Dorset
Area of Outstanding Natural Beauty

State of the River Asker

03/01/2019

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This project was delivered by a partnership of the Dorset Area of Outstanding Natural Beauty, Dorset Coast Forum, Dorset Wildlife Trust and Farming and Wildlife Advisory Group SouthWest on behalf of the Dorset Governance Group, and in conjunction with residents of Loders, Uploders and Askerswell.

Report version: FINAL

Date: 03/01/2019

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INTRODUCTION

Project background

Over the winter of 2014-2015, a small project was commissioned by the Dorset Governance Group (leading on the Catchment Based Approach in Dorset[1]) to research the main water quality issues faced by local people and organisations within the West Dorset Rivers & Coastal Streams Operational Catchment. The project was also asked to scope a model for delivery of the catchment based approach that was appropriate for the area. This project was delivered by a partnership of the Dorset Area of Outstanding Natural Beauty (AONB), Dorset Coast Forum (DCF), Dorset Wildlife Trust (DWT) and Farming and Wildlife Advisory Group SouthWest (FWAG).

Based on the findings of the report, which analysed participants responses to questions about water quality issues and the Catchment Based Approach in the area, a clear alternative to the traditional catchment partnership was identified that focussed on delivery at a community level in tandem with a local approach to tackling diffuse pollution based on Catchment Sensitive Farming. The Dorset Governance Group have allocated a trial of this this approach with the communities along the River Asker.

Project area

The River Asker rises under Eggardon Hill, in West Dorset, at the meeting between greensand and mudstone and flows over these calcareous mudstones, limestones and sandstones west to Bradpole where it meets the Mangerton Brook (see Figure 1 for a location map). The catchment is predominantly agricultural and the farming is mixed, with dairy units and their associated permanent and temporary grassland along with maize as well as some arable. The principle settlements within the area of interest are Askerswell, Uploders and Loders.

The length of the main river is approximately 12km with another 12km of tributaries. The catchment area is approximately 18km^2.

The entire catchment is in the Dorset Area of Outstanding Natural Beauty.

[1] www.catchmentbasedapproach.org/

Why the Asker?

The Environment Agency monitor river water quality and classify it as one of five categories, with 'High' as largely undisturbed conditions progressing through 'Good', 'Moderate', 'Poor' and finally 'Bad', which represents a significant deviation from an undisturbed system. The River has been classified as 'Poor' by the Environment Agency because the fish species diversity and aquatic plant diversity is below that expected of a river of this type. The main pressures causing the plant failure are uncertain but could be nutrients: nitrates and phosphates, likely to be from agricultural sources and riparian shade. The main pressures causing the fish failure is likely to be barriers to movement. There is an ambition by the Environment Agency to improve the condition of the Asker to 'Good' by 2021.

The Environment Agency have classified other elements of the water quality as 'Good' or 'High'. These include the following specific elements:

- Invertebrates: ....High
- Ammonia:..................................High
- Biological Oxygen Demand: ....High
- Dissolved oxygen: ....High
- pH: ....High
- Phosphate:.................................Good
- Temperature: ....High
- Hydrological regime: ....Good
- Morphology: ....Good

The findings of the Environment Agency are backed up by the research undertaken in 2014/15, where these were the main threats identified by the 34 contributors:

- Invasive species
- Diffuse agricultural pollution
- Point source pollution
- Habitat degradation
- Sediment runoff
- Flooding
- Low flows

These issues, along with interest from the communities of Loders, Uploders and Askerswell, combine to make the River Asker a high priority for action.

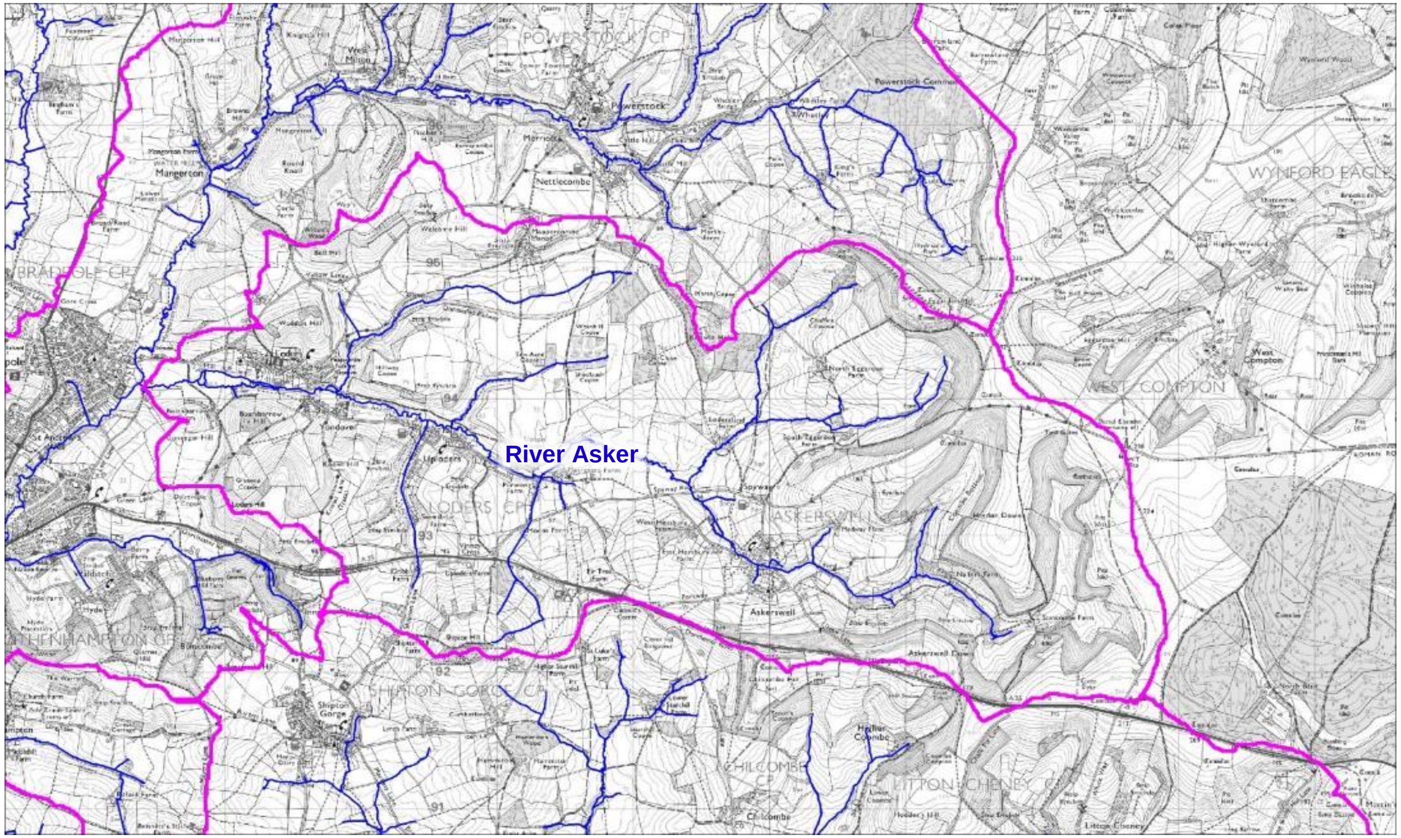

Figure 1: Map of the River Asker

Key

River

Catchment boundary

Project outline

Over the course of 2018, the communities along the River Asker will come together, with the support of the Dorset AONB, DWT, FWAG and DCF, to improve the quality of the River Asker. It is anticipated that over the course of the year, the project will follow some key milestones. These are described below:

Community engagement

An article on the Colmers and Eggardon View will call for people's recollection of the river, to help build up a picture of what is important to local people. Efforts to collect people's memories will continue over the course of the year, and help prioritise actions. The findings will be included in a later version of this report.

Establish working group

Following an initial consultation with Loders Parish Council and Askerswell Village Meeting, a meeting was convened on the 19th February. 17 interested residents attended to find out more about the proposal and the resources that are available over the coming year. At this meeting it was recognised that landowner representation is needed, and both FWAG and DWT have been building leads within the catchment since the meeting. It was also decided that a steering group made up of representatives of the residents, delivery partners and landowners will be needed to steer the project over the coming months. And finally, it was requested that a 'State of the Asker' report is produced that summarise what we know already and identifies options to overcome any identified problems. This is the first draft of this report.

Evidence gathering

Further information on the condition of the River Asker will be sought from the Dorset Environmental Records Centre, Environment Agency and other relevant agencies. This will be reinforced with a walk-over survey of the river, undertaken in spring and summer, that will help identify problems and potential solutions. The findings of the additional research and walk-over survey will be included in a later version of this report.

Identify, prioritise and deliver action

Following the completion of the walk-over survey, the significant risks facing the river will be set out. Some of these are likely to need addressing through direct involvement of the landowners within the catchment, and work is ongoing to make these connections. However, there will also be opportunities for community-led action, and these will be explored further and resources provided to undertake those that are the greatest priorities for the communities.

Initial planning is underway to develop an invertebrate (river-fly) monitoring scheme along the river along with work parties to tackle the Himalayan balsam problem that has already been identified.

Timescale

The timescale set-out below is our plan for the coming year:

- **Community engagement**

  On-going throughout the year, to include:
  - An article in the Colmers and Eggardon View
  - An event to promote the findings of the report in December 2018
  - Engagement with Loders School.

- **Establish a working group**
  - Established:.....................April 2018

- **Evidence gathering**
  - Draft report: ....April 2018
  - Walk-over survey:............June / July 2018
  - Final report: ....Autumn 2018

- **Identify, prioritise and deliver action**
  - Identify actions: ....Autumn 2018
  - Deliver: ....Winter onwards

CATCHMENT DESCRIPTION

Geology

Considering the small size of the catchment, there is a wide range rock types, which impart particular properties on the River Asker. The rock types are described below and illustrated in Figure 2.

Starting in the east, under Eggardon Hill, the bedrock is chalk. This rock is made up of tiny calcareous skeletons of organisms called coccolithophores which makes the rock porous, with the ability to hold significant amounts of water, like a sponge. It was laid down in warm, shallow seas about 90-100 million years ago, during the cretaceous period. The chalk is the youngest rock within the catchment, meaning that it has been eroded to expose the older rocks below. Chalk covers approximately 25% of the catchment area, and gives rise to the important calcareous grassland habitat present as well as providing a stable flow of calcium -rich water into the river. This stable flow of temperature-constant water from chalk provides the perfect conditions for plants, insects and fish to thrive. 'Chalk streams[2]' are almost unique to southern England and are therefore considered globally rare habitats. Because the Asker quickly flows over a succession of other rock types, it is not considered a 'classic' chalk stream - such as the River Avon in Wiltshire - but none-the-less it is of importance for wildlife because of these characteristics.

Moving westward the next rock in the sequence is sandstone, laid down between 110-110 million years ago. This rock is less porous than the chalk above it, and therefore the water that was stored in the chalk is forced out and forms the headwaters of the River Asker. This type of sandstone is thought to naturally release nutrients into rivers and can make things more complicated when identifying sources of pollutants. The sandstone covers approximately 17% of the catchment area.

Flowing westwards, the river next passes over a mudstone laid down between 165-170 million years ago and makes up 29% of the catchment area. The river next flows over a mix of mudstones and limestones from the Inferior Oolite Group and Lias Group. These were laid down between and 200-210 million years ago and make up approximately 30% of the catchment area. Vinney Cross Local Geological Site is a fossiliferous exposure of the Inferior Oolite[3].

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[2] http://assets.wwf.org.uk/downloads/wwf_chalkstreamreport_final_lr.pdf

[3] https://www.dorsetrigs.org/wp-content/uploads/2013/03/DIGS-Vinney-Cross.pdf

As the river moves over the 59% of the catchment made up of mudstones, the character will change from that of a chalk stream. These impermeable rocks will no longer absorb rain fall and release it slowly, like the chalk and sandstone, but will force rainwater to flow over land, therefore making the river much quicker to react to rainfall events, increasing the likelihood of flooding. Overland runoff will also erode more soils, leading to increased sedimentation within the river.

In summary, the differing geologies of the Asker catchment impart different properties on the river. In the east, with the chalk and sandstone, the river will display rare chalk stream characteristics. Moving westwards over the mudstones, it becomes more typical of other English lowland rivers, reacting quickly to rainfall events and becoming muddy (or turbid).

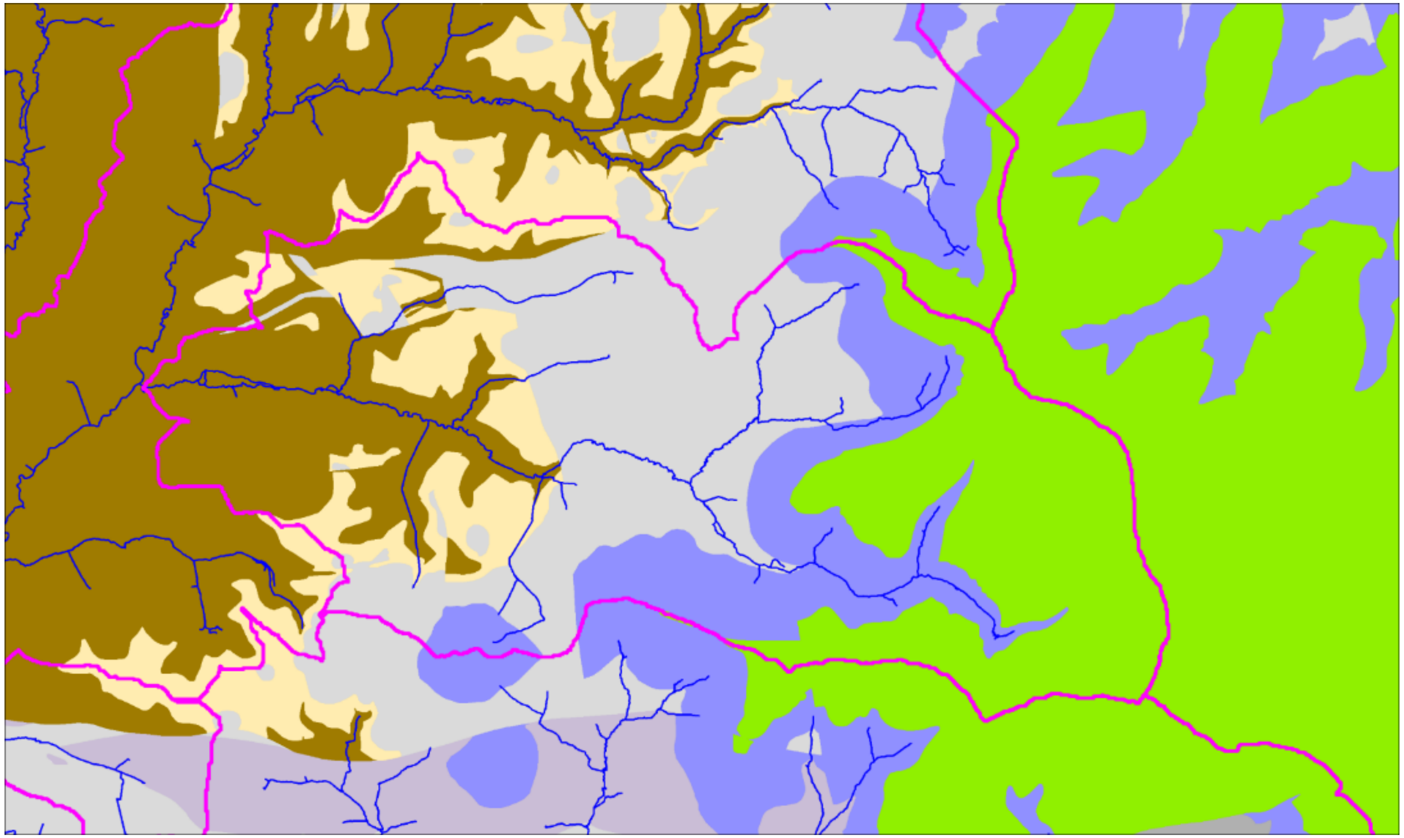


Figure 2: Geology of the River Asker catchment

Key

- River
- Catchment boundary
- Chalk (Holywell Chalk Nodular Formation)
- Sandstone (Upper Greensand Formation)
- Mudstone (Forest Marble Formation)
- Mudstone and limestone interbedded: Inferior Oolite Group
- Mudstone and limestone interbedded: Lias Group

Soils and Agricultural Land Classification

Moving east to west along the course of the River Asker, the following soil types are encountered. They are closely linked to the underlying geology. There are no freely-available maps of soil types. The information provided below has been sourced from Soilscapes, provided by the Cranfield Soil and Agrifood Institute[4].

