

Monitoring and Evaluating Targeted Mitigation Approaches to Improve Water Quality: Measures for Water

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Project Overview

- M4W aligns with the national WaterEIP to achieve the goal of assessing the impact of mitigation measures
- Multi-disciplinary
- Combines different research methods including catchment water quality modelling
- Target audience of project includes farmers and policy-makers
- The measures being assessed will (i) Reduce pollution sources (ii) break pathways (iii) manage farm infrastructure

Measures: Examples from S.E Ireland



Leaky Dams in open drain (ditch)



Sediment Trap

EIP Measures

| | |
|-----|---|
| 1 | Rainwater Management Plan |
| 2 | Farmer Training Course |
| 3 | Nutrient Management Plan |
| 4 | Nitrogen Surplus |
| 5 | Multi Species Swards |
| 6A | Catch/Cover Crops (Other Cropping Systems) |
| 6B | Catch/Cover Crops (Winter Cropping Systems) |
| 7 | Low Drift Nozzles |
| 8 | Mobile Drip Tray |
| 9 | Water Storage Tank (IBC tank) |
| 10 | Retrofit a clean water tank |
| 11 | Decommission Sheep Dip Tub |
| 12 | Submersible Pump |
| 13A | Hedgerow establishment including earthen mound: |
| 13B | Hedgerow establishment without earthen mound |
| 14 | Spatially targeted riparian buffer zones:. |

| | |
|----|---|
| 15 | Linear Riparian buffer zones: Grassland |
| 16 | Linear Riparian buffer zones: Tillage |
| 17 | Tree Planting within Buffer Zone |
| 18 | Small Scale Wetland Pond |
| 19 | Earthen Bund |
| 20 | Swales |
| 21 | Management of CSA |
| 23 | Water Bars |
| 24 | Sediment Traps |
| 25 | Culverts |
| 26 | Watercourse Crossing/Bridges |
| 27 | Gateway Improvements |
| 28 | Willow Filter Bed |
| 29 | Farmyard Settlement Tank |
| 30 | Bovine exclusion from water bodies |

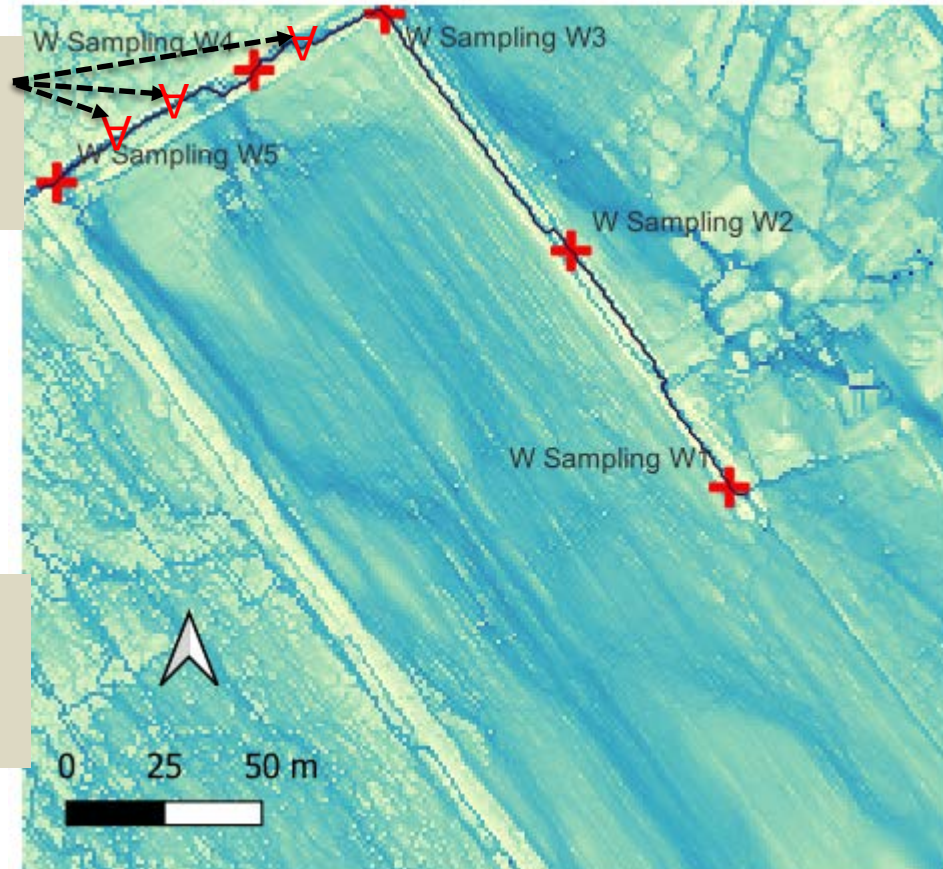
| | |
|----|---|
| 31 | Ovine exclusion from water bodies |
| 32 | Ovine exclusion from water bodies - mountain fencing |
| 33 | Solar powered electric fencer |
| 34 | Alternative Water Supply - Pasture Pump |
| 35 | Alternative Water Supply - Solar Pump |
| 36 | Alternative Water Supply - Water Trough |
| 37 | Alternative Water Supply - Piping, fixtures and fittings |
| 38 | Vegetated Bunded Drains |
| 39 | Host Farmer Payment |
| 40 | Contractor Mobilisation Fee |
| 41 | Bespoke Measure - Individual details of proposal required |
| 42 | Farmyard Bucket and Brush |
| 43 | Slurry Testing |

