

N.Ireland.

The potential of fast growing willows for the reduction of nutrient losses to waterbodies.

22nd May 2019

Chris Johnston

AFBI Agri-Environmental Technologies, Hillsborough

Overview

- Policy Direction and WaterPro Pilot site relevance
- Water Quality Pressure
- WaterPro Pilot Site
 - Platforms
 - Preliminary Results
- Legacy (ref. Interreg CatchmentCARE)
 - Platform

Water Quality Pressure

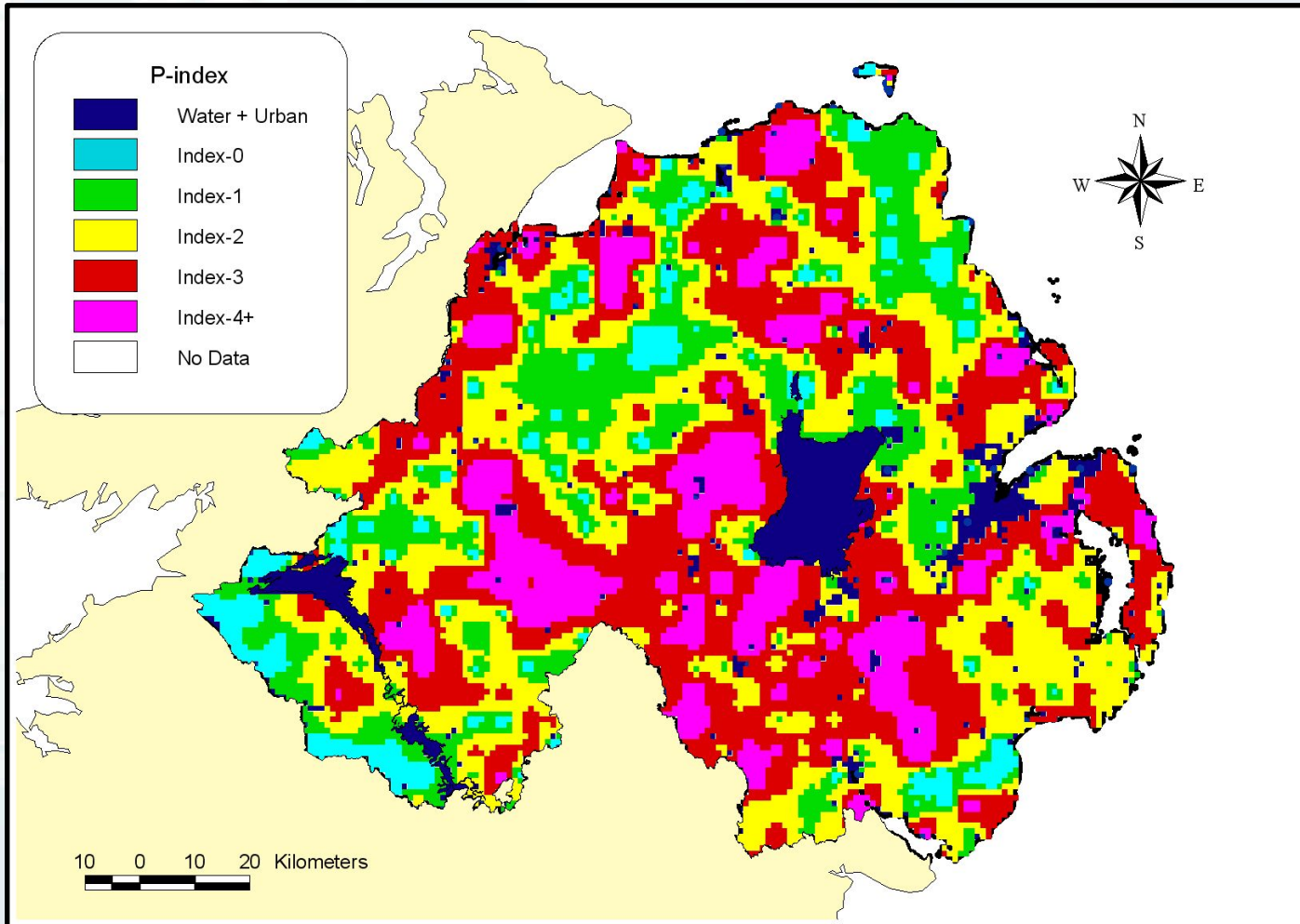
What is the Problem ?



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Impact of P Loss from Soils



Over the past 10 years there has been a significant increase of 0.31 mg Olsen-P/l/yr identified across NI.