Shallow lime-rich freely draining soils over chalk or limestone (Soilscape 3). This soil type support herb-rich downland and limestone pastures, beech hangers and other lime-rich woodlands. It is suited to spring and autumn cereals but the soils are especially vulnerable to nitrate leaching and attract stricter fertiliser limits. Lack of soil moisture due to the free draining nature of the soil is most likely a limiting factor to yields. The soil is particularly vulnerable to leaching of nitrate and pesticides to groundwater; surface capping and erosion of chalk soils on steeper slopes under cereals is linked with eutrophication and silting of chalk streams and their gravel trout spawning beds. This soil type falls mostly within Agricultural Land Classification (ALC) 3.

Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (Soilscape 18). This soil type supports seasonally wet pastures and woodlands. It is suited to grass production for dairying or beef; some cereal production often for feed. Timeliness of stocking and fieldwork is important, and wet ground conditions should be avoided at the beginning and end of the growing season to avoid damage to soil structure. Land is tile drained and periodic moling or subsoiling will assist drainage. The main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water. This soil type falls mostly within ALC 4 and 5.

Lime-rich loamy and clayey soils with impeded drainage (Soilscape 9). This soil type supports base-rich pastures; some wetter areas and lime-rich flush vegetation. It is suited to autumn sown crops and grass but shortage of soil moisture can restrict yield, and timeliness with field work is important to avoid structural damage, particularly in spring. Land is drained and nitrate vulnerable with potential for rapid pollutant transport. Surface capping can trigger sheet erosion of fine sediment to stream networks. This soil type falls mostly within ALC 3.

Freely draining slightly acid loamy soils (Soilscape 6). This soil type supports neutral and acid pastures and deciduous woodlands. It is suited to a range of spring and autumn sown crops; under grass the soils have a long grazing season. Free drainage reduces the risk of soil damage from grazing animals or

[4] Soils Data © Cranfield University (NSRI) used with permission http://www.landis.org.uk/soilscapes/

farm machinery. Shortage of soil moisture is most likely a limiting factor on yields, particularly where stony or shallow. Groundwater contamination with nitrates, siltation and nutrient enrichment of streams from soil erosion on certain of these soils. This soil type falls mostly within ALC 3.

Figure 3 shows how these soils have been classified under the Agricultural Land Classification. 70% of the catchment is classed as Grade 3, with most of the remainder Grade 4 and 5. Only 1% of Grade 2 is present in the south west of the catchment. ALC provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use.

In summary, the variable nature in soils mirror the underlying geology and have the potential for different impacts on the River Asker as it flows westwards through its catchment.

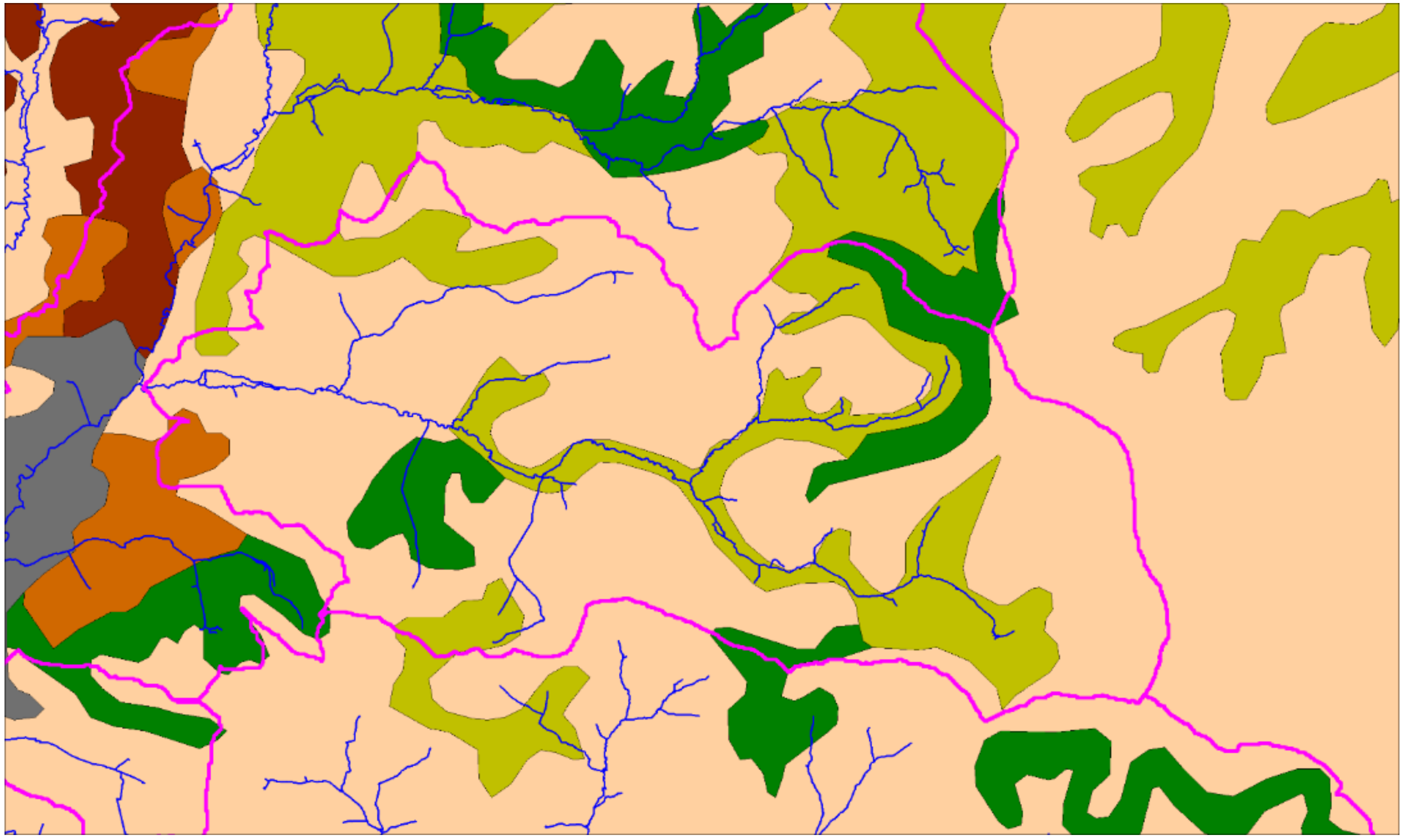


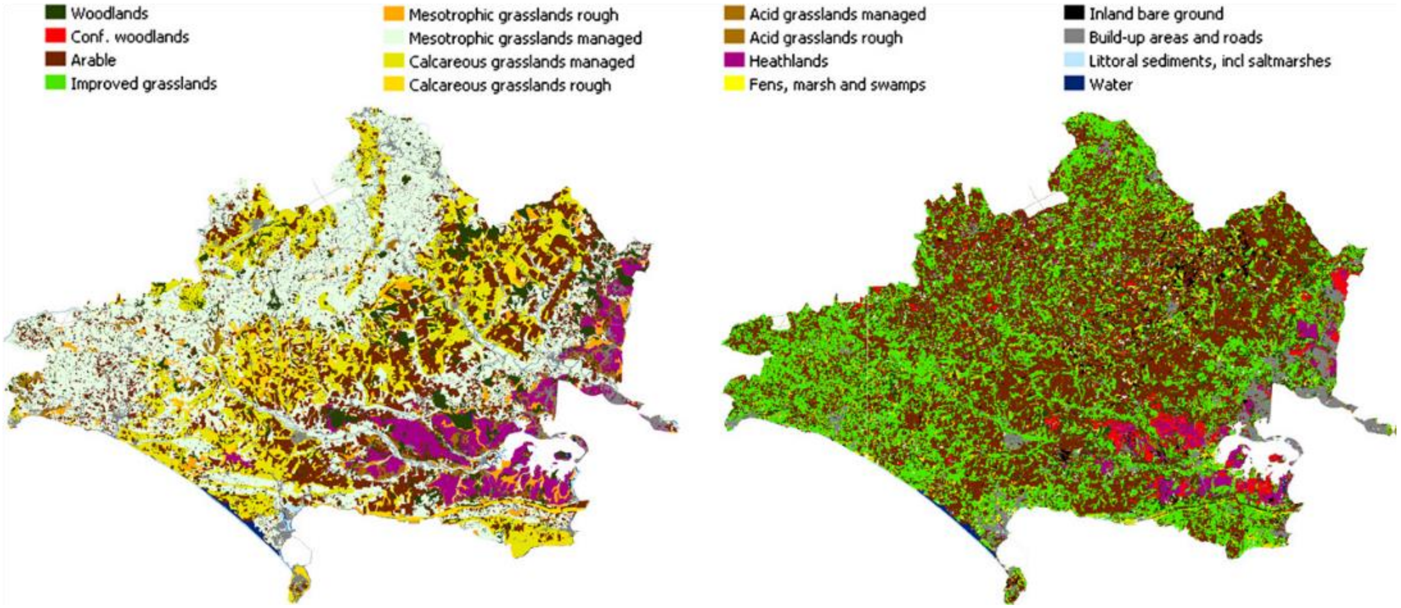
Figure 3: Agricultural land classification of the River Asker catchment

Key

- River
- Catchment boundary
- Grade 1 - Excellent agricultural land
- Grade 2 - Very good
- Grade 3 - Good to moderate
- Grade 4 - Poor
- Grade 5 - Very poor agricultural land
- Urban

Land use

The geology and soils of the Asker catchment has strongly influenced how this land has been used. Where it is fertile and accessible to farm machinery, it may be used for arable crops or intensive grass for dairy or beef. Where the soil is less fertile or the land too steep or waterlogged, then it may be more extensively used, leaving fragments of semi-natural habitats. This fragmentation of semi-natural habitat has increased greatly since the Second World War because of improved capability of farm machinery and techniques that make farming marginal land economically viable. This was driven by an increasing population and subsequent higher demand for food. As a result, over 97% of all semi-natural habitats mapped in Dorset in the 1930s have been converted to agriculturally-improved arable or grassland, as shown in Figure 4. This will have knock-on impacts on the water quality of the River Asker, with increased contamination of sediments and nutrients from agriculture along with increased isolation of the semi-natural habitat the exists along the river corridor.



A **B**

Figure 4: Land use change between 1930s and 2000 in Dorset

Habitat maps of Dorset indicating 15 Broad Habitats for:

A: 1930s, based on Dudley Stamp maps combined with the UK National Soil map; and
B: in 2000 from the Land Cover Map.

Looking in a bit more detail at the land use of the Asker catchment, we can split it down into a number of categories that are described below. The figures are derived from a study undertaken in 2012 that mapped land use in the Dorset AONB from aerial photography and satellite images. Intensive land use is also mapped in Figure 5 and Extensive land use is mapped in Figure 6.

Intensive land use

Improved grassland covers 39% of the catchment area and will predominantly be used to support dairy cows. The grassland will be planted 'leys' dominated with grass species, such as ryegrass, possibly with clovers. that are periodically ploughed up and replanted. To maintain their condition, they will be treated with nitrates and phosphates several times during the growing season.

Arable covers 25% of the catchment area. This will include several crop types grown within the catchment, grown in rotation along with maize which is grown as a fodder crop to support dairy production. Winter cereals and maize are high risk crops with regards to soil erosion, because bare soil is exposed at times of potential high rainfall. Good agricultural practises can mitigate these risks, by - for example - growing of cover crops that bind soils together.

In total, intensive land use covers two thirds of the catchment area and therefore has the potential to have significant effects on the water environment of the River Asker.

Extensive land use

Covering approximately the other one third of the catchment area are habitats associated with more extensive land use. The most significant of these is calcareous grassland, which covers 6%. This habitat strongly features on the steepest slopes within the catchment, at the eastern limit. Most of this grassland type within the catchment is protected by Site of Special Scientific Interest (SSSI) status; a national conservation designation. The calcareous grasslands support a very rich flora including many nationally rare and scarce species, including species such as squinancywort, common spotted-orchid, rock-rose, betony, devil's-bit and rough hawkbit are often abundant. The invertebrate fauna is also diverse and includes scarce species like the adonis blue butterfly and small blue butterfly.

On the more basic soils further west, small pockets of neutral grassland exist, but they only cover 0.5% of the catchment. The other remaining semi-natural habitat is broadleaved woodland, including wet woodland along the river corridor. This covers 6% of the catchment.

The final extensive land use category is semi-improved grassland, which cover 19% of the catchment. Semi-improved grassland is not as rich in wildlife as semi-natural grasslands such as the calcareous grassland found in the Asker catchment because it has been improved in the past to favour a grass-dominated sward. However, having not been ploughed up recently and as intensively managed, it holds great potential for restoration back to semi-natural habitat.