Farm to Field Scale : Measures



Left: EPA PIP-P map (5m)
Right: LiDAR > 1m TWI map

3x leaky dams



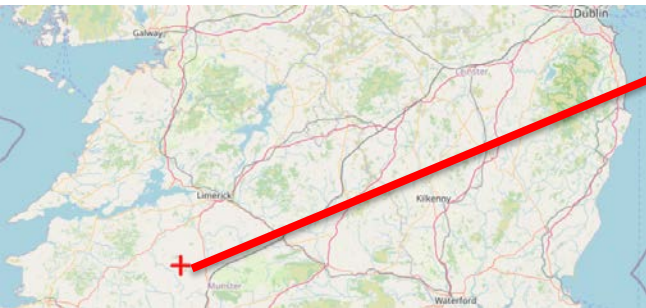
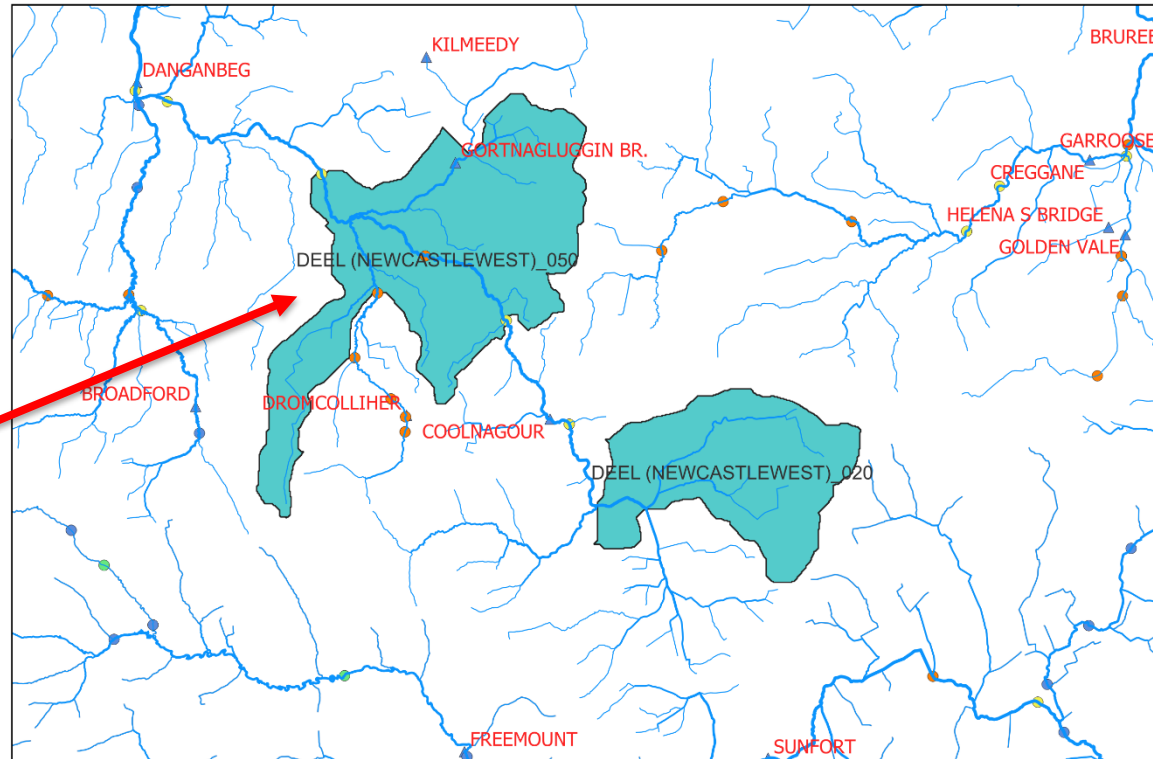
- *Right Measure, Right Place*
- PIP_P maps can be used to identify high-risk areas but local survey important
- Evaluating in-line ditch mitigation measures (*SENSUS* project)

Site Selection: Deel catchment

- Upper Deel AFA
- LAWPRO lead for restoration
- Moderate EPA WFD status (2016-21)