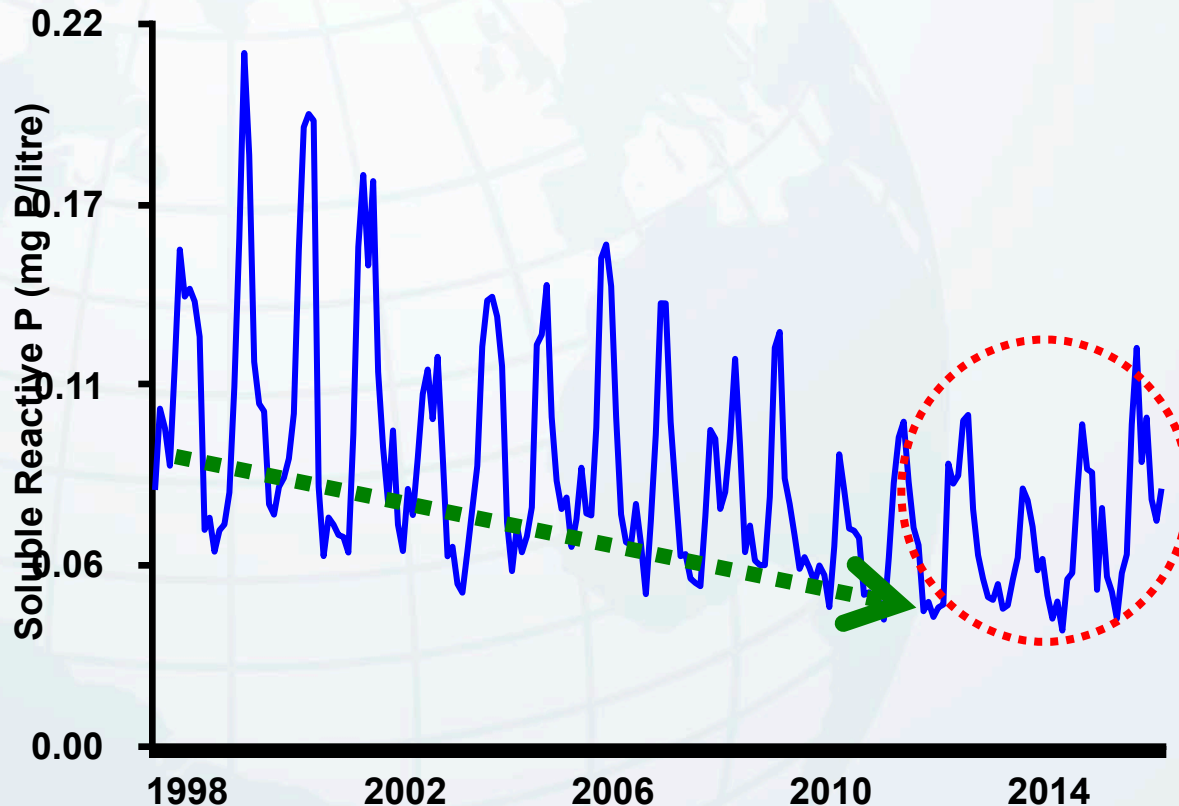
Slurry spreading is a high risk activity ref. P losses



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Soluble Reactive Phosphorus (SRP) (127 NI rivers, NIEA)

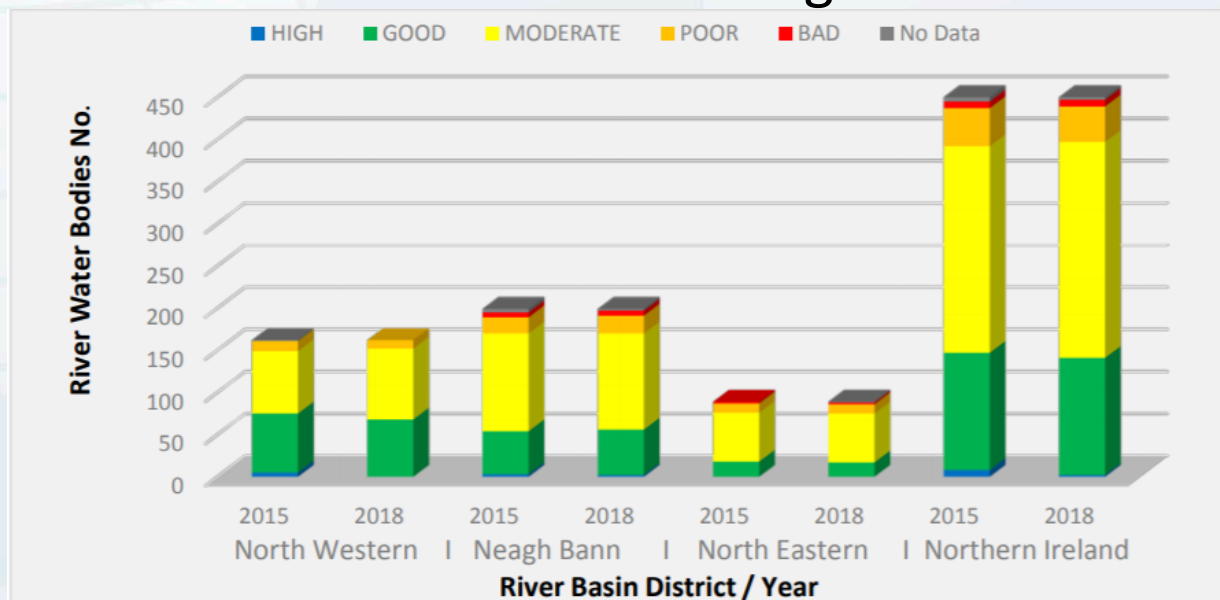


- Until recently, P concentrations in NI rivers had been declining
- ‘Easier’ to justify no further ‘tightening’ of our Nitrates Action Programme
- In the past 3 years, however, P levels appear to have been rising again, which is a **MAJOR CONCERN!!**

In many of these rivers, the concentrations still remain above that required for the WFD

Northern Ireland's River Classification Status

- In 2018, 31.3% of 450 river water bodies were classified as 'high' or 'good' quality, compared to 32.7% in 2015.
- In 2018, five of the 21 lake water bodies in Northern Ireland were classified as 'good' status and 16 lake water bodies were classified as less than 'good' status.