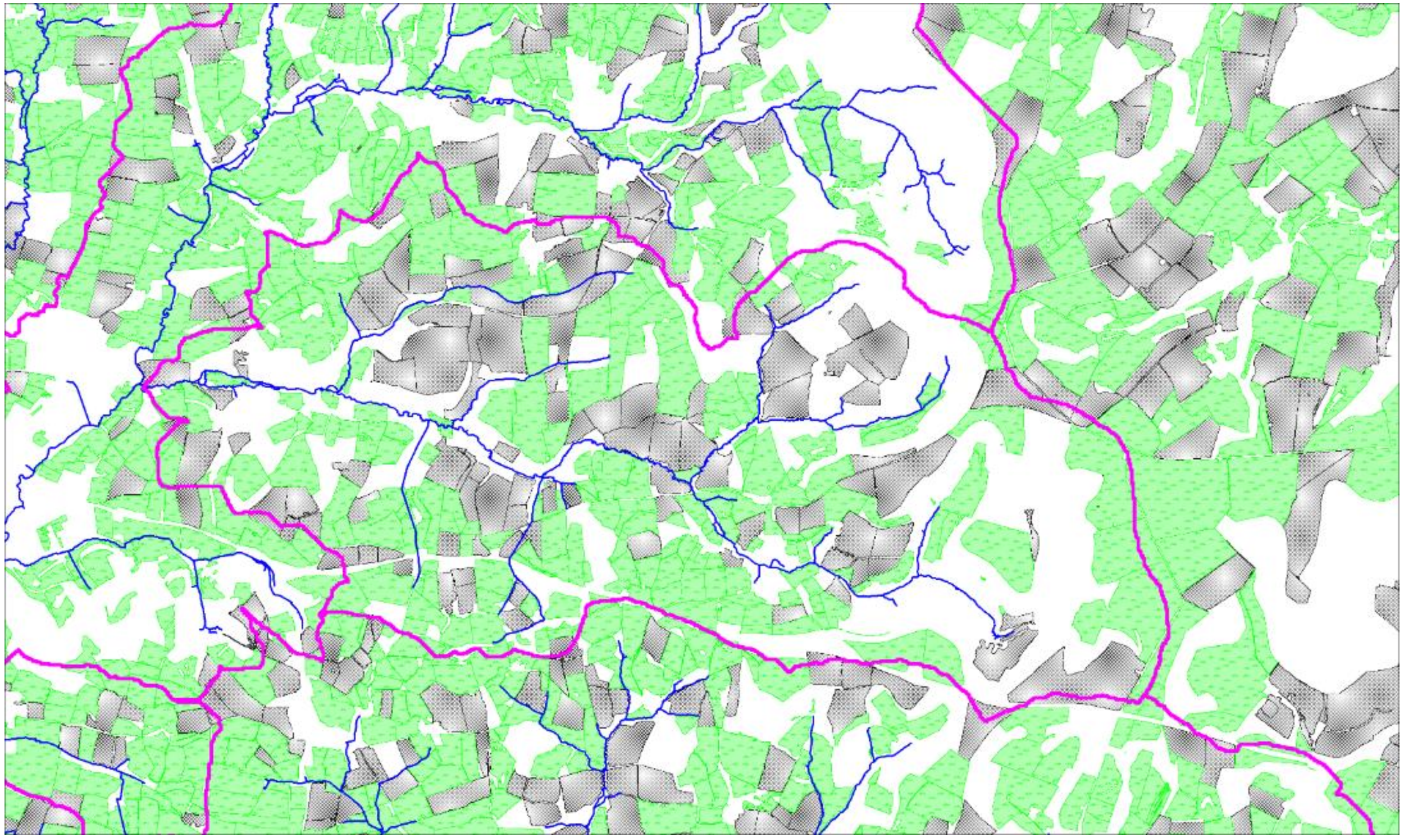


Figure 5: Intensive land use of the River Asker catchment

Key

- River
- Catchment boundary
- Arable
- Improved grass

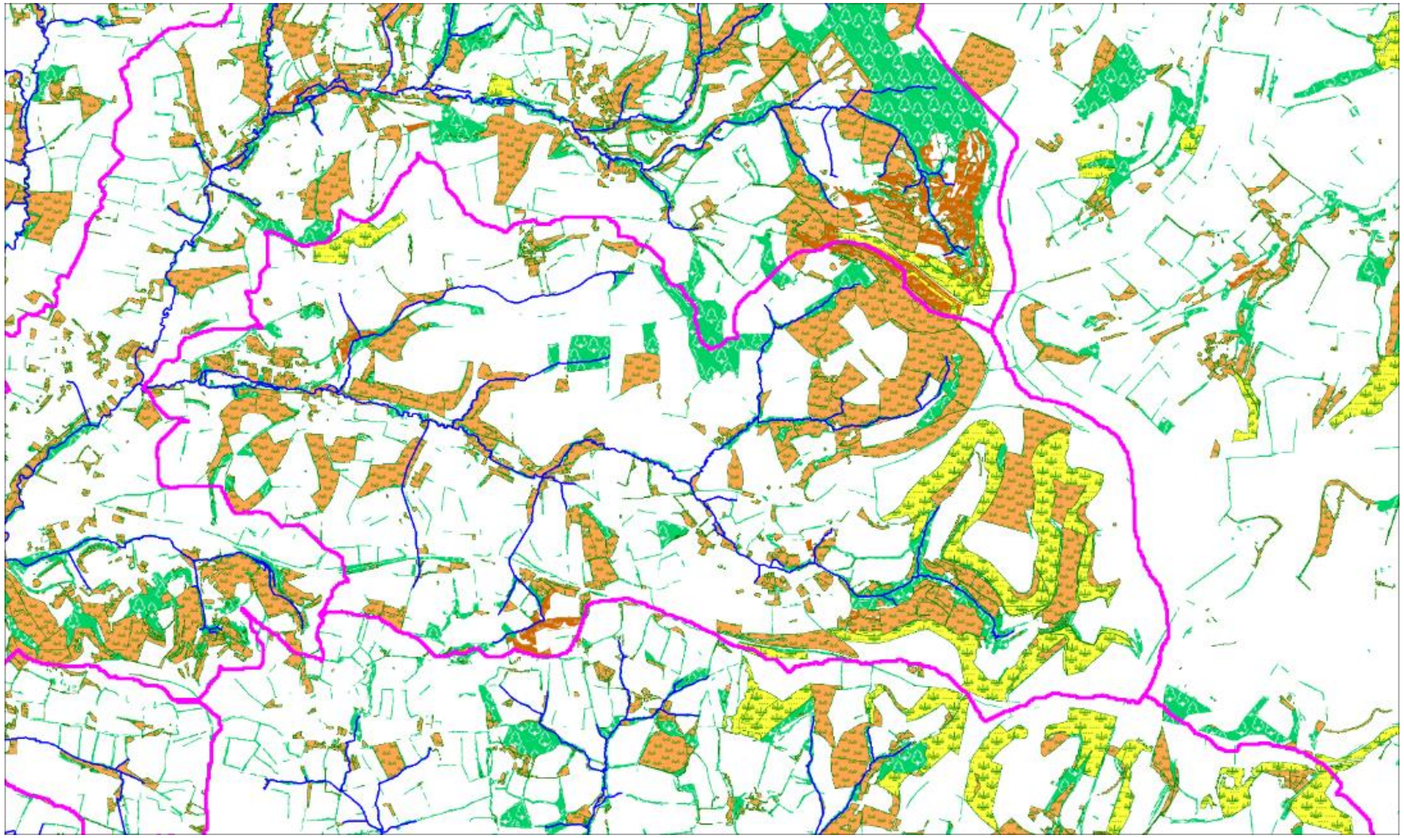


Figure 6: Extensive land use of the River Asker catchment

Key

- River
- Catchment boundary
- Calcareous grass
- Neutral grassland
- Semi-improved grass
- Broadleaved woodland

Designations and records

The semi-natural habitats and the species they support has resulted in several designations within the catchment. These are summarised in Table 1, below:

Statutory Designations or records	Location / Description	Count
National: Sites of Special Scientific Interest (SSSI)	Haydon & Askerswell Downs Approximately half of Eggardon Hill & Luccas Farm	107.4 ha c. 43 ha
Local: Sites of Nature Conservation Interest (SNCI)	6 sites, predominantly grassland and woodland	31 ha
Priority habitats	Calcareous grassland Purple moor grass Lowland meadows Lowland fens Wet woodland Other woodland	107 ha 0.75 ha 2.75 ha 0.03 ha 3.5 ha 2 ha
Local Geological Site	Vinney Cross	0.3 ha
Biological records	Plants, including undesirable species such as Japanese knotweed, ragwort & wall cotoneaster Invertebrates Reptiles Birds Mammals, including bats, otter, badger, water vole as well as sika deer and grey squirrel	117 161 2 21 120

Table 1: Environmental records and designations for the River Asker catchment.

CATCHMENT PRESSURES

Water quality

Overview

Good water quality is vital in supporting a thriving aquatic ecosystem, and there are many factors within the catchment that influence this, including the geology, soils and land use described previously. There are also many specific elements that impact water quality and these can enter the water course directly but are more likely to be transported via flow of rainwater, either overland or through the soils, rocks, roads, ditches and drains that lie within the catchment. Where they enter the river at a discrete point, it is known as 'point source pollution' and where it enters over a wide length of the river, this is known as 'diffuse pollution'.

The pollutants that impact water quality can be broadly split into five areas[5]:

- Nutrients: phosphorus & nitrogen containing compounds
- Suspended solids: including both sediment & organic material in suspension
- Pesticides: including other chemical pollutants from domestic sources
- Microbiological contaminants: including faecal coliforms & cryptosporidium
- Colour, taste & odour compounds: including metals & soluble organic compounds

The most significant elements that are likely to be encountered in a rural catchment like the Asker's are nutrients, suspended solids and pesticides, and these are described in this chapter.

A useful and cost-effective way of monitoring water quality is by using riverflies, the aquatic larval life stage of winged insects, such as mayflies, stoneflies, dragonflies and sedges. These larvae have known tolerances to certain pollutants and habitat conditions and can be modelled against what you would expect in a pristine river of a similar type and location. This indicates how far from perfect the actual conditions are. The Environment Agency have riverfly monitoring data for the Asker at Yondover. The lifecycle of the mayfly is illustrated in Figure 7.

[5] http://wrt.org.uk/project/catchment-management-evidence-review-water-quality/

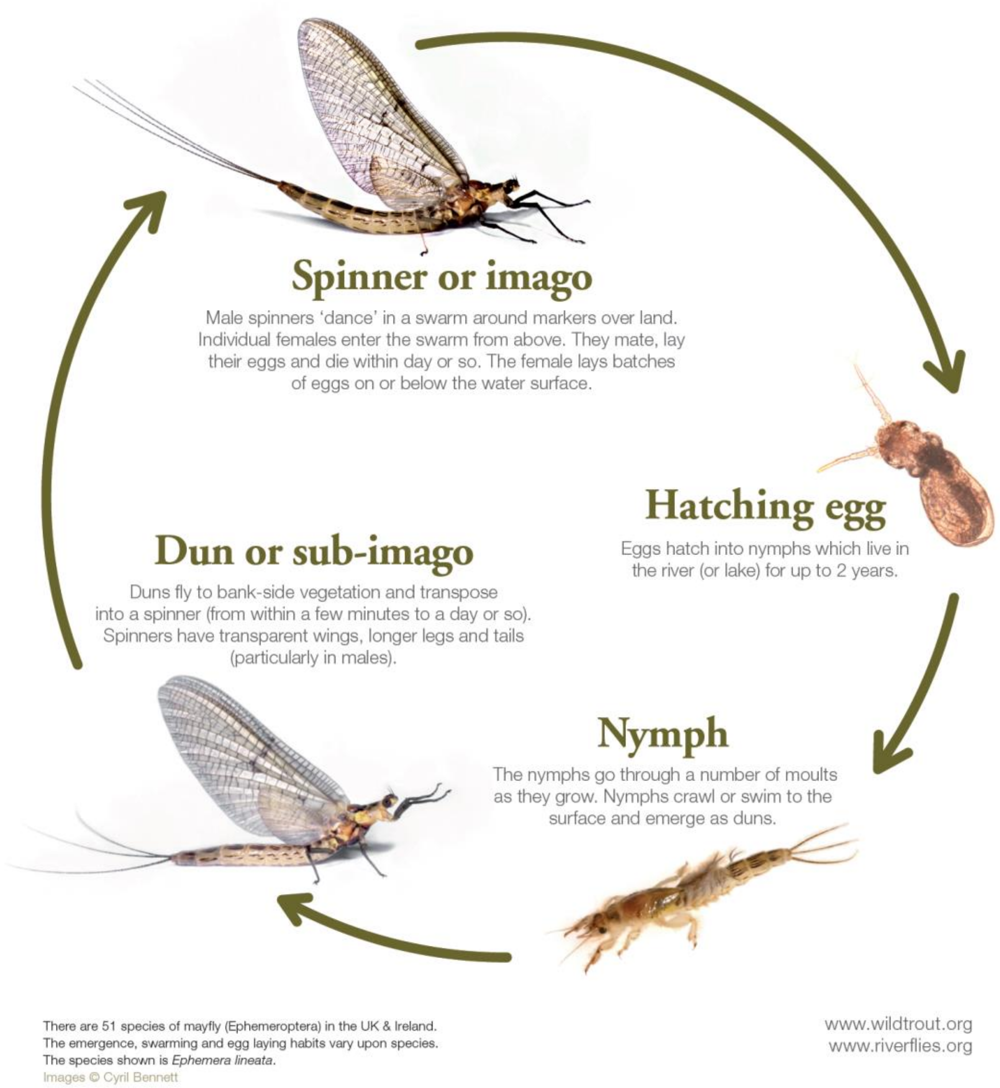


Figure 7: Life cycle of the mayfly

© Wild Trout Trust & The Riverfly Partnership

Images © Cyril Bennett

Nutrients

Phosphorous is the top reason for English rivers not achieving good ecological status. It's the main cause of eutrophication: excessive algal and plant growth which damages the ecology and quality of waters. The main sources of phosphorus in rivers are sewage effluent and run-off from agricultural land. Phosphorus levels in rivers increased from the 1950s to the early 1990s, but have been reducing since the mid-1990s. This decrease is closely associated with improvements at sewage treatment works. There are no sewage treatment works in the Asker catchment and only five licensed discharges from private residences, so the most significant source is likely to come from agricultural activity. This can be either directly from livestock or from the spreading of land with phosphate-based fertilizers, manures and slurries. Phosphate adheres strongly to soil particles and is therefore closely linked to areas of high soil erosion.

The concentrations of phosphorous found in the Asker are thought to be impacting macrophytes and phytobenthos (aquatic plants and algae).

Nitrates are applied to agricultural land to enhance crop yields. Its main impact is on the quality of water abstracted for drinking water treatment (and not ecology), and there are no licenced abstraction points in the Asker catchment. Nitrate levels in many rivers increased dramatically during two periods in the second half of the 20th Century. The first increase, during World War Two, was associated with mass conversion of land to arable farming, when extensive ploughing released nitrogen stored in the soil. The second, in the 1960s, was linked to further conversions to arable coupled with substantial increases in fertiliser use. There have been slight declines in nitrates in rivers since 2000.

The concentrations of nitrates in groundwater are high in the headwaters of the Asker and because of this, it has been classified as a 'Nitrate Vulnerable Zone for Groundwaters', which limits the amount of nitrate that can be applied to the land. The total amount varies, depending on the crop type that is being grown but is designed to limit the impact on the underlying ground water. Refer to Figure 8 for a map of the Nitrate Vulnerable Zones that partly lie within the Asker catchment.

Invertebrate monitoring of species sensitive to organic pollution at Yondover indicate that the site is high quality, with increasing numbers of pollution-sensitive species. This is illustrated in Figure 9, where the Average Score Per Tax (ASPT) score is derived as a ratio between the observed fauna over that expected at a pristine site. The closer to 1 the better.

Suspended solids

Soils eroded from the catchment, in conjunction with adhered nutrients can end up in the river, either directly from the field or via the network of connected ditches, drains and roads. Certain soil types combined with high-risk land use can result in significant erosion, for example, lighter soils on steeper slopes left exposed over winter through planting of winter-sown wheat. Suspended soil particles could cause significant damage to the ecology of the River Asker, by blocking light penetration to aquatic plants, clogging gills of fish and other aquatic organisms and by smothering the river bed, which suffocates the organisms and eggs that reside there. The impacts could be exacerbated if the width and depth of the channel has been altered by man.

The likely risk of soil erosion has been modelled, along with the hydrological connectivity to the river (if the soil is eroded but can't get in to the Asker, it is not a water quality problem, so it is essential to look at both elements; erosion risk and hydrological connectivity). Figure 10 illustrates the modelled risk (please note: the data is from GIS modelling and requires ground truthing before these maps can be finalised). Invertebrate monitoring of silt-tolerant species indicates that the River Asker has in the past been moderately sedimented, but has improved and is now slightly sedimented, as shown in Figure 11[6].

Pesticides

Pesticides applied to agricultural land, like nutrients, can end up in the watercourse if they are misapplied or washed off the land surface. By their very nature, they are harmful to plants and insects, as well as other target groups. The threat is dependent on the properties of the pesticide used, and include half-life, mobility and solubility as well as extrinsic factors such as rainfall, wind and application rate. Current high-profile concerns include neonicotinoid insecticides and metaldehyde molluscicide.

Monitoring of invertebrates can be used to indicate the severity of pesticide pollution[7]. This has been analysed for the River Asker and shows that there has been a moderate impact in the past, but the situation has improved and now there is little impact on the invertebrate assemblages from pesticides. This is shown in Figure 12.

Other

Other elements that are likely to impact water quality include temperature, pH, Biochemical Oxygen Demand. These are not thought to be specific threat to the ecology of the Asker.

