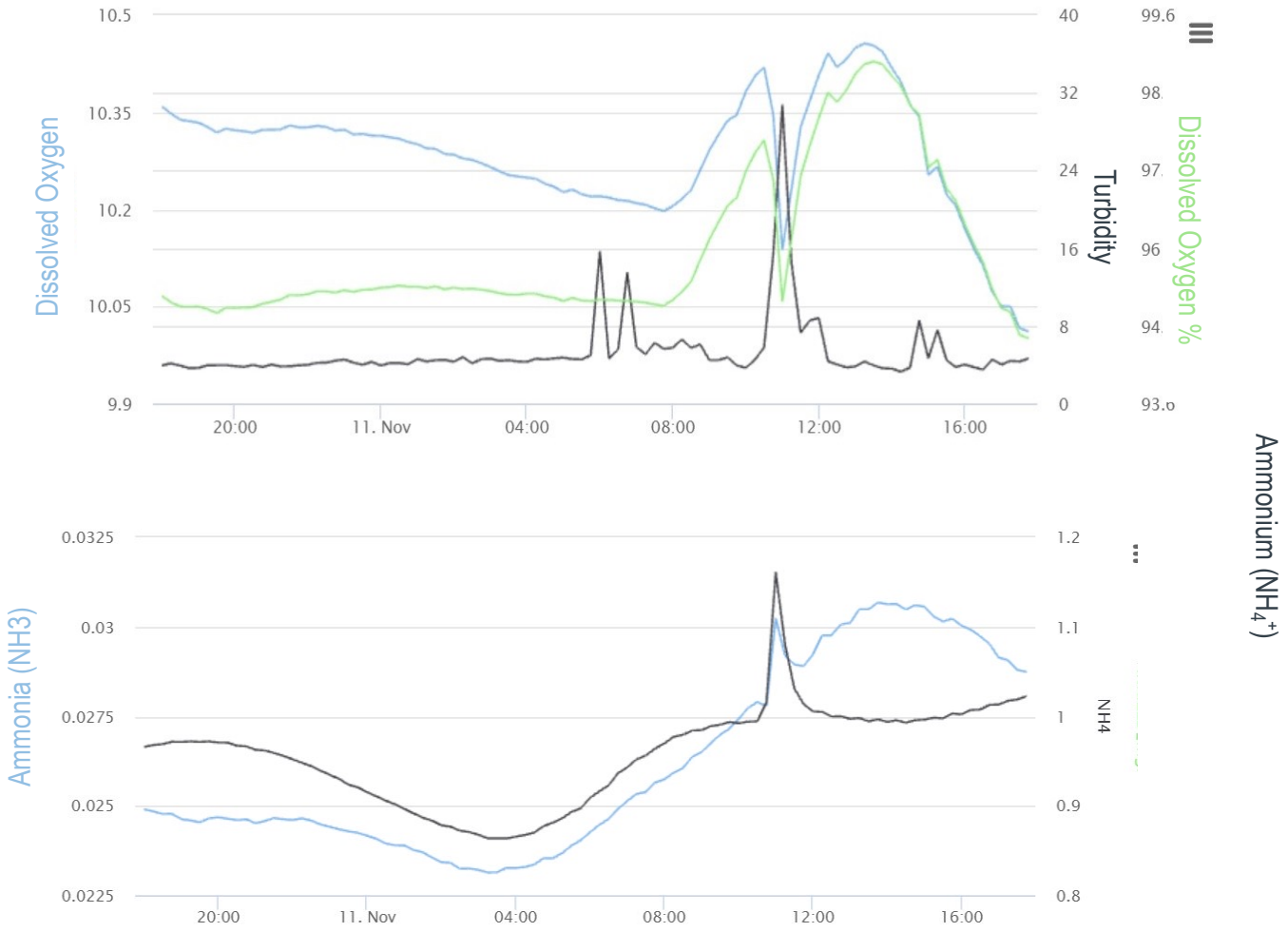
Queen's Head to Chesham Moor





Investigating urban runoff with sensors

Rickmansworth River Chess sonde



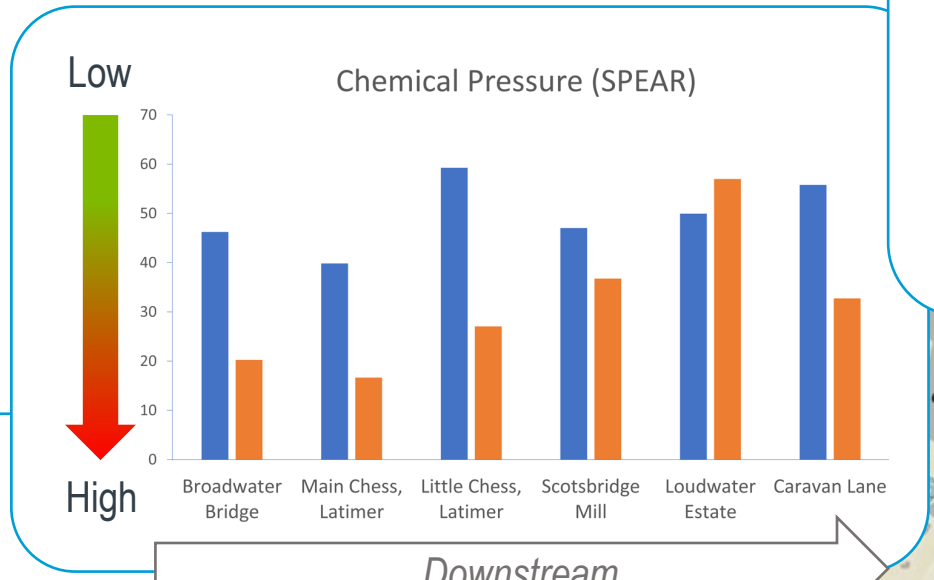
SmartRivers Results 2022

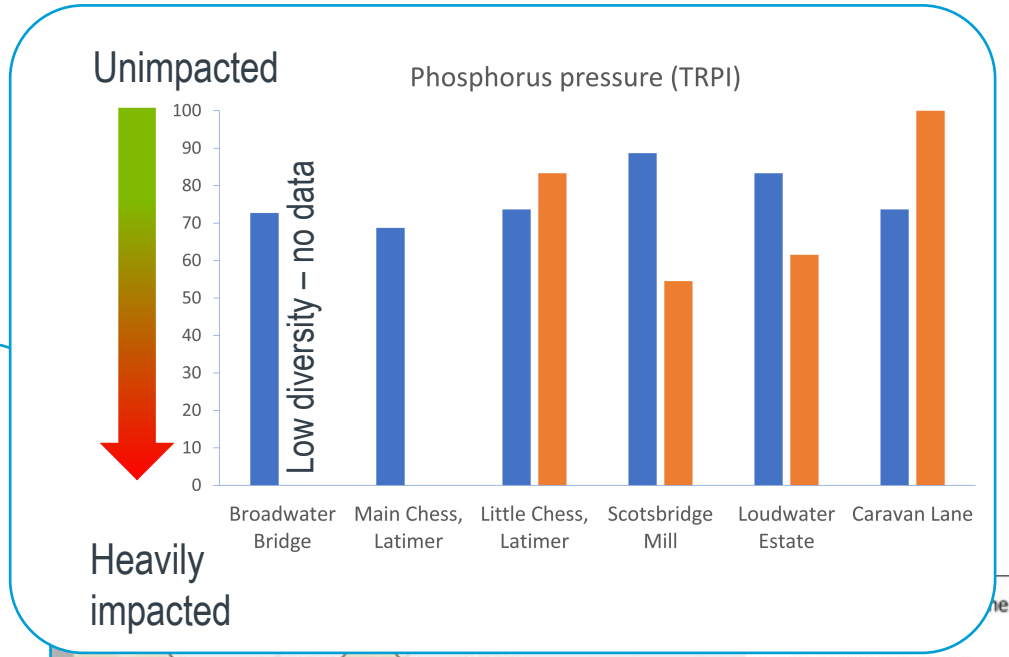