<https://www.daera-ni.gov.uk/news/northern-ireland-water-framework-directive-statistics-2018-released>

Policy Direction

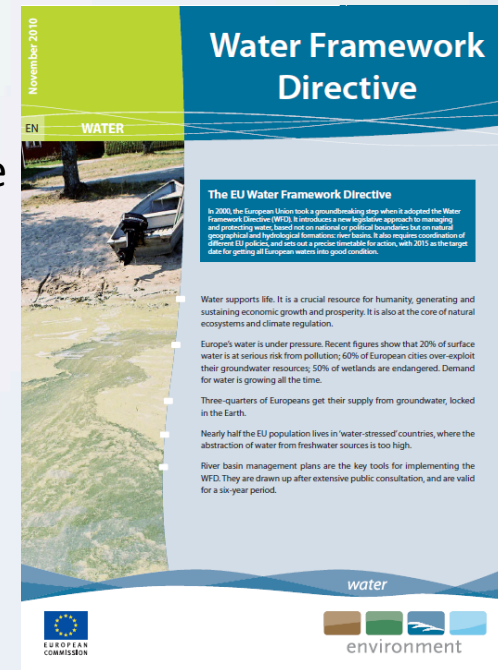


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Policy Direction and Momentum

- EU Water Framework Directive (Improve water quality)
- DRD Long Term Water Strategy, Social & Environmental Guidance
- AFSB “Going for Growth”
 - Increase in food production and agri-food processing
 - Increasing outputs
 - Sustainable Intensification
 - Increasing energy demands
 - Increasing waste management
 - Biosolids / Organic waste recycling
- **Recommendation 22** – Govt. must develop a Strategic Land Management Policy, specific to AgricultureWhilst enhancing Environmental Sustainability.
- **Recommendation 25** – Govt. must review incentives for renewables to be complementary to the agri-food industry.



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Sustainable Agricultural Land Management Strategy (NI) - Recommendations

- Woody riparian strips in overland water flow path
 - populated by plants such as willow
 - which can withstand wet conditions
 - to slow the flow of surface water,
 - collect the sediment and
 - absorb the Phosphorus pre-watercourse
 - can be coppiced regularly (fuel / value chain)
- Carbon sequestration, biodiversity, flood alleviation



WaterPro AFBI Pilot Site

How we go about looking into a solution



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How do we reduce P loss in runoff?

.....and keep agriculture profitable !!

CENIT Case Study

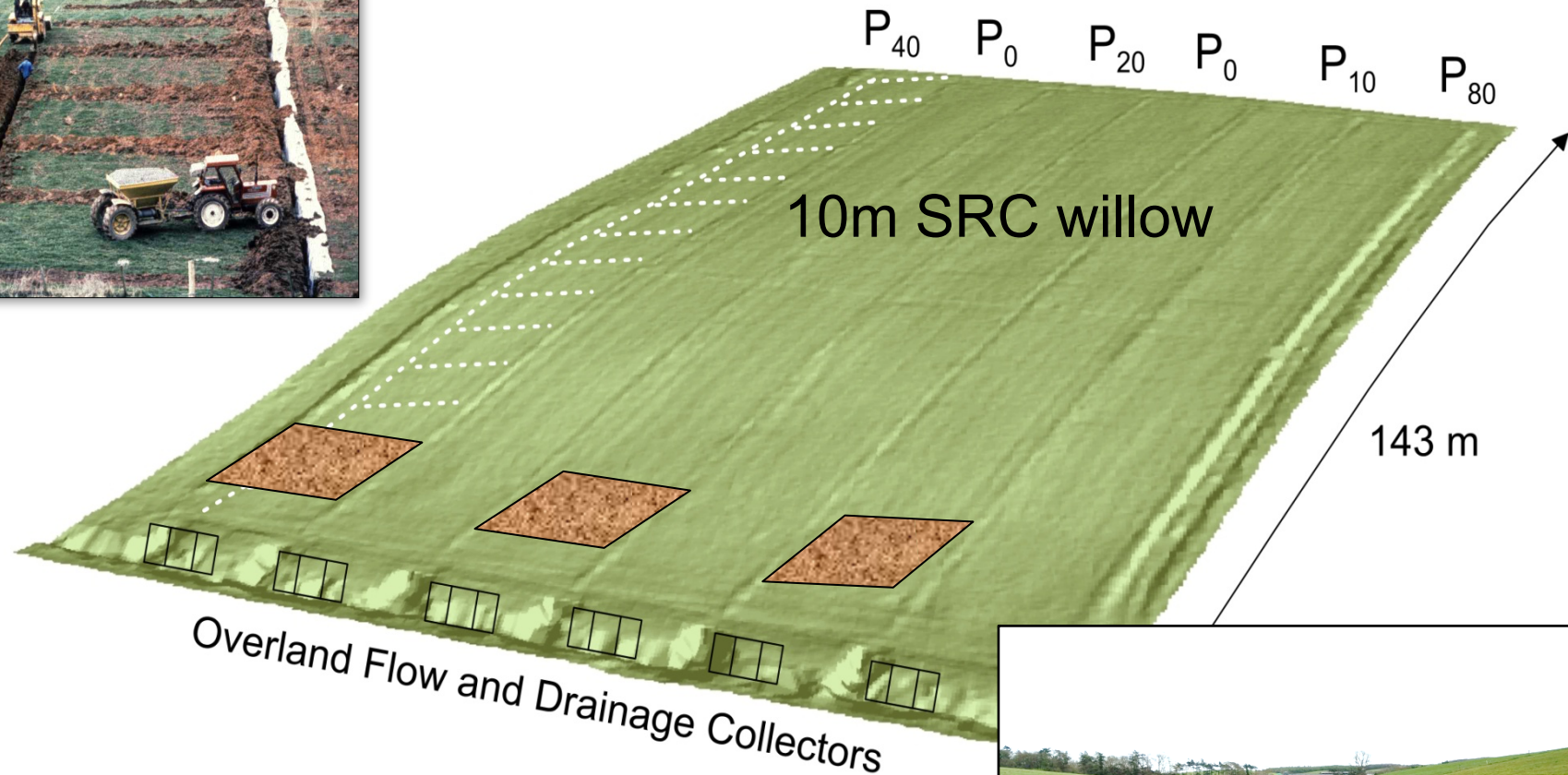


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SRC willow planting (5 double rows)