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[6] https://onlinelibrary.wiley.com/doi/abs/10.1002/rra.1569

[7] https://www.gov.uk/government/publications/freshwater-biological-indicators-of-pesticide-contamination

Combined

The Number of Scoring Taxa (NTaxa) index provides an overview of the state of the waterbody, as it reflects multiple pressures. Individually, as described above, the condition of the Asker is High. However, the Ntaxa data shows that the combined pressures are having an impact and the condition of the River Asker has declined slightly since 2012. It still passes Environment Agency criteria but does mean that more can be done to improve the state of the river. This is shown in Figure 13. The Ntaxa score is derived as a ratio between the observed fauna over that expected at a pristine site. The closer to 1 the better.

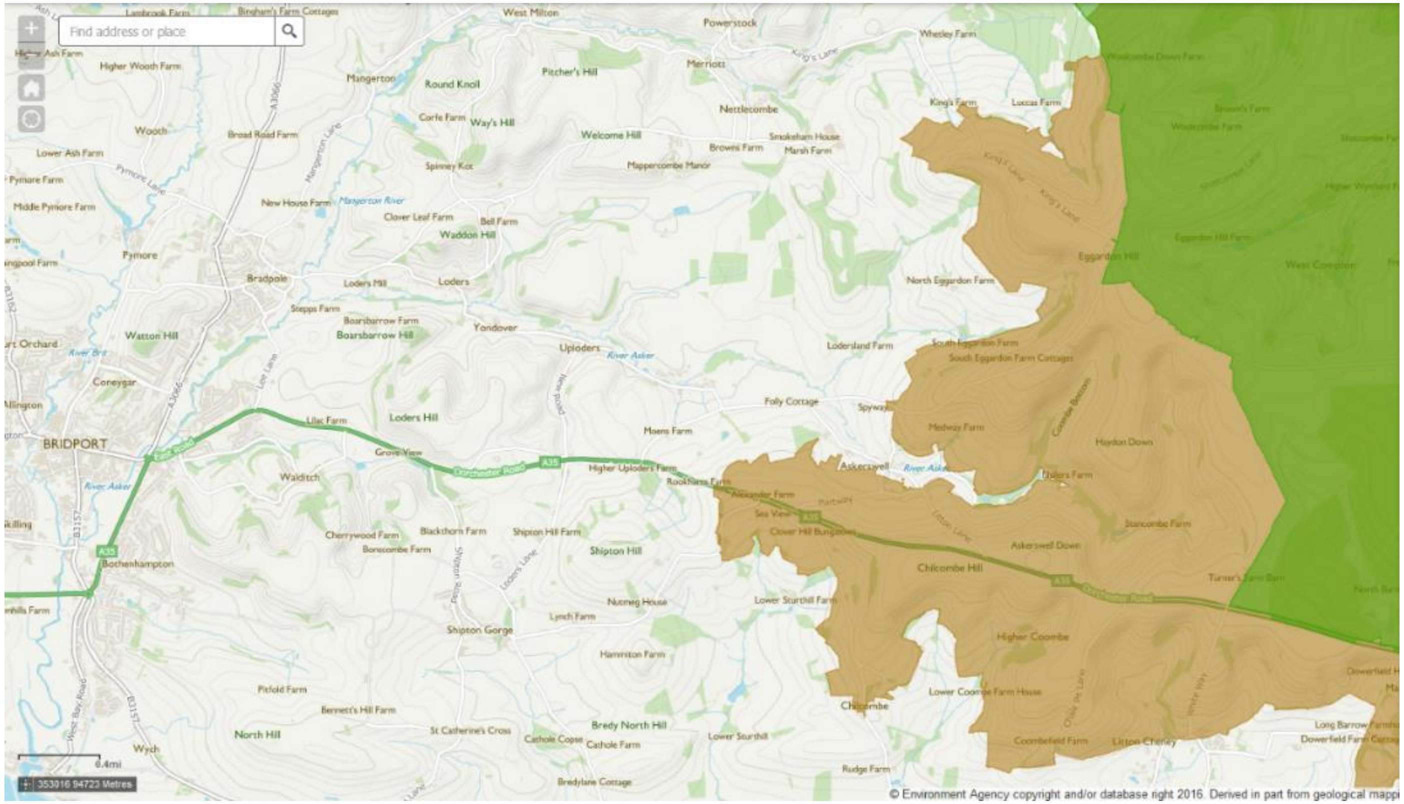


Figure 8: Nitrate Vulnerable Zones in the River Asker catchment

Key

Nitrate Vulnerable Zone (groundwater)

Nitrate Vulnerable Zone (eutrophic waters)

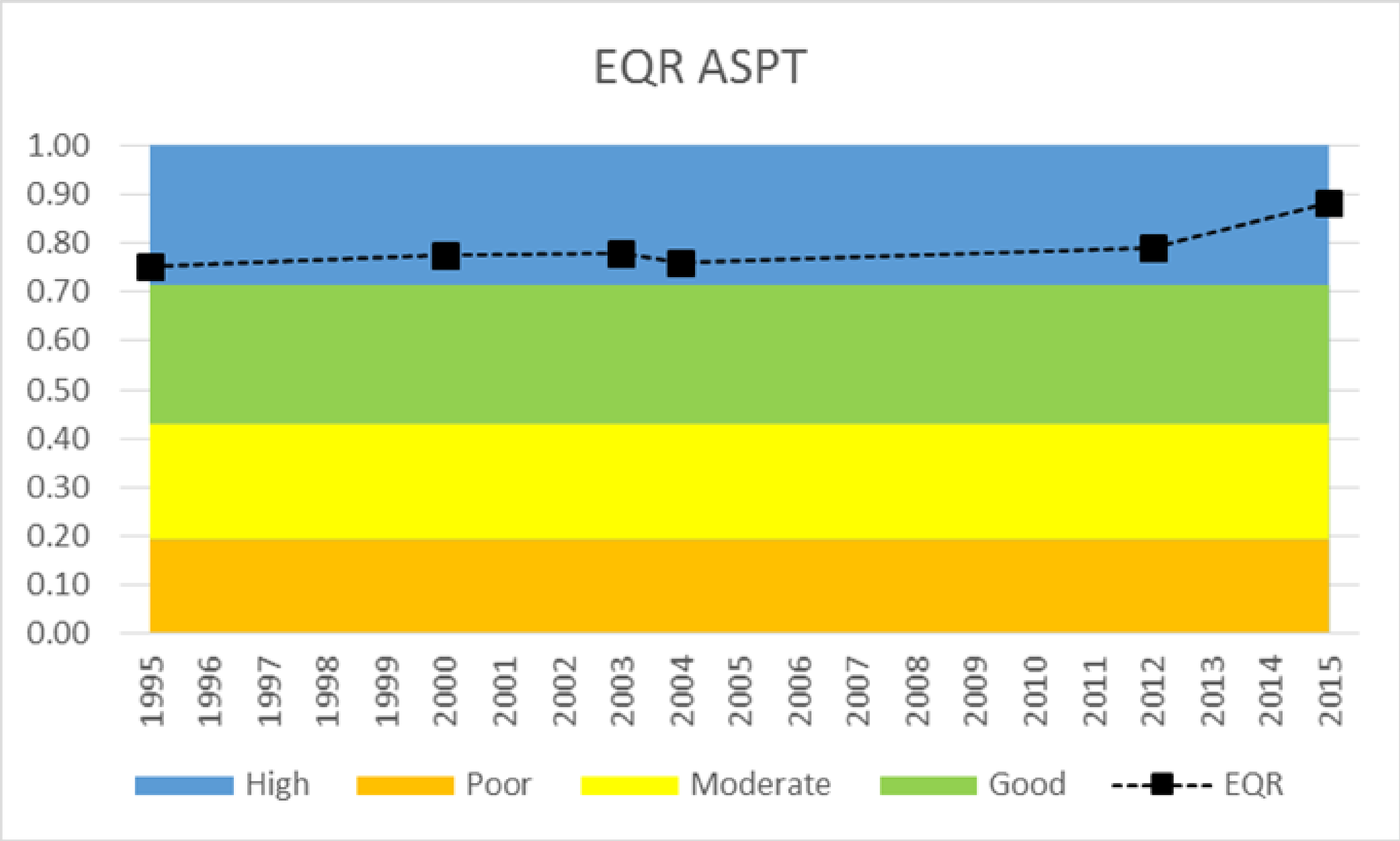


Figure 9: Invertebrate modelling data that shows the organic pollution state of the River Asker at Yondover

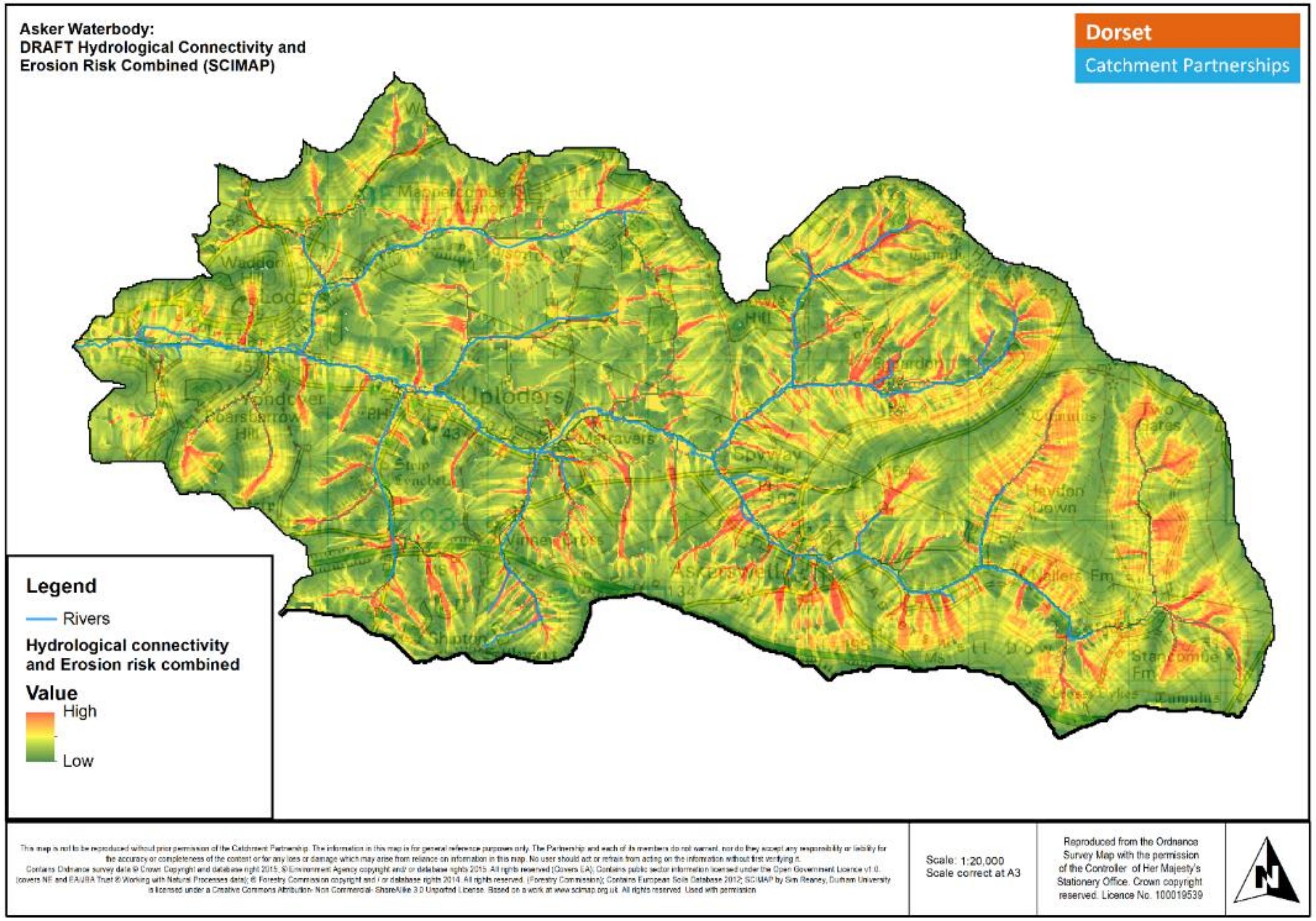


Figure 10: DRAFT A map showing the modelled erosion risk and hydrological connectivity for the Asker Catchment

Figure 11: Invertebrate modelling data that shows sedimentation state of the River Asker at Yondover

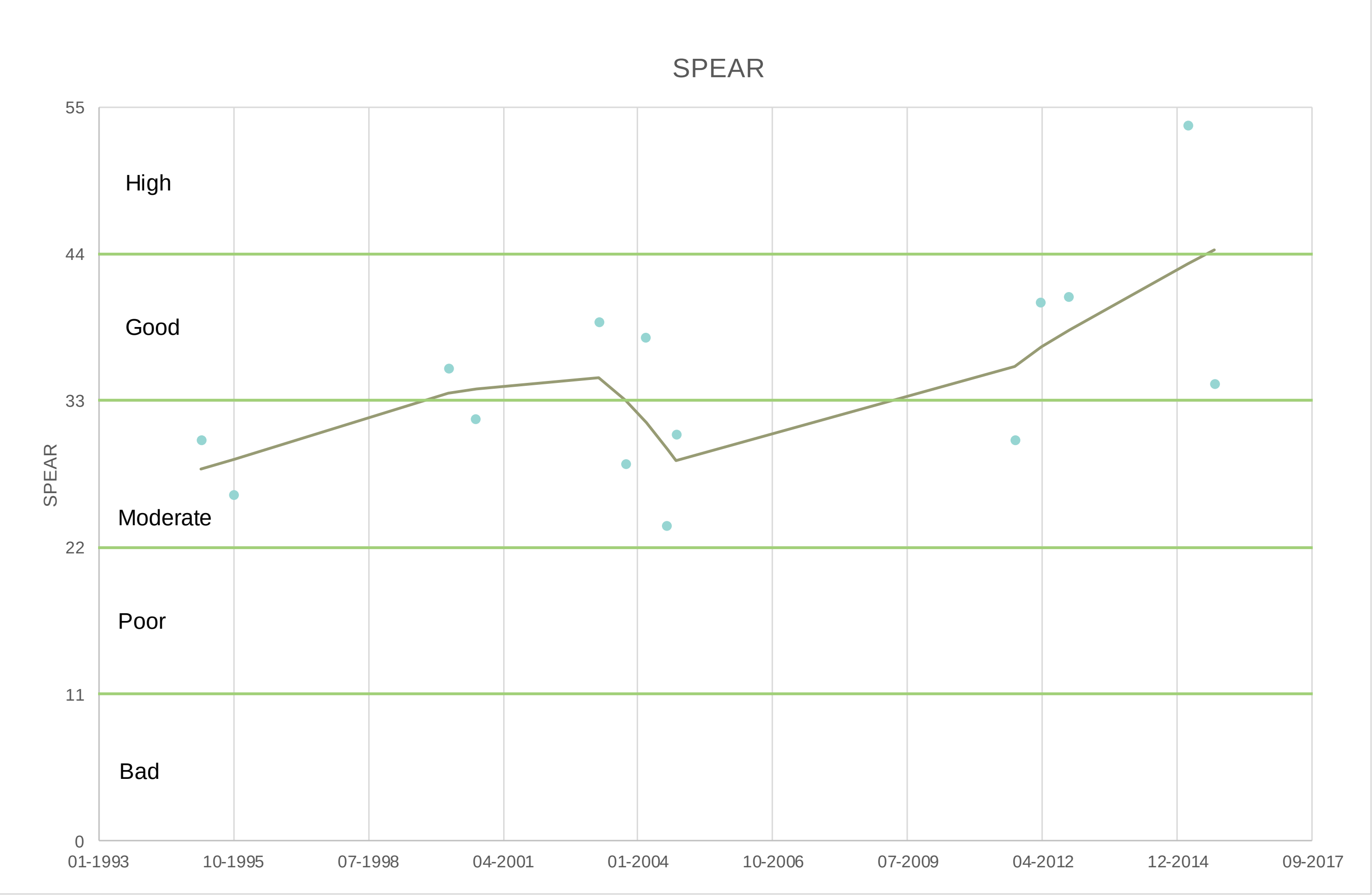


Figure 12: Invertebrate modelling data that shows proportion of pesticide intolerant species in the River Asker at Yondover