River Chess Smarter Water Catchment

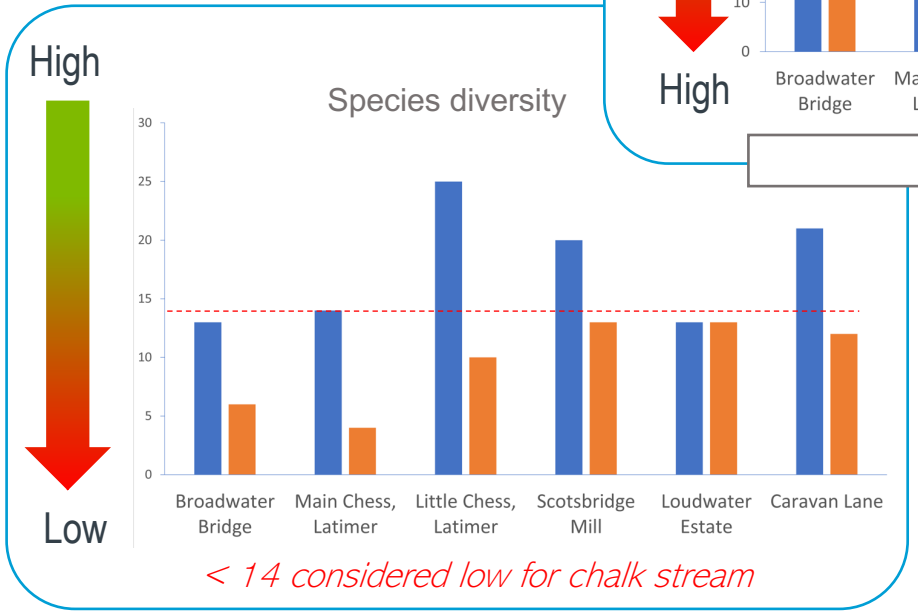
Thames Water

Key finding:

Main River Chess channel at **Latimer** has lowest species diversity, highest chemical pressure and highest phosphorous pressure in Autumn.