- BACI / Experimental Protocol
- (Before, After, Control, Implementation)

Pre-Testing



Bulk Density

Infiltration Test



Soil Moisture
& Penetrometer



Willow Planting



- Planting of SRC willow. Six varieties from two different breeding programmes



- After grass burn-off SRC Cuttings planted by hand.
- Normal step-planter configuration
- Five double rows

May 2016



June 2016

*At Time of WaterPro Launch at
afbi Hillsborough*

- 
- A photograph of a rural landscape. In the foreground, there is a grassy field with a fence line. In the middle ground, there is a small building and a fence line. In the background, there is a green hillside with trees and a small building. The sky is blue.
- Monitoring of Overland and drainage flows commenced ...
 - P & N fractions, pH, Ec, SS, Volume, physical soil measurements

May 2017 - *After Cutback*



July 2017- *2 months later*



May 2018 – 1 year old



Agri-Food and Biosciences Institute:

Automatic water Quality and flow monitoring from field drains in Hillsborough Research Farm

Equipment:

- 🔵 ISCO 6712 Portable Autosampler (x6)-Overland Flow
- 🔵 ISCO 730 Bubbler Flow Module (x6)
- 🔵 ISCO 6712FR Refrigerated Autosamplers (x6)-Drainage Flow
- 🔵 ISCO 710 Ultrasonic Flow Module (x6)

Sampling Strategy & Analysis:

Overland Flow:

- 🔵 Overland flow collected in a shallow trench the width of each plot
- 🔵 Travels under gravity to a mini v-notch weir
- 🔵 ISCO 730 Bubbler Flow Module detects if flow meets/exceeds the required level ($>0.01\text{L/s}$)
- 🔵 If triggered, ISCO 6712 Portable Autosampler takes composite sample of 300ml x6 each day (2 Litres), with a 60 minute interval between samples
- 🔵 Flow data from ISCO 730 Bubbler Flow Module downloaded on inspection days

Drainage Flow:

- 🔵 Drainage flow from each plot is recorded at 5 minute intervals
- 🔵 Comprised of a composite sampling schedule: 300ml x6 each day (2 Litres).
- 🔵 Flow data from ISCO 730 Bubbler Flow Module downloaded on inspection days

Analysis:

- 🔵 Nitrates (TON , NO_2N , NO_3N , NH_4N)
- 🔵 Phosphates (SRP , TSP , TP , SOP , PP)
- 🔵 pH
- 🔵 SO_4
- 🔵 Conductivity
- 🔵 Suspended Solids

