PROWATER – Pilot Action Plan
Little Stour and Nailbourne
The Little Stour and Nailbourne are an example of the globally rare chalk streams found in the South East of England, and one of 3 PROWATER pilot catchments.

While the Nailbourne is an ephemeral stream, the Little Stour carries flow at all times. Abstraction (for public water supply, industry and agriculture) beyond sustainable levels leads to these rivers running low more regularly than they should. They are also impacted by diffuse pollution from agriculture, sewage treatment and septic tanks. This has led to the Little Stour, Nailbourne and neighbouring Wingham being classified as ‘poor’ under the Water Framework Directive, and issues with the quality of drinking water supply. The groundwater body that feeds the Little Stour and Nailbourne, the East Kent Chalk, is also in poor condition due to abstraction, pollution from poor nutrient, soil and livestock management, and sewage treatment. The area can also suffer from groundwater flooding.

Chalk grassland, a habitat valued for its high biodiversity, is found in the catchment. At the bottom of the Stour catchment is Sandwich and Pegwell Bay National Nature Reserve, which are impacted by eutrophication.

Average annual rainfall in the catchment is 740 mm, of which 316 mm contribute to groundwater recharge and river flow. Climate change will bring more intense summer storms, overall reduced summer rainfall and a shorter recharge period, increasing vulnerability of the groundwater body to shorter droughts and pollution.

PROWATER aims to protect the availability of water resources and their quality through implementing nature-based solutions such as habitat conversion, soil management and wetland restoration at a catchment wide scale. These measures respond to pressures from land use and climate change and create a more resilient catchment.
Understanding our natural assets:
Soils, habitats and topography are key influences on water resources.

Geology & Soils

Underlying the catchment is the East Kent Chalk. Chalk aquifers are important sources of drinking water. Water moves through the East Kent Chalk from the South West towards the North East, meaning that areas SW of abstractions influence the quantity and quality of water reaching the abstraction point.

Soil type and texture influences how fast and how much water reaches the bedrock. Heavier soils slow and filter water, while shallow, permeable soils infiltrate faster. Between the soil on the surface and the chalk bedrock, impermeable layers limit drainage into the chalk. On the edges of these layers, however, infiltration can be increased. Erosion and surface capping, as well as loss of organic matter, can reduce the ability of soils to retain water, with negative impacts on water resources and drought resilience.

Landcover

Vegetation influences how much water reaches the ground and is taken up again by roots without reaching the groundwater. It can also improve water quality by taking up nutrients and other potential pollutants. Root systems help infiltration and remediate compaction (which could reduce recharge).

A large proportion of the catchment is arable (48%), which can be intensively cultivated and increase risk of soil degradation and diffuse pollution of water systems from fertilizer and pesticides. Arable land can contribute significantly to recharge due to the shallow root systems of crops that take up little water. However, it is important that soils are protected in the winter and nutrients don’t leach out. This can be achieved with cover crops and good soil management. Woodland (9.2%) is mainly found on impermeable areas. Natural grasslands, an important asset to water resources as they protect the soil, have little nutrient input and a high biodiversity value, cover less than 4% of the area.

Topography

How water moves through the landscape is strongly influenced by topography. A spatial targeting tool developed by the University of Antwerp identifies areas where different processes are likely to dominate this movement on the surface. The map shows areas most suitable for the infiltration, attenuation and retention of water, based on their location in the landscape. Additionally, surface water flow models are used to target opportunities for intercepting overland flow that can occur in heavy rainfall or as a result of soil sealing or degradation. Different measures to enhance or restore the natural function can then be investigated on the ground. For example, soil management may be most important in infiltration areas, while swales may be suitable to attenuation areas. However, it is crucial to view this in the context of soils, vegetation and groundwater catchments.

Above: Soils, slope, groundwater catchments and groundwater vulnerability.
Looking across the catchment, some areas can be identified as higher priority for protecting water resources.

We have identified these areas by accounting for the following factors:

- Hydrogeology (highly productive aquifer = high)
- Soil texture (permeable = high)
- Groundwater vulnerability (vulnerable = high)
- Soil depth (shallow = high)
- Soil organic carbon (high carbon = high)
- Erosion risk (high erosion risk = high)
- Land cover (grasslands = high)
- Protected habitats (present = high)
- Location related to abstraction (within SPZ 1-2 or near non-PWS abstraction = high)

The higher the number of criteria fulfilled, the higher the priority of the area.