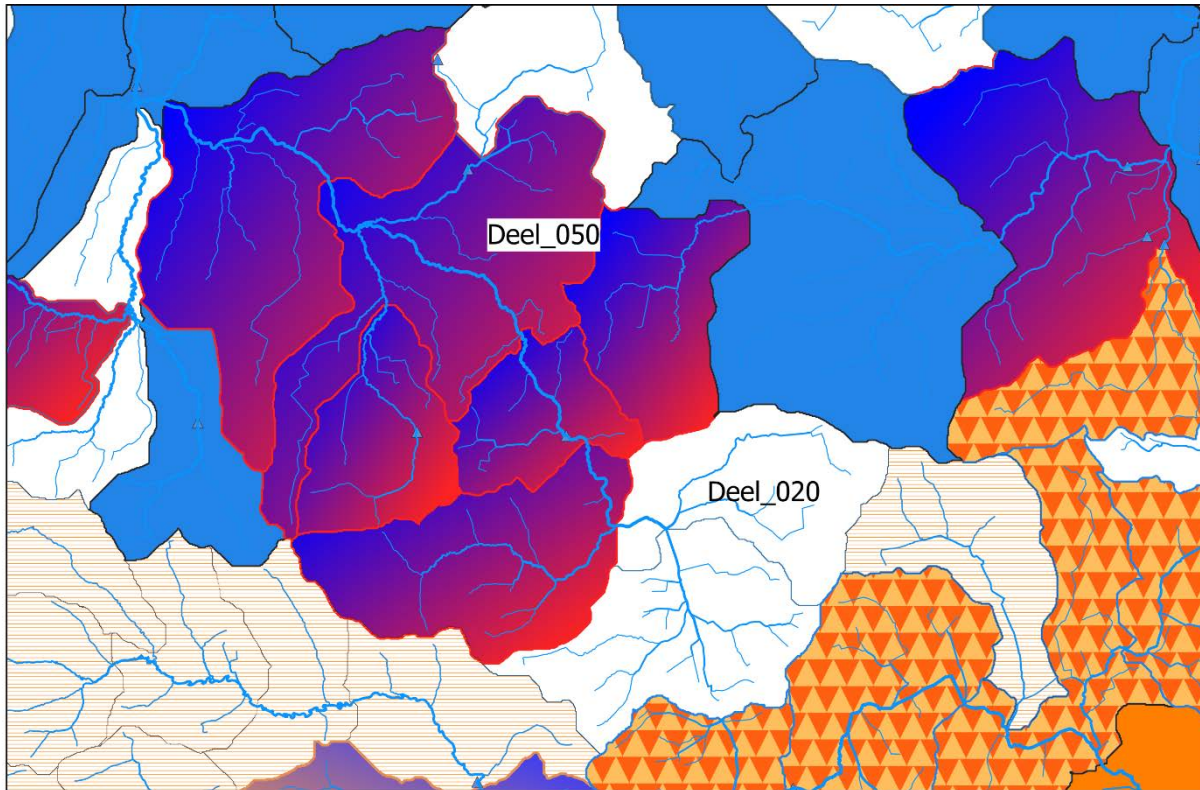
Monitoring WFD Status

- Bad
- Good
- High
- Moderate
- Poor
- Unclassified
- ▲ Flow Gauges



0 2.5 5 km

Site Selection: Targeting Agricultural Measures (TAM)



- TAM_Download
- Navy & Orange Flags - phosphorus/sediment and nitrate losses
 - Navy & Red Flags - point source and phosphorus/sediment losses
 - Navy Flag - phosphorus/sediment losses
 - Navy, Red & Orange Flags - point source, nitrate and phosphorus/sediment losses
 - Orange Flag - risk of nitrate losses (review PIP-N)
 - Orange Priority Flag - high nitrate
 - White Flag - Protect measures