Water flow and quality monitoring info card AFB
Hillsborough Research Farm



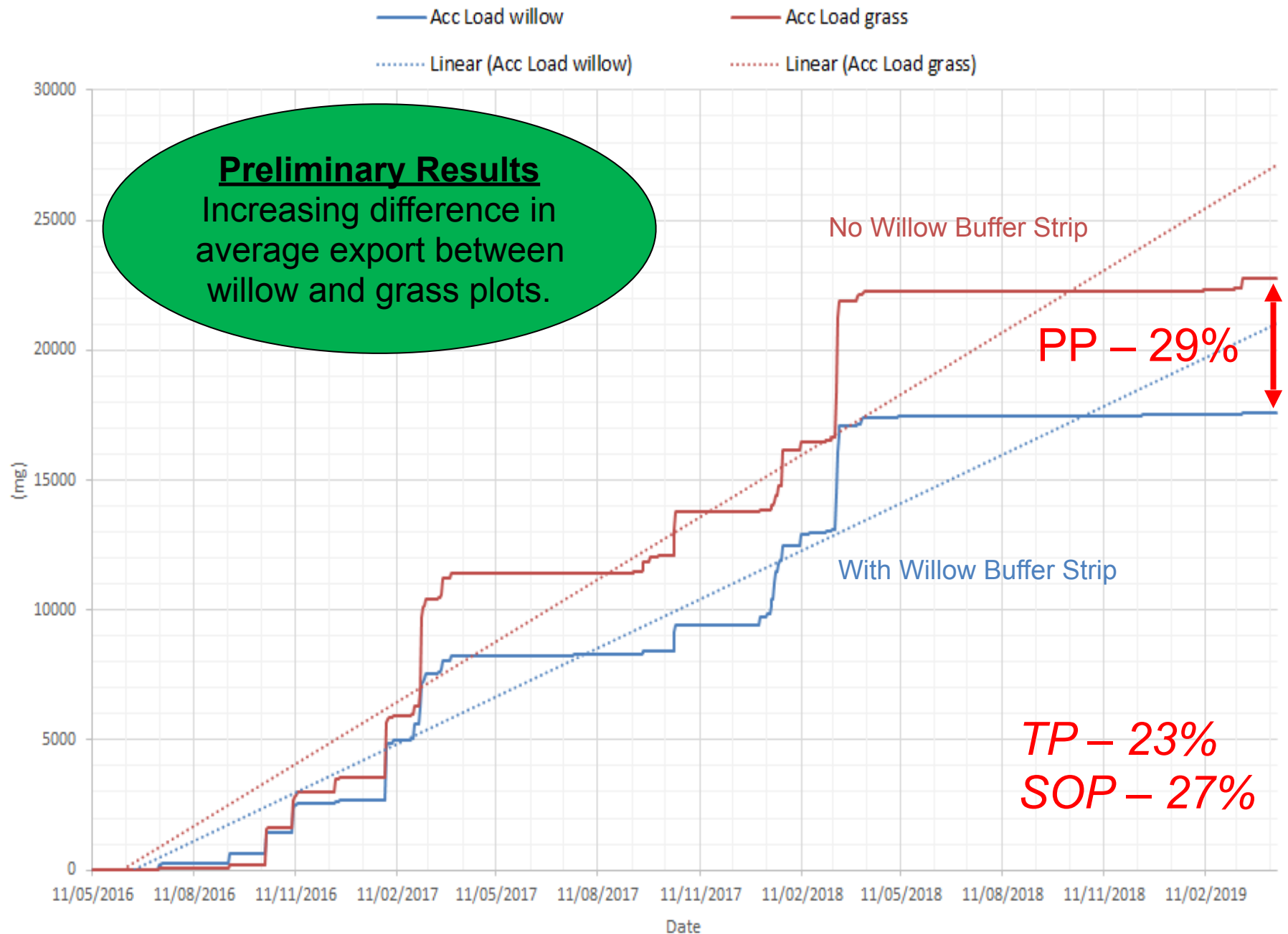


Results from CENIT plots

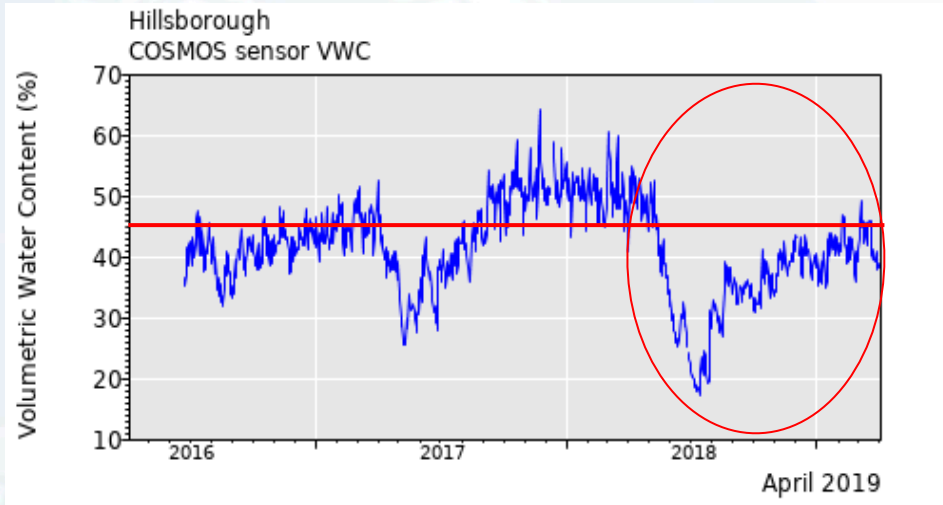
Averages of replications

- Difference in Daily Flow volumes (l/d) – **No real patterns visible**
- Differences in Run-off TP concentrations (mg/l) – **No Real patterns visible**
- Total Daily Overland Flow Load (mg P/d)
 - Some patterns emerging
 - Some differences becoming apparent and seen in Average Loadings
 - t-test comparing P export from the willow vs the grass plots shows a significant difference between the data as shown by the $p < 0.05$

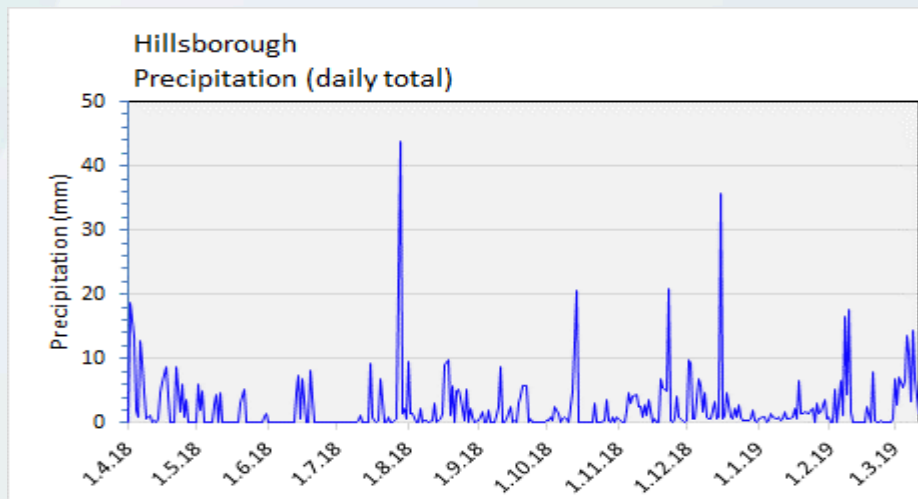
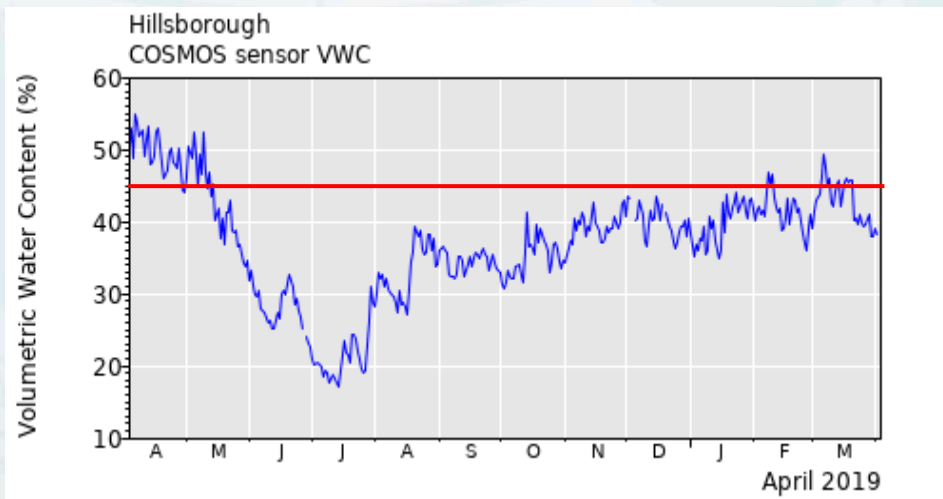
Run-off - Accumulative Particulate Phosphorus