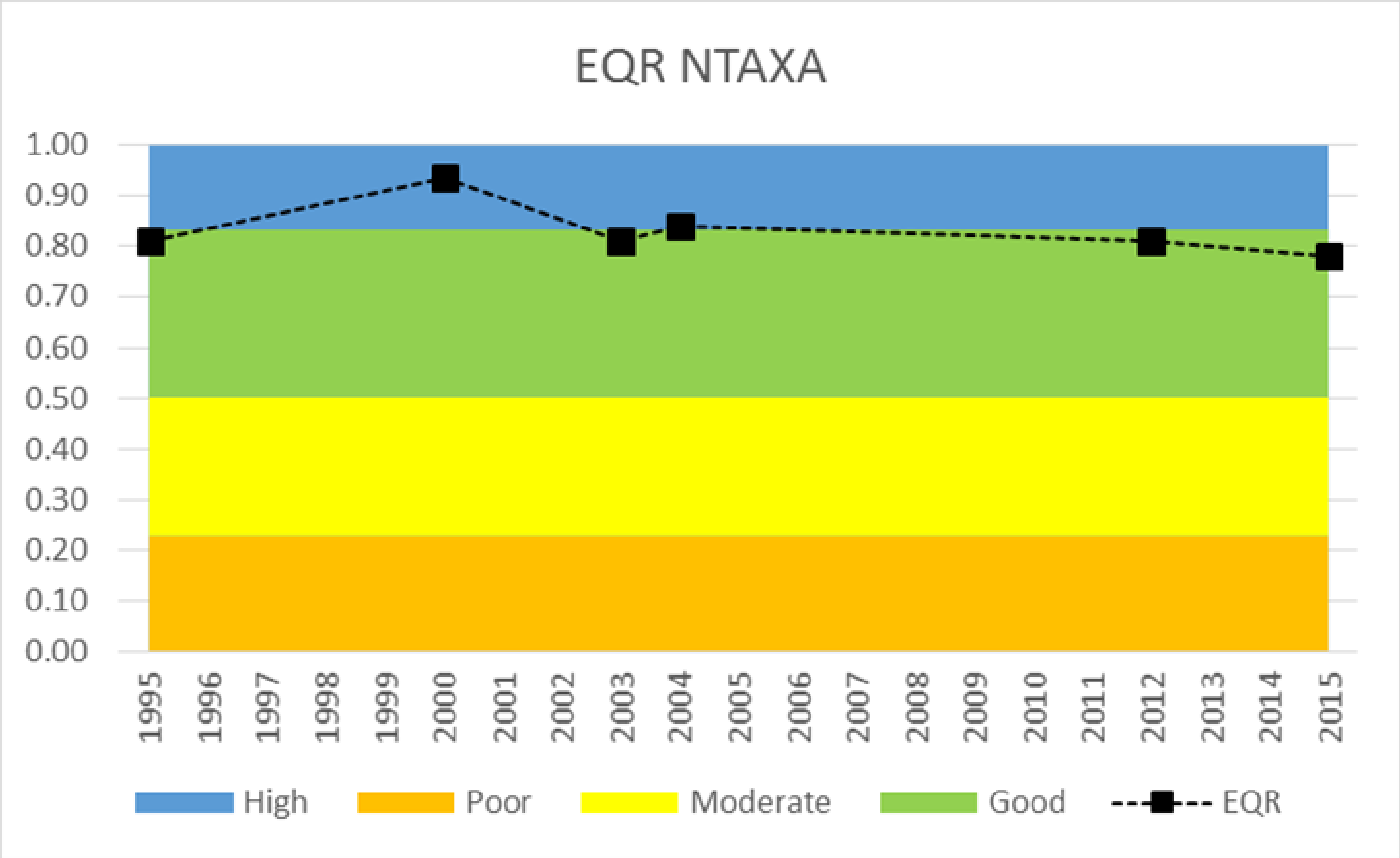


Figure 13: Invertebrate modelling data that shows the wider response of invertebrates to environmental pressures in the River Asker at Yondover

Water quantity

Overview

The extremes of the hydrological range (flooding and drought) can cause major disruption and significant environmental damage. Low flows can lead to reduced dilution of contaminants, poor habitat quality and increased fine sediment deposits. High flows can lead to flooding of homes, businesses and farmland. It can also lead to greater phosphorous concentrations and sedimentation in the river.

Climate change will have a significant impact on water quantity, with predicted drier summers leading to more drought conditions. However, models also predict increased storminess, so when it does rain, it is more likely to lead to flooding. This is predicted for both summer and winter.

High Flows

Flooding from ground water is rare within the catchment. However, it is known that there is flooding from rivers and overland flow to property and land within the catchment. The magnitude of flooding can be exacerbated by poor land management practices, new development, blocked drains and gullies and highways acting as pathways. Modelled flood risk for a 1:30 year return period flood (one which has a 3.33% chance of happening in any given year) is shown in Figure 14. This map only shows extent, and not depth, velocity and other elements that will impact the severity of such an event.

Low Flows

There are no known abstraction licences within the catchment and water availability is not considered an issue. This is supported by the LIFE invertebrate index which shows the invertebrates present at Yondover are not impacted by low flows; see figure 15.

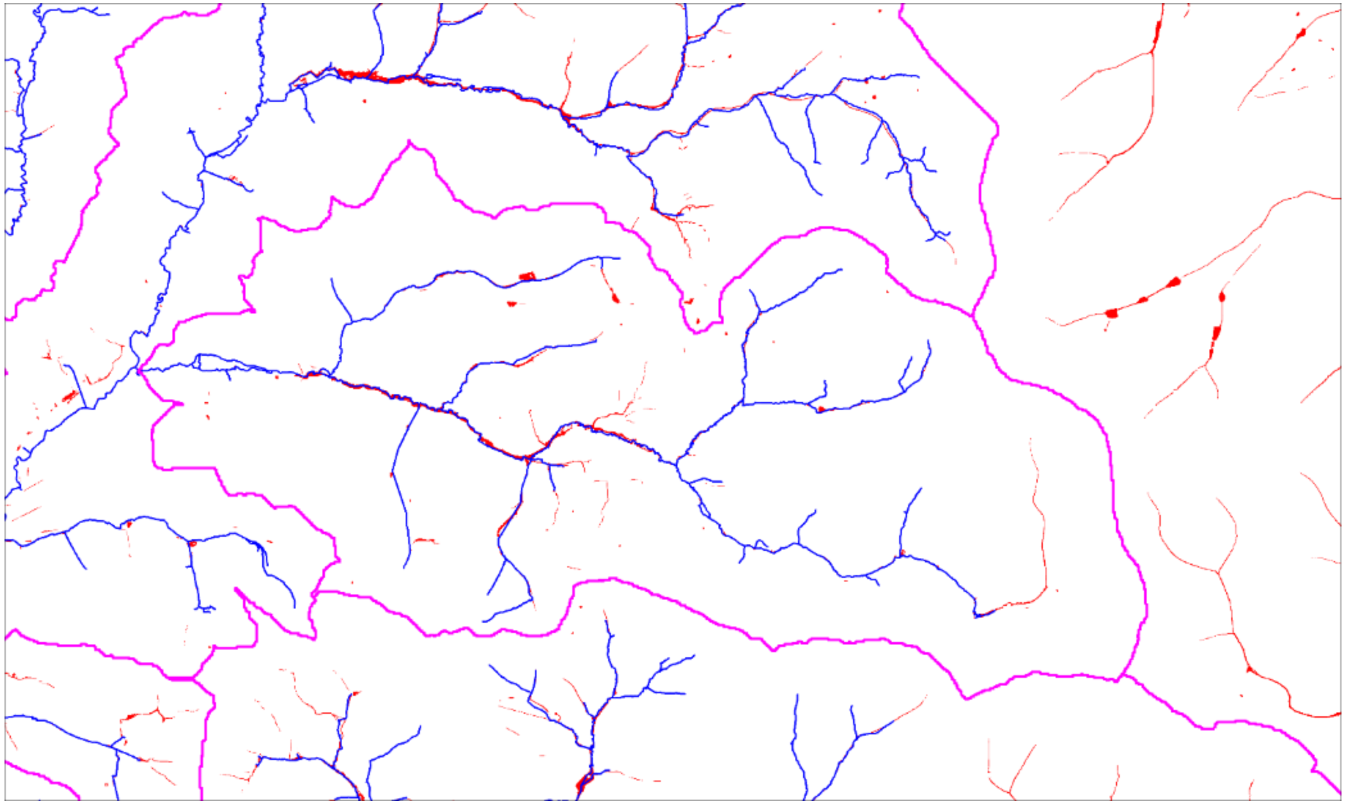
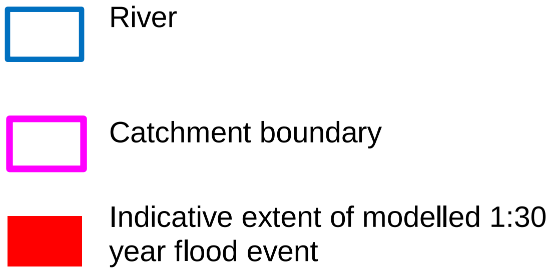


Figure 14: Flood risk for an 1:30 year return period event (3.33% chance of occurring in any given year)[8]

Key



[8] https://data.gov.uk/dataset/95ea1c96-f3dd-4f92-b41f-ef21603a2802/risk-of-flooding-from-surface-water-extent-3-3-percent-annual-chance

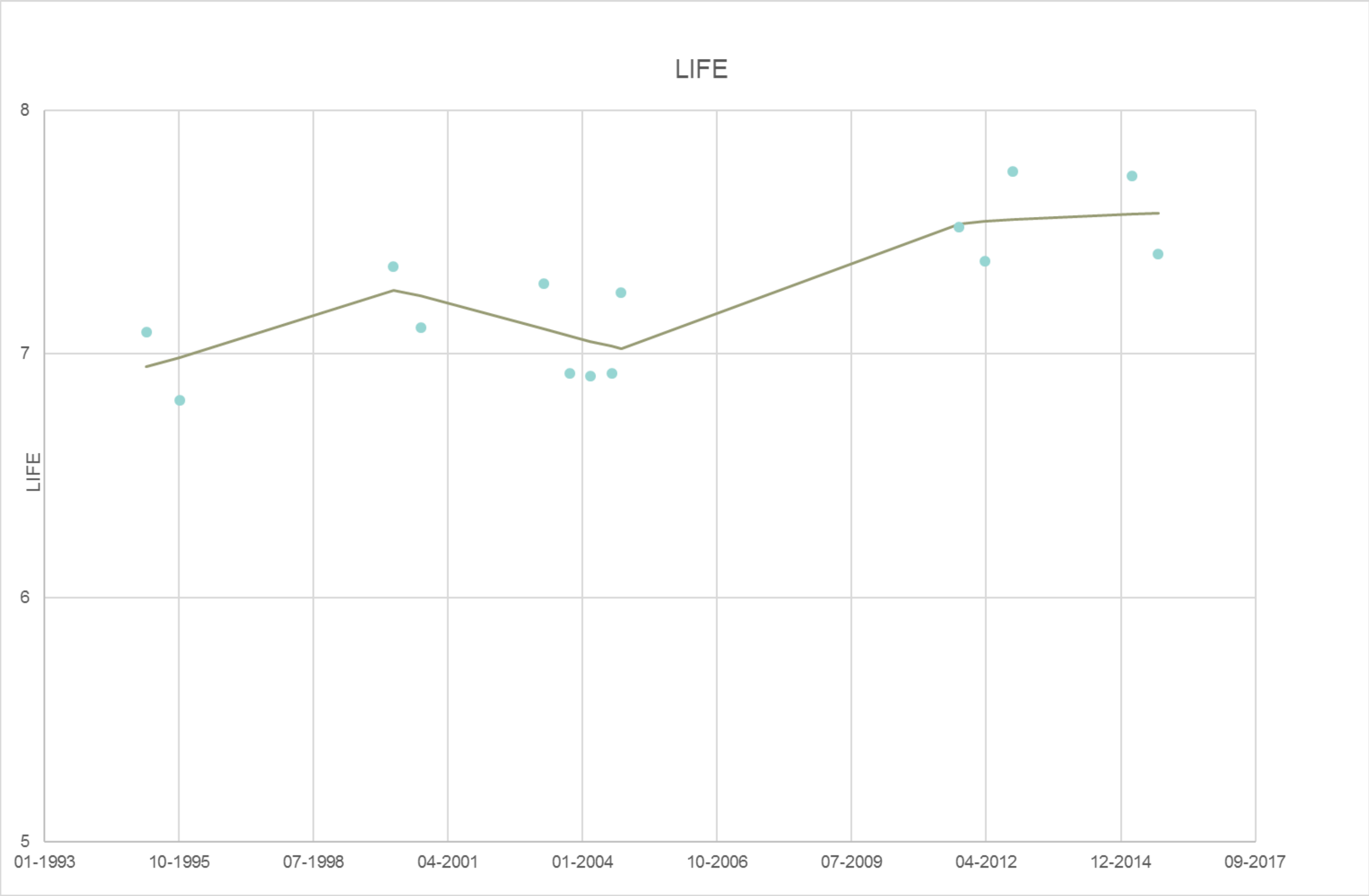


Figure 15: Invertebrate modelling data showing the impact of low flows, with a high score being good, at the River Asker at Yondover.

Habitat quality

Overview

Low energy river systems such as the River Asker have long been utilised by man to power mills, create water meadows and water and wash stock. This has often resulted in systems that are far-removed from their more original state, pre the industrial revolution. In some cases, the river channel has been totally replaced by a new channel cut at the edge of the floodplain. This historic manipulation combined with more modern developments, such as culverting and reveting to accommodate development, has a significant impact on habitat potential, with - for example - impoundments restricting water flow, species movement and increasing sediment deposition due to slow flows. Channels have often been widened, which also results in slower flows and increased sediment deposition. This particularly impacts salmonid reproduction, because these species (brown / sea trout and salmon) need to move freely along the river and have clean gravels into which they lay their eggs: sediment acts like a blanket, suffocating the eggs before they hatch.

Geomorphology

A brief examination of the current route of the River Asker compared to that mapped on 1st edition Ordnance Survey maps (c.1888-1913) show that there has been little change over the past 100 years. However, predating these maps, the old railway route from Maiden Newton to West Bay runs over the river for a reasonable stretch, with attendant infrastructure. There are also a number of historic mills situated along its length, with barriers and artificial mill races impacting species movement and water flow. Mills have been identified at Loders, Yondover and Hembury. See figure 16 for a location of the railway and mills.

In recognition of the historic value of the mills and railway, along with mostly natural planform of the river, there is little opportunity to look at realignment options for the River Asker. However, for shorter sections where the habitat is less than optimal; for example, where the channel is straight and of even width and depth, there may be opportunities to install deflectors and mattresses to vary the flow and create pool and riffle sequences.

Barriers

As well as altering the planform of the river, the mills have also created barriers to water and fish movement. Three weirs associated with Loders Mill have been identified as impacting water and fish movement, along with another in the grounds of Loders House.

Further, specialist, investigations would be required to see if these weirs could be bypassed or have fish ladders installed to mitigate their impact. See figure 16 for a location of these weirs.