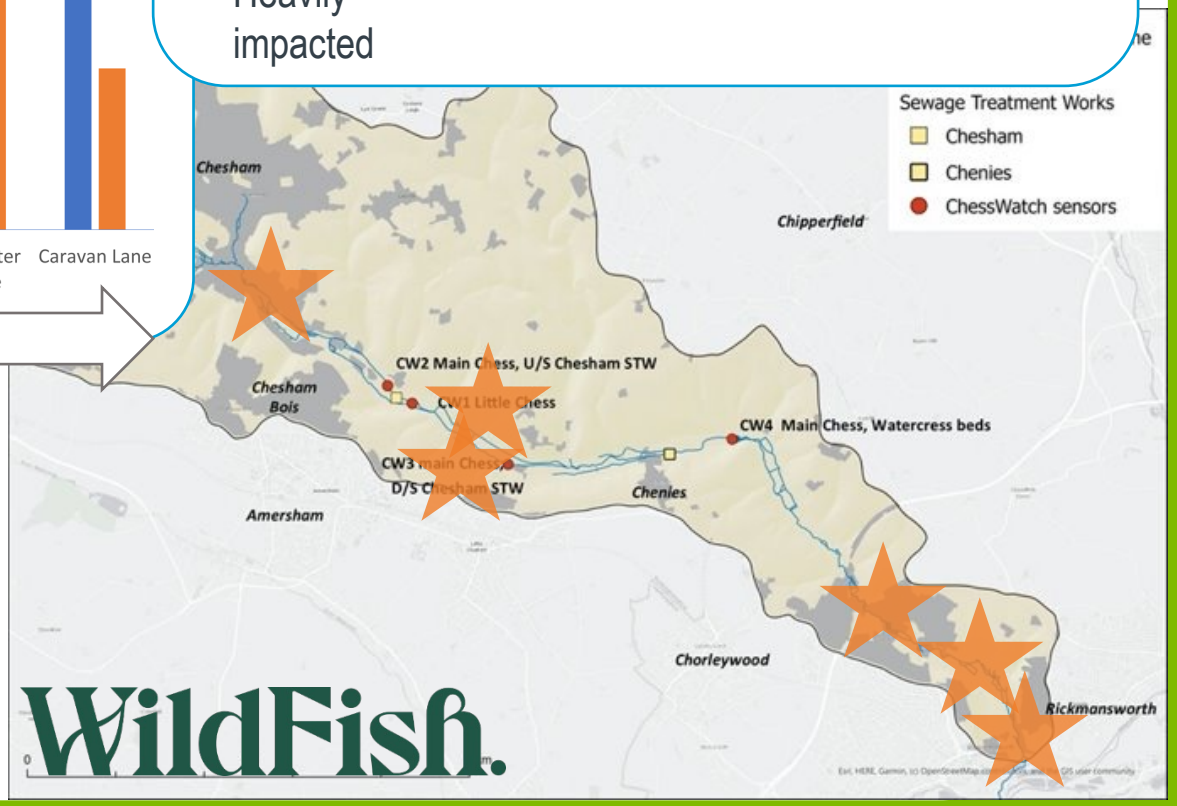




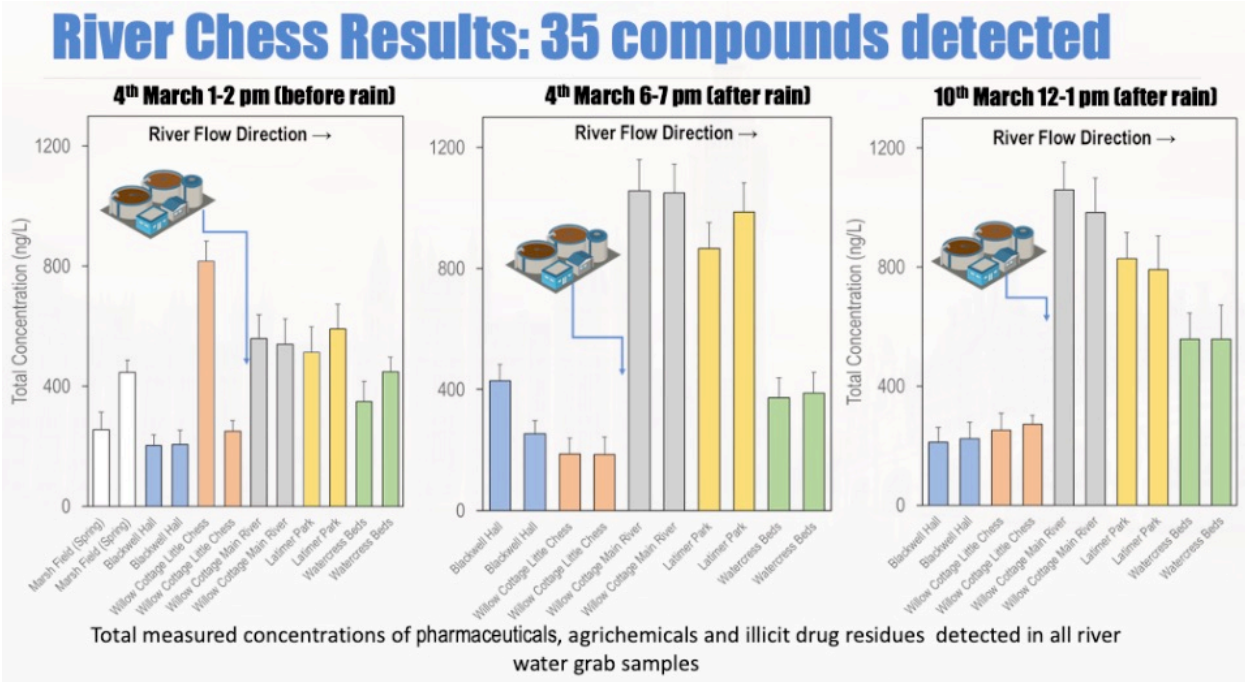
Downstream

Spring 2022

Autumn 2022



Contaminants of emerging concern



Total measured concentrations of pharmaceuticals, agrichemicals and illicit drug residues detected in all river water grab samples

- Grab samples and passive samplers collected from River Chess
- Returned to Imperial College London for analysis of 200 (conc'n) and 2,500 (presence/absence) chemicals
- Pilot study in 2021 showed influence of Chesham STW on total concentrations of CECs

Critical challenges……

Flows

- Low flows lead to water quality challenges (lack of dilution of treated effluent & little sediment entrainment to move sediment downstream)

Fine sediment

- Fine sediment falls outside WFD so there is a poor evidence base
- Relying on sediment quality standards from other countries to interpret levels of harm arising from sediment-associated contaminants such as PAHs

Storm Tank Overflows

- Groundwater infiltration into sewer network causing storm tank overflow during higher groundwater levels
- Not yet known whether repairs and replacements to network will solve the issue

Phosphate

- 'Best available Technology' on Chesham STW will only take phosphate to 'moderate' status
- Water temperature in parts of Chess exceeds 20°C in summer heatwaves so climate change likely to create further stress

Emerging contaminants

- Full extent of challenge not yet known but monitoring has commenced (pharmaceuticals)

Critical opportunities….

- Smarter Water Catchments project has provided funding for investigations and mitigation actions and enabled partnership working, but it takes time to develop 'trust' between partners and an effective network, so needs long-term investment (> 5 years)
- New Citizen Scientist toolkits are empowering local groups with improved evidence base e.g. MudSpotter, SmartRivers
- Partnership approach in the catchment is gaining traction BUT needs input from local authorities & National Highways to tackle urban runoff
- Tackling urban runoff needs agreement on ownership of SUDS features and their maintenance, as well as capital investment