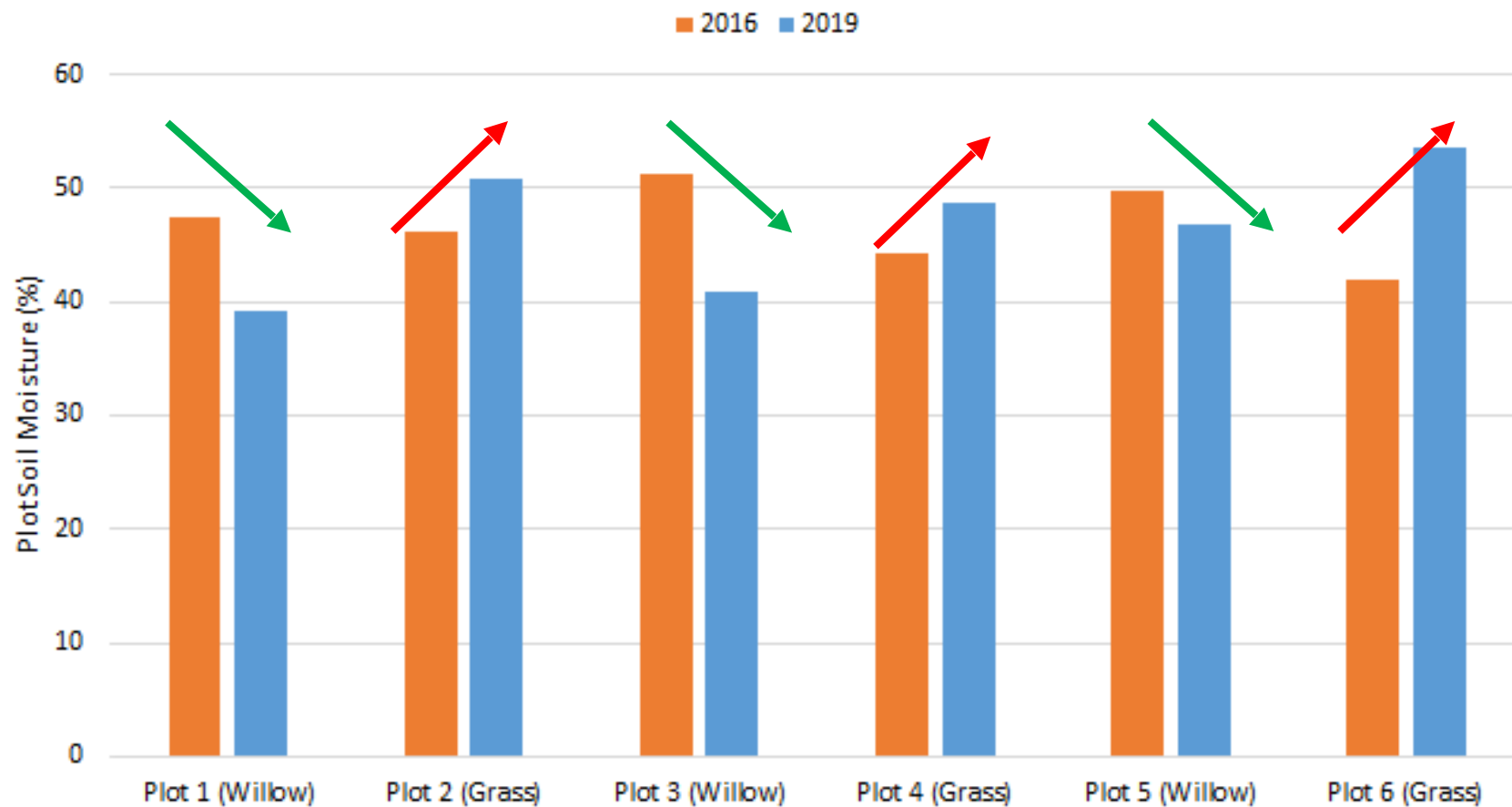
Soil moisture



- Array of 10 TDT soil moisture probes,
- Five pairs at depths down to 50cm.
- About 1m apart



Average Plot Soil Moisture





WaterPro Legacy

How the development continues after the project?