Fish

The Environment Agency have carried out fish surveys on the Asker at a number of locations over the past 20 years. The locations are downstream of Loders weir and at the confluence with the Mangerton Brook. The survey that is carried out is an electric fishing survey, where a small electric current stuns the fish present, which are then captured and measured before being released after the survey has been completed. On average, an 80m survey is undertaken between stop nets which prevent fish escaping and allow capture the majority of fish within the section of river. The site is fished three times and the depletion in the catch between the runs is recorded. This gives a catch efficiency and allows an estimate to be made on the population density of the fish species within the section, allowing an understanding of fish status within the river. The target species for these surveys are brown trout and salmon, but the presence of other species are recorded, particularly: bullhead, stoneloach, lamprey, eel and minnow.

The fish population on the River Asker have been classified as poor, because there are less species there than you would expect from a river of a similar type. This may be due to impoundments within the river.

Figure 17 illustrates the number (total: 49) and length of brown trout captured downstream of Loders weir on 23rd October 2014 (the latest data available).

Shade

Shade from bankside trees also plays an important role in habitat diversity along the length of a river. Where it is open, more light reaches the river bed and you get increased plant growth. This in turn regulates river levels, provides cover for juvenile fish and insects, and scours gravel free of sediment. Where trees shade the river bed, there is less vegetation growth and more chance of bank erosion. However, it does regulate temperature, with water temperature above 22.5 degrees Celsius fatal to trout. 40-60% shade is thought to be a reasonable compromise[9].

[9] https://www.wildtrout.org/sites/default/files/library/Tree_Management.pdf

The plant (macrophyte and phytobenthos) population on the River Asker has been classified as poor. Though the primary reason for this is thought to be phosphate pollution, there may be too much shade for plant life to grow. Comparison of aerial photography images show that the level of tree covers has increased markedly over the past 70 years, as illustrated in Figure 18.

Invasive species

There are a number of invasive species known to live in and along the River Asker. The most problematic of these are:

- Himalayan balsam
- Japanese knotweed
- American mink
- Signal crayfish

Plants[10]

Himalayan balsam and Japanese knotweed have historically been introduced by botanical collectors from abroad. As with many non-native species, they have thrived in the absence of the natural predators, pests and diseases that control their abundance throughout their natural range. On many river systems, they cover large tracts of the bankside.

The dense growth resulting from the invasive nature of these species tends to shade out native flora, reducing its abundance and diversity. Further damage is caused by the almost total die back of the invasive species during winter. This leaves large areas of bare, exposed riverbank, which is very vulnerable to damaging erosion. This damage can be very significant, with many miles of some river systems affected.

Control of invasive plant species is not easy. The species can all recolonise via water borne seeds or vegetative fragments. Consequently, to be truly effective, any control programme needs to be co-ordinated on a catchment wide basis. Himalayan Balsam plants can be cut at ground level before their flowering stage (June) or they can be pulled up by the roots and disposed of by composting or burning unless seeds are present. It should be possible to undertake limited control of stands using chemical control with the herbicide glyphosate. Treatment should be undertaken when the plants are actively growing. Japanese knotweed in particular will require co-ordinated treatment over a period of years. Note that the use of glyphosate or any other herbicide

[10] https://www.wildtrout.org/sites/default/files/library/Manage_Riparian.pdf

on or near water requires the consent in writing of the Environment Agency. Successful elimination of invasive plant species can result in areas of bare ground, liable to erosion. These areas may benefit from dense planting with native shrub species to increase soil stability.

Animals[11,12]

The American Mink escaped from fur farms in the 1950s and 1960s, and now breeds across most of the country. It is an active predator, feeding on anything it is big enough to catch, including ground-nesting birds and our native Water Voles, which are now under threat of extinction. Mink are good swimmers and females are small enough to enter the water-line burrows of Water Voles and take their young. Mink are fiercely territorial; their dens are close to the water and the females have one litter of four to six kittens a year. Mink are much more likely to be seen than the shy and secretive Otter.

Signal crayfish are from North America; they were introduced to Sweden and Finland in 1960s and then distributed throughout Europe (including Britain). They are the most abundant of the introduced crayfish in the UK and now occur in many rivers in England, Wales and Scotland and are spreading along rivers, streams and canals, becoming very abundant. Signal crayfish carry crayfish plague and compete with the White-clawed crayfish for shelter. They have a ferocious appetite and a considerable impact on other freshwater animals as well as damaging our river banks through burrowing.

See figure 16 for location of these invasive species, as found during survey work over the summer of 2018 and from records held at Dorset Environmental Records Centre.

Catchment land use

As mentioned previously, certain soil types combined with high-risk land use can result in significant erosion, for example, lighter soils on steeper slopes left exposed over winter through planting of winter-sown wheat. Suspended soil particles could cause significant damage to the ecology of the River Asker, by blocking light penetration to aquatic plants, clogging gills of fish and other aquatic organisms and by smothering the river bed, which suffocates the organisms and eggs that reside there. The impacts could be exacerbated if the width and depth of the channel has been altered by man.

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11 https://www.wildlifetrusts.org/wildlife-explorer/mammals/american-mink

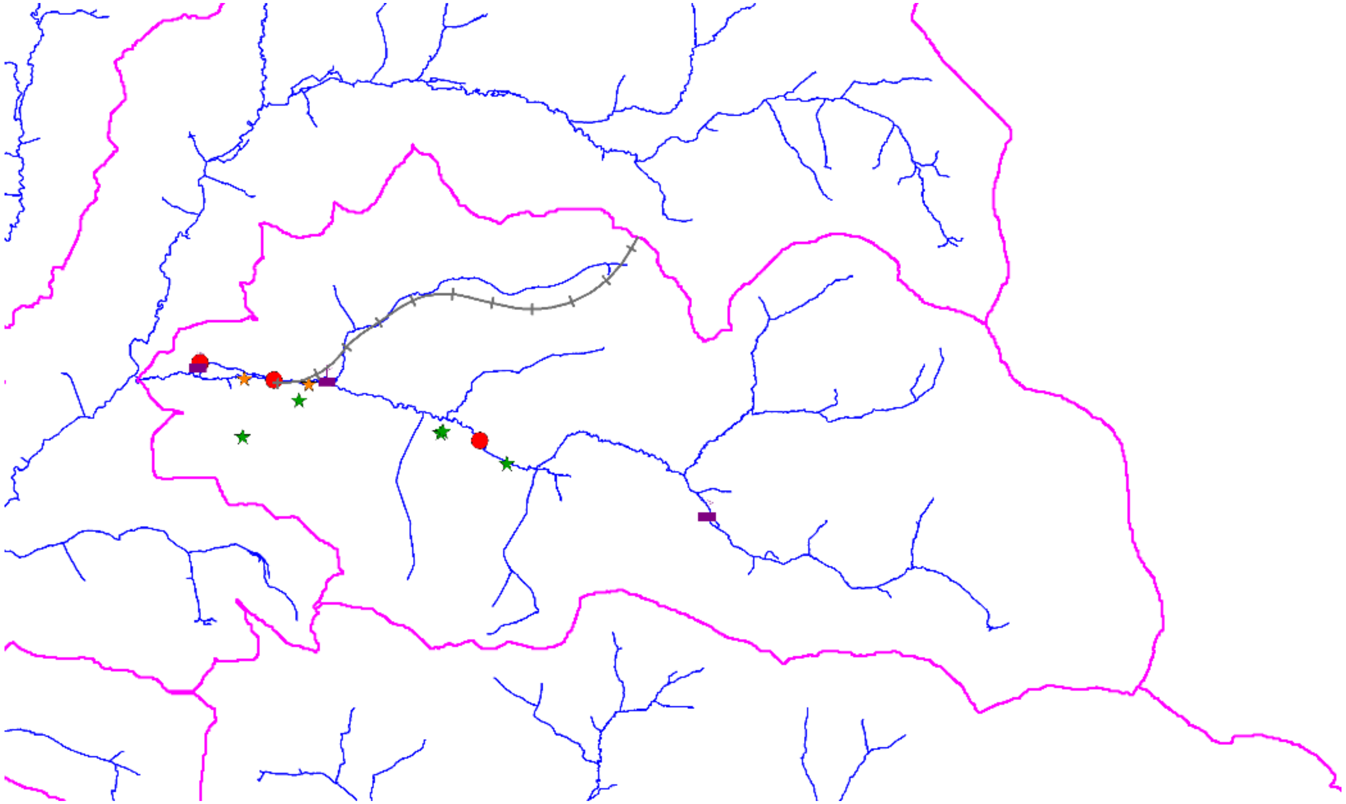
12 https://www.buglife.org.uk/sites/default/files/Invasive%20crayfish%20species%20-%20Profiles_0.pdf

When managing this runoff, there are is a hierarchy of options: stop the source, intercept the pathways then look at protecting the receptors such as ditches and streams. Along with sediment, phosphate adhered to the sediment particles also impact the ecology of the river. Therefore, the greatest risk of loss occurs where soils are prone to erosion, soil phosphate levels have accumulated in excess, and/or when fertiliser or manure application is closely followed by heavy rain. The target soil index for phosphate is 2, levels of 4 and above increase the risk of diffuse pollution.

The likely risk of soil erosion has been modelled, along with the hydrological connectivity to the river (if the soil is eroded but can't get in to the Asker, it is not a water quality problem, so it is essential to look at both elements; erosion risk and hydrological connectivity). Figure 10 illustrates the modelled risk (please note: the data is from GIS modelling and requires ground truthing before these maps can be finalised). Invertebrate monitoring of silt-tolerant species indicates that the River Asker has in the past been moderately sedimented, but has improved and is now slightly sedimented, as shown in Figure 11[13].

[13] https://onlinelibrary.wiley.com/doi/abs/10.1002/rra.1569

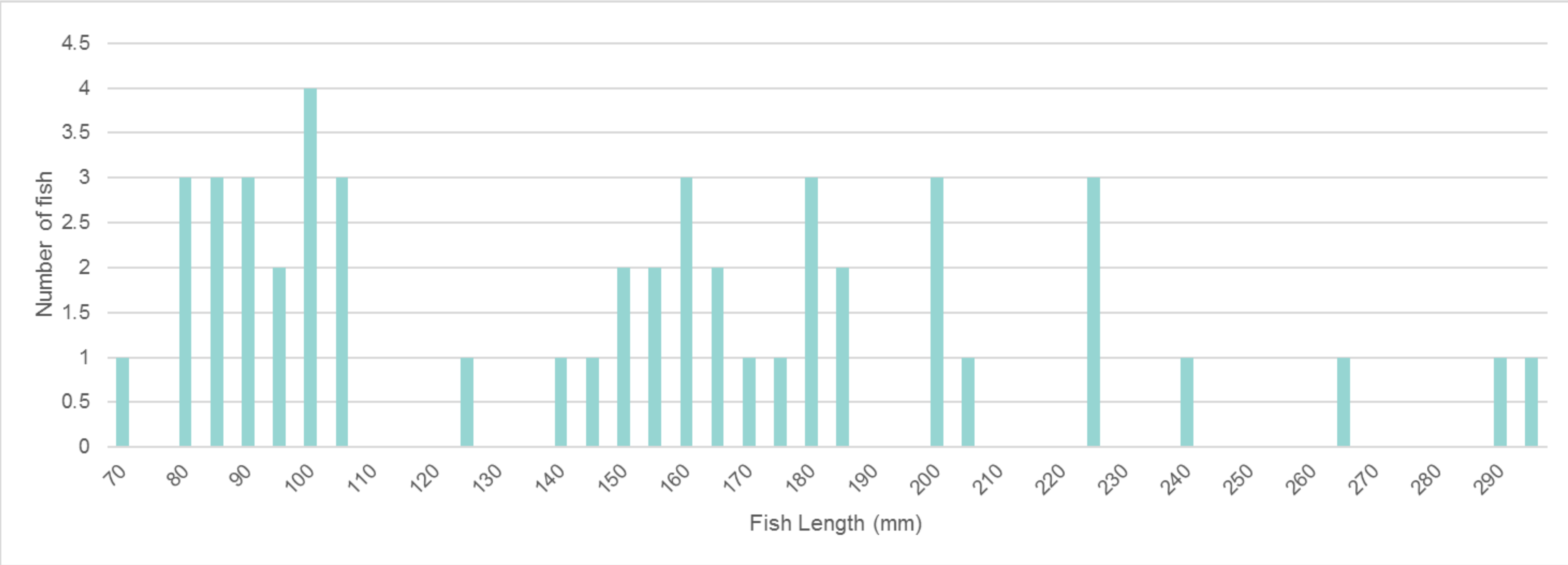
Figure 16: Location of the old railway line, mills, weirs and invasive species on the River Asker



<u>Key</u>

- River
- Catchment boundary
- Old railway line
- Old mills
- Weirs
- Himalayan balsam
- Japanese knotweed

Figure 17: Number and length of brown trout caught downstream of Loders weir on 23rd October 2014 (5mm length intervals).



1947

2017

Figure 18: Tree cover change between 1947 and 2017 in Uploders

1947: Sporadic bank-side tree coverage

2017: Continuous bank-side tree coverage

CATCHMENT OPPORTUNITIES

Overview of issues

Having described the catchment and its uses, along with reviewing existing information on water quality, water quantity and habitat quality, the main issues affecting the River Asker can be summarised as:

1. **Artificial barriers:** this impacts fish populations and causes sedimentation of the river bed
2. **Shade from riparian trees:** this impacts aquatic plants and riparian plants.
3. **Catchment land use:** this has the potential to impact the duration and severity of flood waters and is a source of phosphate-contaminated sediment.
4. **Agricultural phosphate from diffuse sources:** this impacts aquatic plants.
5. **Invasive species:** this impacts riparian plants and causes bank erosion, which is a source of sediment.

Overview of solutions

The identified issues can be addressed by a number of interventions. These can be remote from the river itself, at the source of the problem, or at specified sites along the riparian corridor and within the river, where the issues are acute. A summary of the most relevant solutions is listed below and described in more detail later:

1. **Barrier removal or bypass:** this would benefit the fish populations in the river, by opening up a greater length of river for spawning and reducing the amount of sedimentation.
2. **Shade management of riparian trees:** this would open up areas that are heavily shaded, allowing aquatic and riparian plants to thrive.
3. **Agricultural land management change:** this could reduce sediment runoff and therefore phosphate pollution. It could also improve rainwater infiltration and therefore delay and reduce flood peaks.
4. **Natural Flood Management:** by slowing flow of water over land and in the headwaters of the River Asker, through gully blocking, installation of woody debris dams and tree planting in appropriate locations. This would delay and potentially reduce flood peaks and reduce sediment runoff.
5. **Installation of fencing, cattle drinking bays and cattle crossing points:** this would reduce the amount of poaching, which is a source of sediment.
6. **Habitat improvement & restoration:** this would restore the natural dimensions of the river where it has been altered, therefore allowing natural process, such as gravel scouring, to occur. This would allow aquatic plants and fish species to thrive.
7. **Invasive species control:** *Plants*: this would allow native bank flora to thrive and reduce the potential for bank erosion, which is a source of sediment. *Animals*: mink control would reduce pressures facing the native water vole, which is fast-declining nationally.
8. **Monitoring & education:** This would give the community early warning of pollution incidents, and an opportunity to inform the relevant authorities. It would also allow the community to monitor the effectiveness of any interventions undertaken. It would also create a sense of ownership and pride in this important habitat.

The following pages provide further details about the possible solutions that are most relevant to the River Asker. They are generic options which give an idea of the sort of things that are possible. Detailed designs will be required for specific locations, along with consent from Dorset County Council and / or the Environment Agency. The findings of the walkover survey, conducted over the summer of 2018 and provided in the section on Catchment Opportunity Maps, give locations of issues and possible solutions. These will need to be worked up in greater detail on a case by case basis.