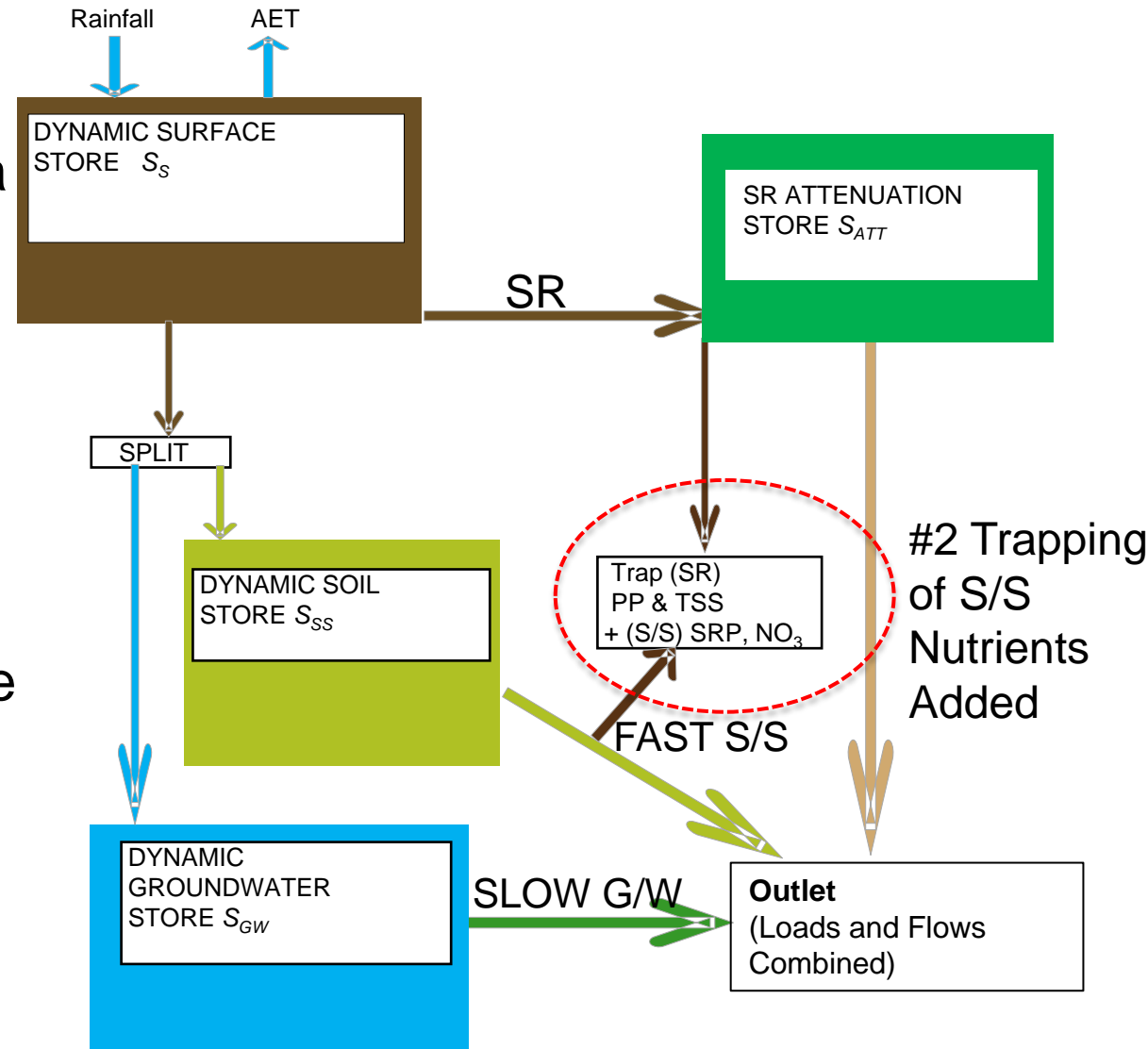
Modelling Strategy

- Most water quality models (e.g. SWAT, HYPE) run on a daily timestep, partly for historical reasons, or due to data limitations (pre *circa* 2010)
- We have over 14 years of sub-hourly monitoring data. This is ideal for modelling baseline conditions and mitigation options on an hourly timestep
- Water quality models generally represent “Nature Based Solutions” (NBS) using simplistic relationships to trap nutrients and sediments
- Model: (i) In-stream measures (i.e. “on-line” or “in-line”), or (ii) sedimentation ponds & wetlands (“Off-line”) which have more sophisticated modelling needs
- M4W will review suitable model options, and choose the most appropriate depending on data availability etc

Catchment Runoff Attenuation Flux Tool (CRAFT)

Overview of Model

- Flow and nutrient pathways informed by the data
- Lumped model with constant C_s in Fast S/S and Slow G/W Pathways, C vs. Q in SR (linear)
- Each store has: $Q_i = k \times S_i$ ($i = S/S, G/W$ or ATT)
The drainage rate can be slowed ($\downarrow k$)
- Attenuation can be added to SR pathway, representing adding (S_{ATT}) storage (*on-line or offline*)
For multiple features this is an *aggregate* storage
- The model can simulate removing sediment and particulate nutrients by trapping: *e.g. buffer strips, ponds*
- Developments (2024) Variable Removal Efficiency, Mitigation of fast S/S pathway added (*interception of field drains by smart buffers*)



Conclusions

- The project is still in its first year and the team has completed some initial site selection work in 3 areas of Ireland
- M4W will align closely with the programme of measures (43) adopted by WaterEIP although there is scope to evaluate “bespoke” measures such as water retention features
- A website will be developed, this will be used to disseminate the findings along with social media. Watch this space!