Further Research Activity - WaterPro Legacy



Interreg VA – CatchmentCare

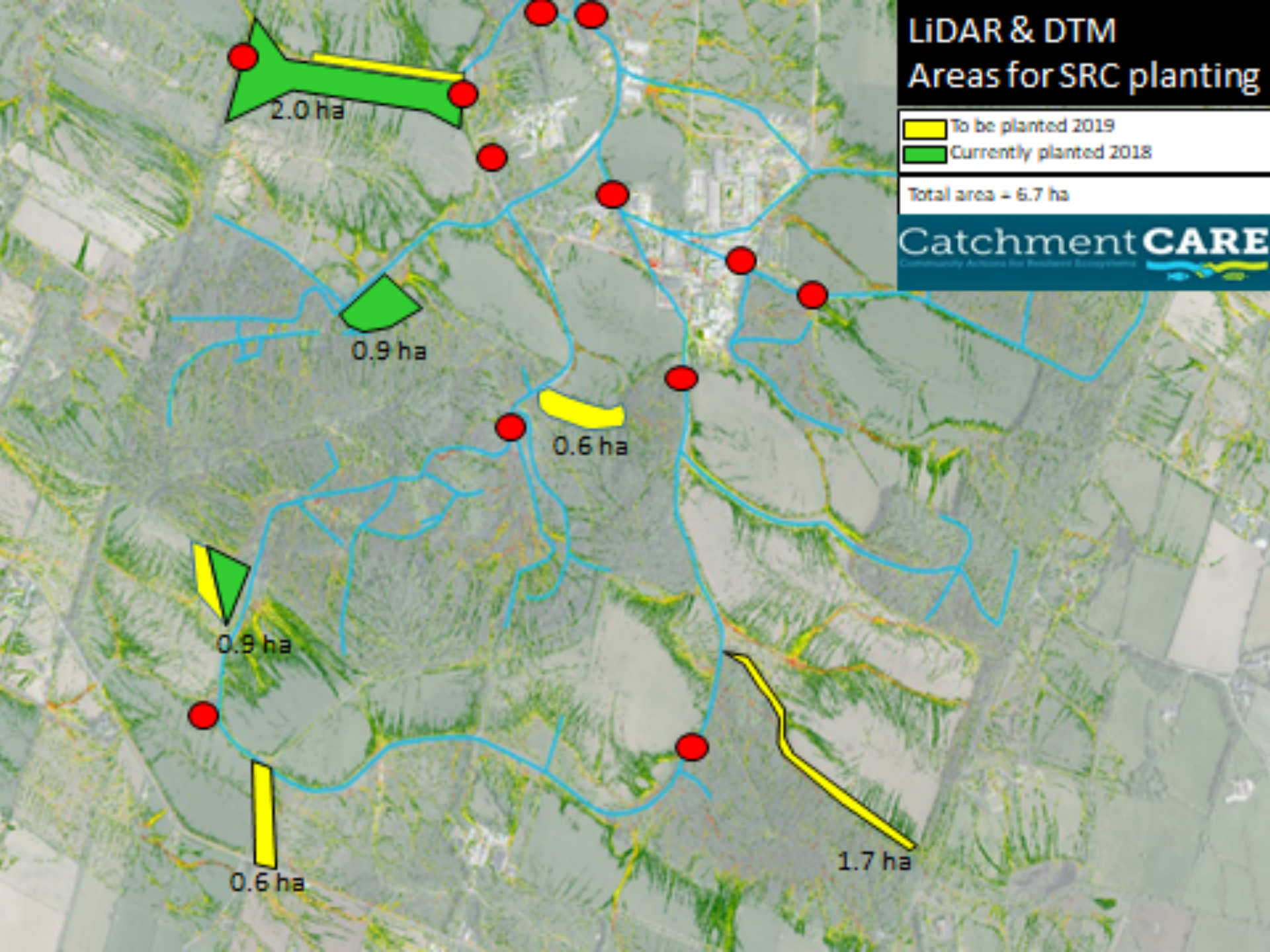
- Potential for mitigation of diffuse pollution - *LiDAR, Biofiltration Blocks*
- Point Source Discharge from WWtWs - *Construction of a number of SRC Willow Waste Water Treatment schemes within sensitive catchments*