A 50 m² grid was applied to the area and criteria assessed on a 3 point scale if they indicated high/low priority (e.g. soil carbon) or simply by their presence/absence (e.g. protected habitats). The highest ranking areas are shown on the map and their areas summarised below:

<table>
<thead>
<tr>
<th>Priority Ranking</th>
<th>km²</th>
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<tbody>
<tr>
<td>Very High (22-25)</td>
<td>11</td>
</tr>
<tr>
<td>High (18-21)</td>
<td>67</td>
</tr>
<tr>
<td>Medium (13-17)</td>
<td>21</td>
</tr>
</tbody>
</table>
Opportunities for protecting and restoring raw water sources - in practice.

To trial the impact of ecosystem-based adaptation measures and understand how they fit in the landscape, a number of measures are suggested on a demonstration farm. The farm was selected based on the criteria set out before (see supporting evidence next page, and location within the catchment). It is currently managed as an equestrian farm, a common land use that is not often engaged on best management practices.

Design and delivery of measures in close collaboration with the landowner will provide a focal site for further engagement and demonstrate how common issues on the ground can be addressed with benefits to the landowner, water resources and the environment overall.

The measures include:

- **Creation of attenuation features**
  - A swale to capture runoff from the track and in extreme rainfall events in a delayed infiltration area with additional protection through planting
  - An infiltration pond in a retention area to store runoff and provide additional treatment

- **Change in soil management**
  - Measures to increase infiltration through mechanical management (9.6 ha) on shallow soils over chalk to protect recharge and improve organic matter
  - Measures to address compaction through pasture species changes (1.7 ha) to deeper rooting species providing stronger root systems and protecting infiltration capacity and soil health

These measures will be implemented and monitored as part of the project until 2022. This will help quantify their contribution to groundwater and inform their future delivery across the rest of the catchment.

Improving soil condition from poor...  ...

... to good...

...could provide water for up to 40 people!

2.220 m$^3$ of rain infiltrate over 1ha severe compaction

+2.220 m$^3$

4.440 m$^3$ of rain infiltrate over 1ha under good management

Based ET for grassland habitat$^1$, loss of infiltration capacity due to soil degradation of 50%$^3$, and per capita consumption of 151l/day
Demonstration site: supporting evidence

Large parts of the demonstration farm lie in Source Protection Zone 1, indicating a short travel time of water draining on the land to the existing borehole for public water supply. All fields are also highly likely to contain solution features, enabling rapid groundwater recharge but high risk of contamination if a pollution source is present.

Additionally, Surface Water Flood Risk of a 3.3% annual chance is indicated around farm buildings in the valley. Road runoff contributes significantly to this issue according to the landowner.

Most soils are shown to be shallow lime rich soils over chalk, with clay deposits on the hill tops giving rise to slightly acidic soils with impeded drainage (Cranfield Soilscape). This can contribute to runoff onto the chalk slopes creating solution features, which allow rapid groundwater recharge.

Topographic modelling by the University of Antwerp indicates green infiltration/attenuation areas and blue retention areas. On chalk, this model is flawed as it assumes slower drainage, but is able to give an indication of microtopography that can help target areas of particular importance to drainage, where soils may be protected more easily from degradation or infiltration should be increased.

Surface water flow paths (shown in purple) additionally indicate opportunities to intersect runoff when it occurs, for example from the impermeable deposits, road, or in a heavy storm.
PROWATER is an Interrreg2Seas project funded by the European Regional Development Fund. It runs from 2019 to 2022. Delivery organisations in South East England are the South East Rivers Trust, South East Water and Kent County Council. The main aim of the project is to create resilience of water resource to climate change through ecosystem based adaptation at the landscape scale.

Find out more at: pro-water.eu

References:
1 – Catchment Data Explorer Environment Agency & Environment Agency
2 – The Chalk Aquifer of the North Downs, BGS 2008
3 - Estimating the impact of rural land management changes on catchment runoff generation in England and Wales, Hess et al 2010