Barrier removal[14,15]

Restoring fish passage and improving habitat for fish and biodiversity should be the primary management goals. These are often complicated and expensive projects and require appropriate time and resources to be completed effectively. A more detailed assessment of existing barriers and potential removal or easement options is required on the River Asker. Where removal of weirs is not feasible or desirable, easements or provision of passage for fish may be the only options, several of which are outlined below:

Pre-barrage boulders

These are used to improve passage mainly at low obstacles and on small watercourses.

Bypass channels

A shallow channel mimicking a natural watercourse and linking the sections below and above the obstruction. Water velocity in the channel is reduced and a rough bottom dissipates energy in the channel, this is combined with a series of constrictions and expansions of the flow created by blocks, groynes and weirs. Well-designed channels have proven to be a highly successful restoration technique and are even used as habitat by brown trout

Low flow notches

A low flow notch serves to concentrate flows, usually at the centre of a weir and at low flows. This type of easement produces a concentrated plume (with as little turbulence as possible) of water and is particularly suitable for salmonids.

Fish passes

If removal or easement is not possible, an alternative is to install a fish pass. A fish pass is a device or structure which facilitates the free passage of migrating fish over, through or around an obstruction, in either an upstream or a downstream direction. There are many different designs with their own pros and cons. However, fish passes need continual maintenance and may not be effective in all flows.

[14] https://www.wildtrout.org/sites/default/files/library/Obstructions%20information%20paper%2020082013.pdf

[15] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/298053/geho0910btbp-e-e.pdf

Shade management[16]

Unless there are specific reasons to do so (for instance, disease, control of alien tree species or Health and Safety concerns) there is generally no reason to cut down or remove trees. The control of over shading by trees is best effected by a combination of coppicing, pollarding or singling.

Coppicing and pollarding

These are techniques traditionally used to manage trees on a regular cycle. In coppicing, the young shoot stems are cut off cleanly immediately above ground level, promoting the development of several new stems. These are allowed to grow from the base (or 'stool') until they are re-cut, normally on a 5-30 year rotation. Coppice regrowth is very palatable to livestock, deer, hare and rabbits. It therefore needs careful protection during the early stages of regrowth. Species that are regularly coppiced include ash, hazel, and alder. Coppice products historically included hazel sticks for hurdle making, ash poles for tool handles and alder trunks for clog making. Pollarding is basically a similar process adapted for areas of 'wood pasture' where livestock were present. Trees were cut above the height that grazing cattle could reach. Some riverside trees, particularly crack willow have historically been managed by pollarding, with trees cut on 15-30 year cycles to promote longevity of individual trees.

Singling

Singling offers an alternative to coppicing, in that rather than cutting all stems of the tree, the most upright stem is retained and allowed to grow into a semi-mature tree. It is a less risky option than coppicing in circumstances where there is significant grazing pressure. It also maintains a large, structural element to the landscape that may be important at sensitive sites.

Crown lifting

An alternative to cutting tree stems is to raise the crown. Crown lifting is carried out to increase the clearance between the ground level and the lower branches to allow light to penetrate to the water without breaking the canopy.

Timing

Whichever technique is chosen, the aim should be to create a mosaic of trees, with individuals at differing stages of succession. This approach avoids abrupt change to overall habitat and helps to maintain refuges and corridors of stable habitat for a range of woodland species. Tree management must be

[16] https://www.wildtrout.org/sites/default/files/library/Tree_Management.pdf

undertaken during the dormant winter period, when the trees are not being used by nesting birds and are less likely to hold colonies of roosting bats. Timber arisings from tree management can be introduced into the river as Large Woody Debris (LWD) deflectors or sold for firewood, charcoal burning and other traditional woodland crafts. The finer brushwood ('brash') can be converted into faggots for use in bank revetments and channel narrowing. Alternatively, both timber and brash can be utilised in the construction of 'log pile' otter holts.

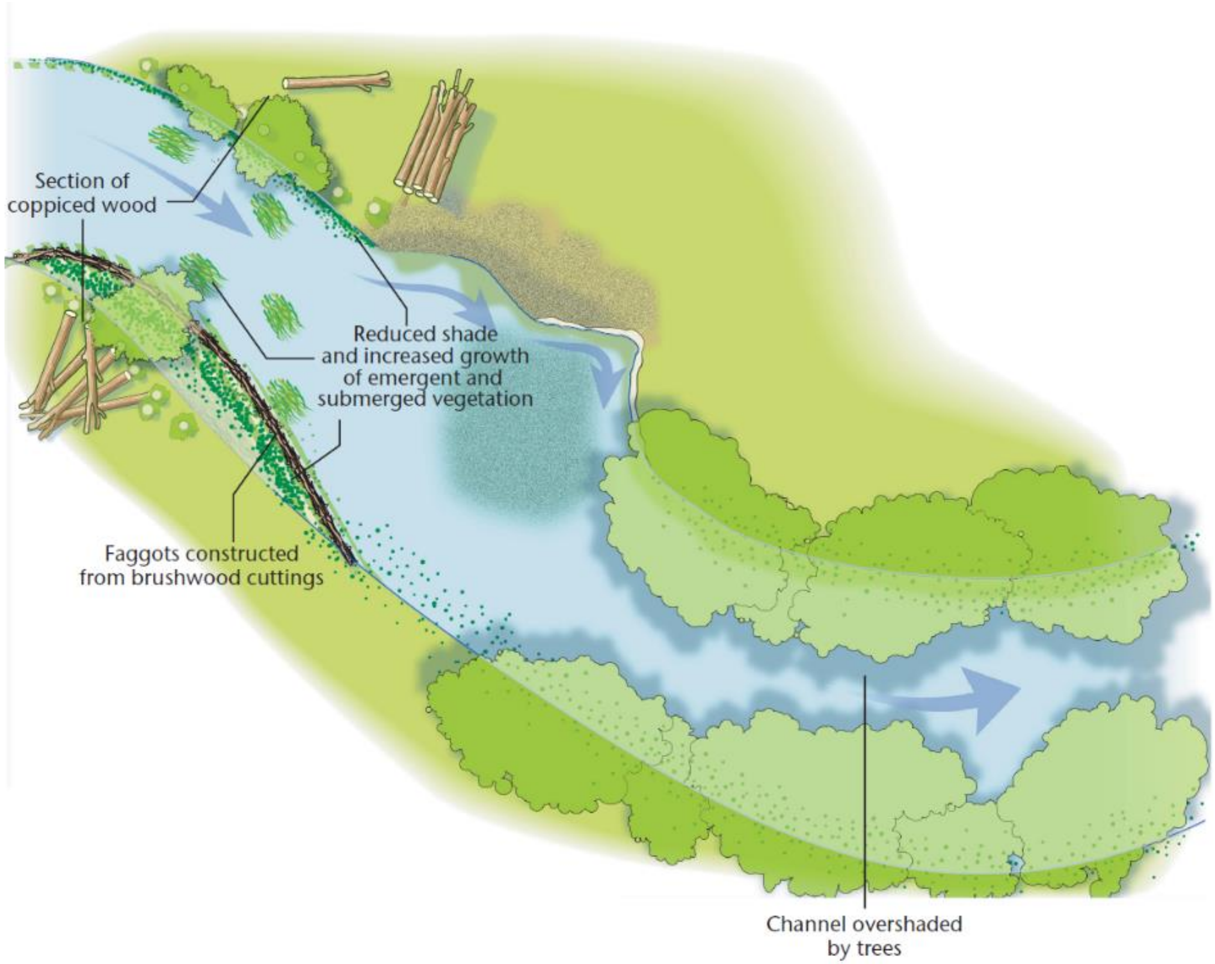


Figure 19: Diagram showing tree management coppicing undertaken to reduce shade and increase the growth of vegetation. Brushwood arisings used to construct faggot bundles and narrow the river.

Land management change

The best way to prevent soil, and the associated phosphate, getting into the river is to try to prevent soil particles becoming detached from the top soil. Good soil structure is paramount in this respect. Given an opportunity, the natural soil biology will engineer a good structure by creating different sized aggregates (clusters of soil particles held together by exudates from micro- organisms) with plenty of air spaces in between them. The stability of these aggregates varies with soil type and management. Soils with good structure are more stable, resistant to compaction, have better nutrient cycling, water infiltration and water holding capacity and are, therefore, more productive.

Many farming techniques hinder soil biology and natural structuring process. For example:

- Cultivations make soils more susceptible to compaction
- Leaving soils bare exposes the aggregates to the physical impact of rain drops which can break them up
- Trafficking with machines compacts soil. This, as well as slumping/capping of the soil surface, limits the soil microbes' access to vital oxygen.
- Chemical inputs such as fungicides and pesticides can kill microbes.
- Manufactured soluble nitrogen and phosphate fertiliser can interfere with the process of energy rich carbon being sequestered to the soil by plants.
- Mono-cropping excludes the benefits of co-operative plant associations seen in multi-species situations.

Mitigation techniques should focus on building optimum soil health. This is a process rather than a "silver bullet" approach and might include options such as;

- Maintaining a green cover to protect the soil from the physical impact of rain drops which can detach particles of soil from the aggregates which can them slump and cap. A green cover also improves water infiltration and captures and fixes solar energy. For example, under-sow maize with grass.
- Minimise cultivations to limit the disturbance of the soil biology.
- Minimise the use of chemicals that could harm the soil biology. For example, consider discussing with a qualified agronomist a two fungicide, rather than four fungicide, programme for wheat.
- Minimise the use of soil acting soluble nitrogen fertiliser. For example, consider using liquid foliar applied nitrogen fertiliser as part of a nutrient management plan prepared by a qualified adviser.
- Aerate compacted soils where necessary, for example, sward lift silage grounds at the end of the cutting season, ensuring that an assessment of the depth and severity of compaction is identified before under taking the cultivation.
- Avoid monocultures. For example, grow cereals with a legume companion crop.

Where dealing with pathways and the receptors, mitigation options such as cross drains on tracks and sediment traps could play a part in limiting the risk. Extending grass buffer strips in problem corners could also be helpful. There may also be some merit in installing a “last line of defence” to protect the river in known high risk areas. Sediment barriers/silt fences are an effective and relatively inexpensive way to limit the amount of soil entering the watercourse from a point source.

These options will be discussed with landowners and managers as part of the ongoing survey of the catchment, and where practicable specific options will be implemented.

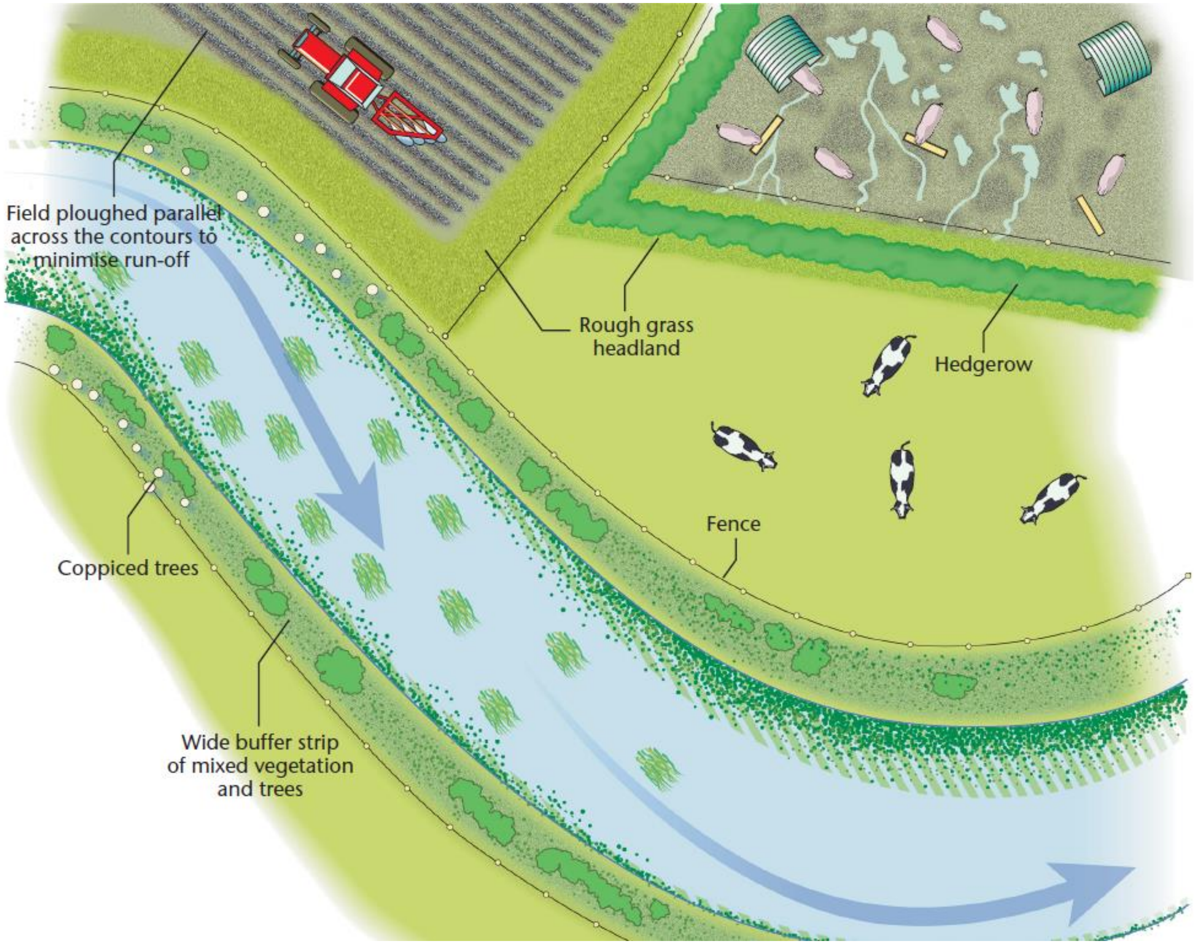


Figure 20: Diagram showing changing farming practice: the creation of buffer strips and the development of grass headlands combine to reduce sediment and nutrient input

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Natural Flood Management[17,18]

Natural flood management (NFM) aims to reduce the downstream maximum water height of a flood (the flood peak) or to delay the arrival of the flood peak downstream, increasing the time available to prepare for floods. It works by restricting the progress of water through a catchment by making the catchment rougher and more difficult for water to flow quickly over land and in stream. The phrases "Slow the flow" or "Working with natural processes" are sometimes used to describe this approach to reducing flood risk. NFM strategies can be loosely classified by their likely location and distribution in a catchment They rely on one, or a combination, of the following underlying mechanisms:

Leaky barriers

Leaky barriers are usually formed of Large Woody Debris (LWD) and they are either formed naturally or are installed across watercourses and floodplains. LWD has several benefits. Firstly, and crucially, the structures reduce high flows, slowing the rate at which flood peaks travel downstream. Secondly, LWD will, over time, speed up the flows that are immediately downstream of each structure, cleaning gravels and stones of silts. Silt and sediment will eventually accumulate behind the structures, creating a small head of water and resulting in long-term changes to stream structure. Large woody debris can divert water during higher flows and allow it to collect on the floodplain. This allows silt and sediment to drop out of the water column onto the floodplain, decreasing the total sediment load in the stream. Woody debris also provides a natural habitat for many invertebrates, lower plants and fungi. It engineers habitat diversity, creating a system of pools and riffles which will attract a range of invertebrates and fish.

Where spring-flow gullies are identified as significant sources of silt and sediment, filling them with loose brash will intercept some of this flow and reduce the transport of silt into the main river.