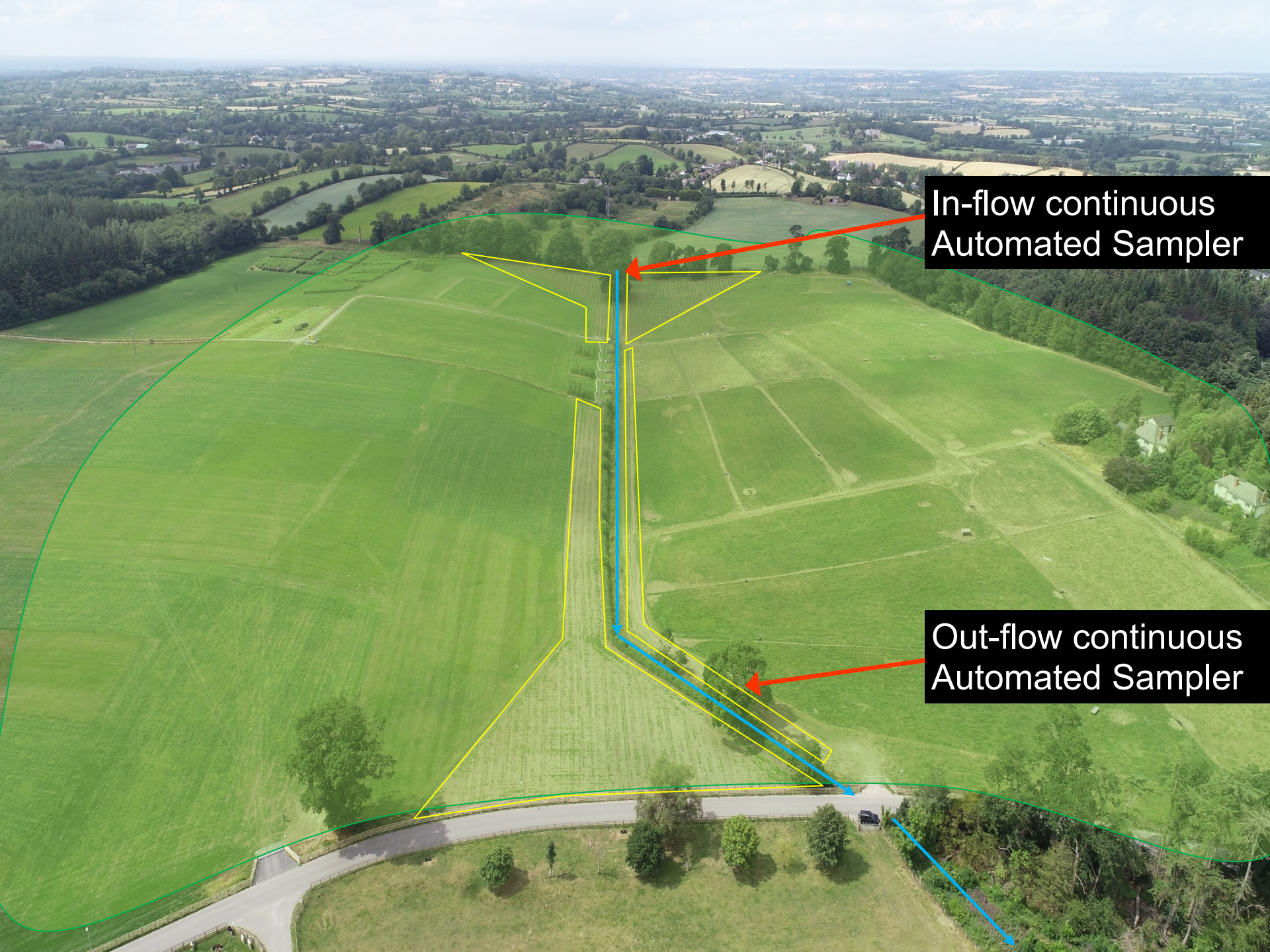
LiDAR & DTM Areas for SRC planting

- To be planted 2019
- Currently planted 2018

Total area = 6.7 ha

Catchment **CARE**
Community Action for Resilient Ecosystems





**In-flow continuous
Automated Sampler**

**Out-flow continuous
Automated Sampler**

Agri-Food and Biosciences Institute: Automatic water Quality and flow monitoring from field drains in Hillsborough Research Farm

Equipment:

- 🔹 ISCO 6712 Portable Autosampler (x2)
- 🔹 110Ah Deep Cycle Marine Battery (x2)
- 🔹 In-Situ Inc. Level TROLL 500 Level Logger
- 🔹 Custom-Made Flume

Water Sampling Strategy:

- 🔹 Two continuous automated Autosamplers.
- 🔹 Farm Sub-Catchment Sampled downstream and upstream as it enters the farm from an external source.
- 🔹 Comprised of a composite sampling schedule: 300ml x6 each day (2 Litres).
- 🔹 Water samples lifted Monday, Wednesday and Friday.

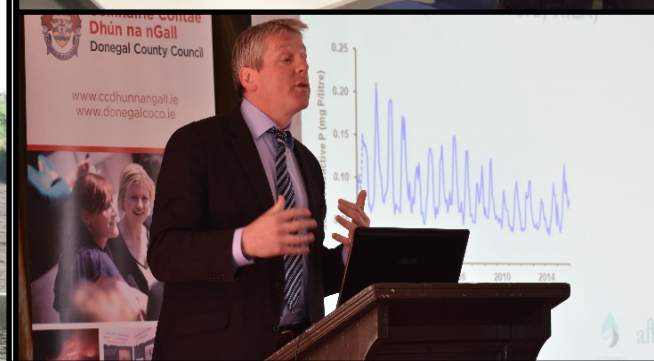
Level Logger Schedule:

- 🔹 Programmed level logger runs autonomously.
- 🔹 Records stream water level every 5 minutes (24/7).
- 🔹 Records pressure and temperature.
- 🔹 Results used in conjunction with custom made flume calculation to determine flow.





Thank you



WaterPro - (EU Interreg IVB NPA Programme)
"Sharing Best Practice to Improve Water Quality"
Chris Johnston & Donnacha Doody
 Agri-Environment Branch, Lurgan Park, Hillsborough, Co. Down, BT26 6DR, UK.

Introduction
 The WaterPro project is developing eco-efficient tools and models for water and storm runoff management practices and environmental protection. This will be done through the ...

- Development of a Tool-Box of good management practices
- A communications platform
- Implementation of innovative, low cost pilot sites

AFBI Pilot Site
 The WaterPro project is developing eco-efficient tools and models for water and storm runoff management practices and environmental protection. This will be done through the ...

- Implementation of innovative, low cost pilot sites in order to evaluate their treatment and cost-efficiency
- Development of a Tool-Box of good management practices and
- A communications platform

AFBI Pilot Site
 The WaterPro project is developing eco-efficient tools and models for water and storm runoff management practices and environmental protection. This will be done through the ...

- Willows for mitigation of overland flow
- Drainage and overland flow monitoring
- Crop monitoring

Vision (Sustainable Agri-Land Mgmt. Strategy)

- Management of leakage / waste waters
- Management of diffuse pollution
- Downhill of farmyards, discharges from septic tanks

These technologies are applicable to all catchments but prioritisation may be required based on need for water quality improvement

Partners

- Seaview University of Applied Sciences (Ireland)
- Agri-Food and Biosciences Institute (NI Ireland)
- Donagh County Council (Ireland)
- Lough Neagh Partnership (NI Ireland)
- Harriet Webb University (Scotland)
- Geological Survey of Ireland
- Agri-Food University of Iceland
- Luleå University of Technology (Sweden)
- Agricultural University Farm Islands
- 17 associated partners

Preliminary Data - Cumulative TP export (mg)

Northern Periphery and Arctic Programme

EUROPEAN UNION
 Investing in your future
 European Regional Development Fund

www.afbini.gov.uk