Runoff management

Run-off pathway management techniques can delay and flatten the hydrograph and reduce peak flow locally for small flood events by intercepting, slowing and filtering surface water runoff. They can include a wide range of different measures, including creation of swales (shallow, broad and vegetated channels designed to store and/or convey runoff and remove pollutants) and ponds and installation of sediment traps. They usually work best as a cluster of features working as a network throughout the landscape.

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[17] https://www.stroud.gov.uk/rsuds

[18] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/654440/Working_with_natural_processes_one_page_summaries.pdf

Floodplain reconnection

River floodplain restoration restores the hydrological connectivity between the river and floodplain, which encourages more regular floodplain inundation and flood water storage. This can decrease the magnitude of the flood peak and reduce downstream flood depths especially for high frequency, low return period floods. The extent of this flood risk effect depends on the length of river restored relative to the overall size of the river catchment.

Woodland

Catchment woodland: Catchment woodland can intercept, slow, store and filter water. This can help reduce flood peaks, flood flows (from 3 to 70%) and flood frequency. Largest reductions in flood risk have been seen for small events in small catchments, the extent of this reduction decreases as flood magnitude increases.

Floodplain woodland: Woodlands in floodplains can slow floodwaters and increase water depth on the floodplain. This can help reduce flood peaks (0-6%), delay peak timing (2 hours or more), desynchronise flood peak and reduce peak height. It can also enhance sediment deposition on the floodplain. Floodplain woodlands have greatest flood risk effect in the middle and lower river reaches of medium to large catchments.

Riparian woodland: riparian woodlands are planted on land immediately adjoining a watercourse, they can slow flood flows and can help reduce sediment delivery to the watercourse and reduce bankside erosion. They also have high evaporation losses and can create below ground water storage. Largest reductions in flood risk have been seen at the reach scale, in middle and upper catchments.

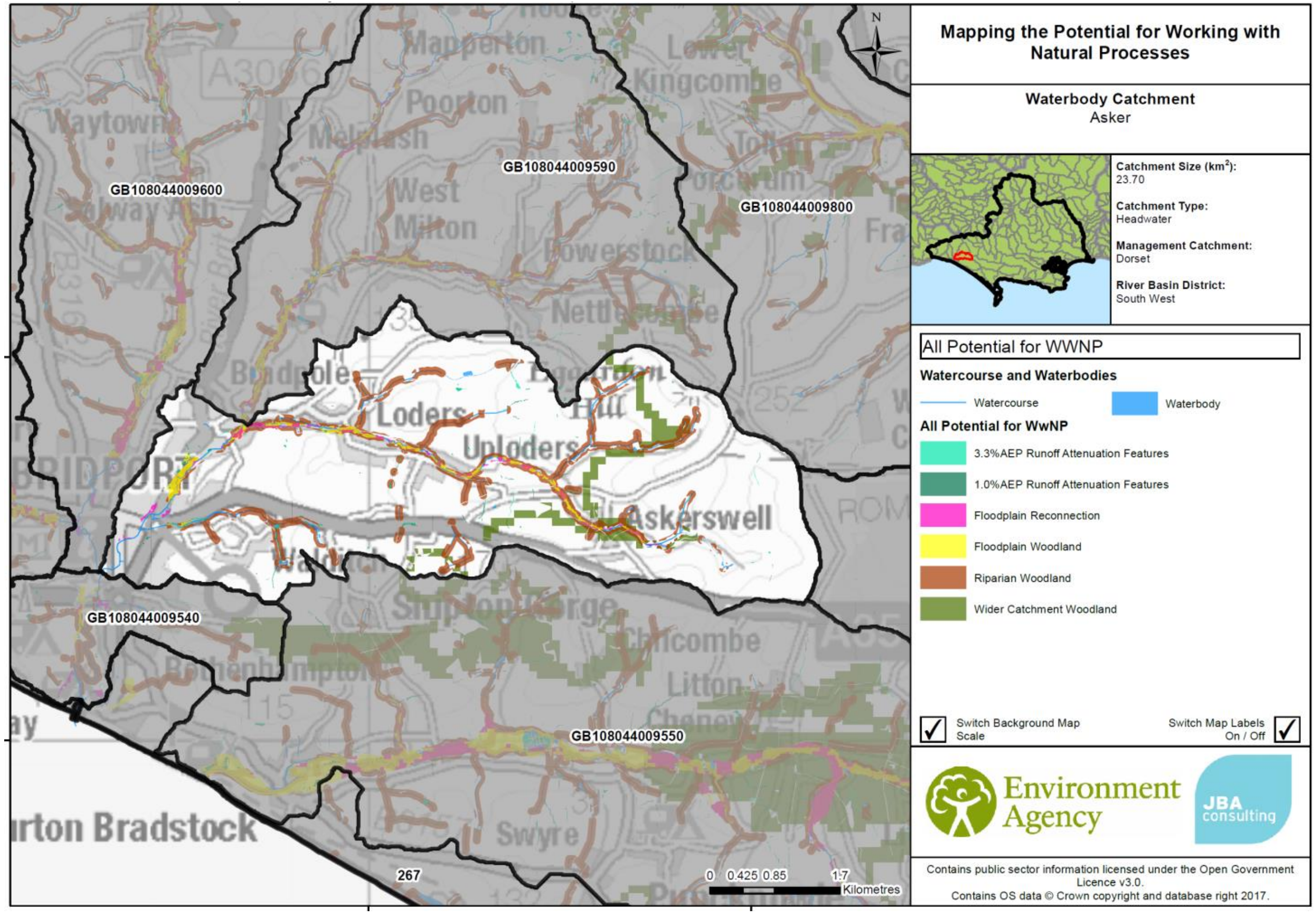

Figure 21: A map showing the potential for Natural Flood Management options within the Asker Catchment[19]

[19] http://wwnp.jbahosting.com/

Fencing & cattle drinking bays[20]

A reduction in the extent of excessive erosion is of fundamental importance to river systems. The cheapest and aesthetically most desirable mechanism to achieve a reduction in erosion is to reduce the number of grazing animals to an acceptable level. This may be possible by utilising agri-environment options. However, in many cases the financial realities of modern farming will not allow a reduction in stocking density. In these instances, the only realistic option is to erect a stock proof fence along the affected length of river. Ideally, the fence should create an ungrazed buffer strip of at least 10m in width. This provides a 'sacrificial strip' of land between the river and the fence that may be partially eroded prior to the development of coarse, well-rooted grass species with a strong binding effect on banks. It also provides a high degree of attenuation of overland flood flows, and associated fine sediment, particularly if combined with a programme of tree planting within the fenced area. Narrower strips are still useful, albeit with a reduced effectiveness for sediment capture. Fencing also provides total protection against over-grazing if stock density increases in riverside meadows.

The cheapest method of fencing comprises posts with 3-strands of barbed wire. Cost for installation should be in the region of £6/m (2018 prices). The relatively low costs per linear metre makes the fencing perhaps the most cost-effective enhancement technique available. It is important that sufficient, easily surmounted stiles are provided for angler access, with a standard agricultural gate into each section of fencing important for machinery access for future maintenance; fencing off a buffer strip will promote the growth of riparian vegetation, and create a maintenance liability over time, particularly with respect to invasive species. The requirements of the agricultural stock must be considered. Once excluded from the river, they will require a source of drinking water, either by the provision of purpose built drinking areas, mains-supplied troughs, or for beef cattle, the use of pasture pumps. Where stock requires access across rivers, simple water gates can be constructed using swinging timber slats or sections of alkathene water pipe. These will prevent animals moving upstream or downstream along the bed of the river.

[20] https://www.wildtrout.org/sites/default/files/library/Protect_Marginal.pdf

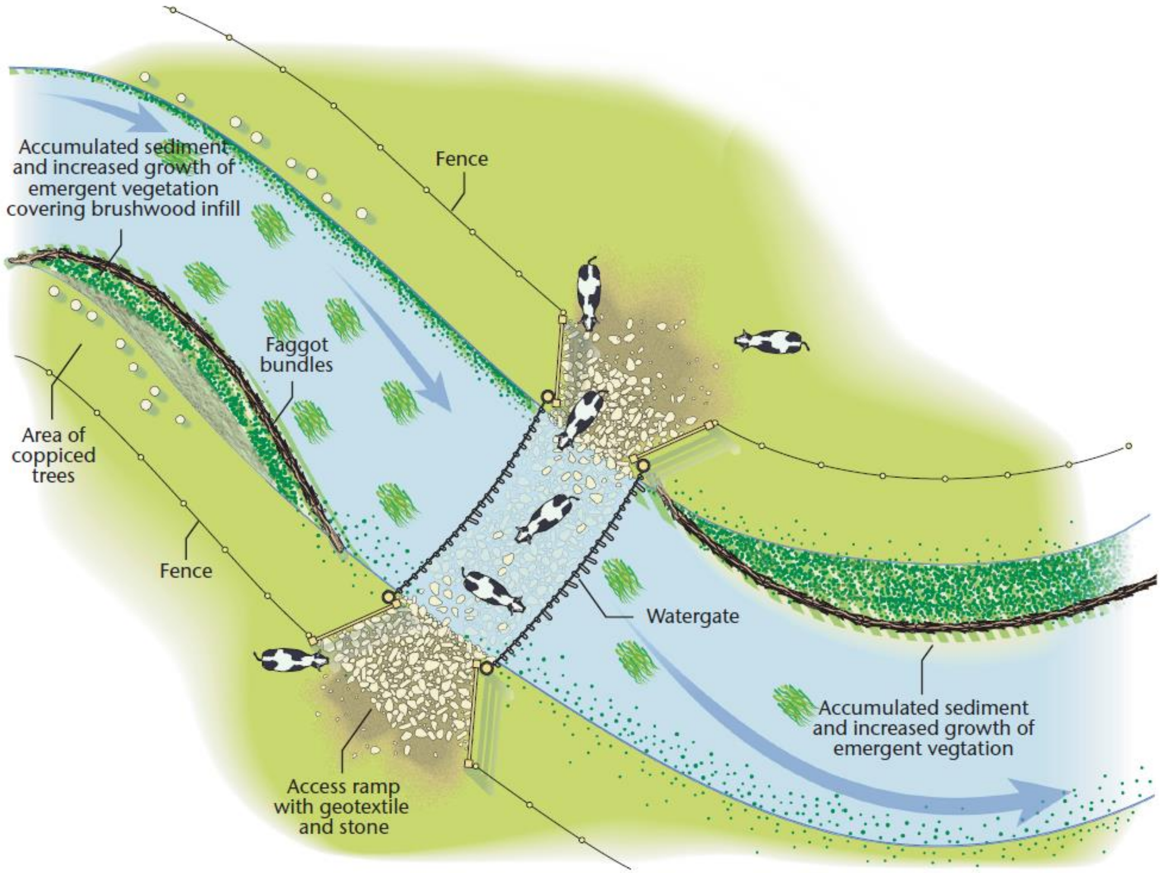

Figure 22: Diagram showing protected marginal habitat through the erection of fencing, and well-designed crossing places and / or drinking bays.

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Habitat restoration[21,22]

River habitat restoration involves the installation of structures to return the river to its natural dimensions, where these have been altered in the past, though, for example, dredging or widening. This will then allow the natural process of scouring and sediment mobilisation to occur, which in turn provides the right conditions for plants to grow and the various life-stages of fish to thrive. There are a number of possible techniques that are discussed below, but all should make reference to the natural form of the river and the availability of suitable, locally occurring materials. Generally, this will mean making use of timber and brushwood derived from the coppicing, pollarding, singling or thinning of riparian and floodplain trees. The use of materials imported to site should be avoided where possible. It is important to note that all the techniques described rely heavily on the establishment of strongly rooted marginal vegetation to optimise their stability and resistance to erosion. Timing of the installation of narrowing is thus fundamental. Ideally, work should be done in spring/early summer to optimise the growth of plants prior to high winter flows. Generally, installation in the autumn or winter should be avoided as it risks significant damage to the narrowing occurring before adequate development of plant growth.

Brushwood

Brushwood arising from the cutting of trees, is a fantastic material, when used as a revetment. Its fine, 'feathery' nature reduces water velocity, promoting the deposition of fine sediment. Perhaps the best-known method of using brushwood is as faggots. These are bundles of brushwood, bound together using string (ideally biodegradable), to form faggots of around 2m in length and 0.3m in width. The faggots can then be installed along the agreed line for narrowing and held in place using untreated stakes (diameter 75mm-100mm) driven firmly at 0.6m centres into the riverbed. Some practitioners weave the faggots through the stakes, creating a robust and very attractive finish to the revetment. A simpler and equally robust approach is to force the faggots over the stakes, wiring them down once in position. It is important that the faggots are packed tightly down and are overlapped in the horizontal plane, to reduce the risk of erosion. A similar concern dictates that the upstream and downstream ends of the faggot bundles are adequately 'keyed' into the original bank line. The area between the line of faggots and the original bank should be filled with excess brushwood, tightly tied or wired down to a matrix of stakes driven vertically. The brushwood backfill can then be 'seeded' with emergent vegetation such as sedge, reed canary grass, reed sweet grass and yellow flag Iris. These and other naturally recruiting plants will grow into the faggot mass, helping to increase its stability. Whilst this is a good and cheap technique that can produce excellent establishment of marginal zones, it may not be suitable in areas where there are aesthetic considerations or concerns regarding wash out of accumulating sediment. In these situations, it may be necessary to use locally derived backfill to create a finished marginal shelf area as part of the enhancement scheme. Reprofiling of the banks (or 'cut and fill') can be used to both provide the necessary infill, and extend the width of the shallow waters

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[21] https://www.wildtrout.org/sites/default/files/library/Channel_Narrowing.pdf

[22] https://www.wildtrout.org/sites/default/files/library/Large_Woody_Debris.pdf

edge shelf, suitable for the growth of marginal plants. The extensive use of chalk backfill can restrict access to burrowing water vole. This concern should therefore be a significant consideration in locations known to harbour this increasingly rare species.

Deflectors

Deflectors function by concentrating flow, either vertically or horizontally, in order to increase velocity locally and create areas of differential scour and deposition. It follows that the most important factor in planning the installation of these deflectors is the desired location of the areas of scour and deposition. Once these have been agreed, and armed with a knowledge of how deflectors function, it is relatively straightforward to achieve the desired outcome. For example, it would be counterproductive to install deflectors that encouraged lateral scour in an overwide river, whilst designing a deflector that deposited fine sediment on gravel spawning areas would not be conducive to improving trout stocks. Although the disturbance patterns caused by water flowing over deflectors can be very variable, their general functioning is relatively simple to understand. In essence, when water strikes a submerged deflector, it is deflected at approximately right angles. Hence, a deflector installed pointing downstream will tend to deflect flow into the bank, causing erosion, whilst an upstream facing deflector will tend to deflect water into the centre of the channel, eroding a small pool here.

Gradually reducing the height of a deflector from the bank to the centre of the channel minimises the risk of bank erosion, whilst maximising the benefits of desirable mid-channel bed scour. Given these properties, it is generally best to install upstream facing deflectors whose outer limits are submerged over the normal range of flows experienced in the river. Paired upstream facing deflectors are very useful in creating mid-channel scour. This not only increases the heterogeneity of the bed profile, but also creates small holding pools and areas of clean scoured gravel suitable for spawning immediately downstream of the structure. Deflectors can be constructed from a variety of materials including naturally derived timber, faggot bundles, and stone. Where possible, it is always best to utilise local materials, on aesthetic, nature conservation and cost grounds.

Erosion protection

Erosion is a natural process that is essential to the functioning of streams. However, often as a result of the impact of poor management such as overgrazing or excessive bankside cutting, rapid and damaging erosion can occur locally. Where possible, the cause of the erosion should be addressed at source; for instance, the erection of stock proof fencing can be effective in preventing overgrazing. However, in some circumstances rapid rates of erosion can continue to present a management problem. There are a number of techniques that can be utilised to help address this problem. They include the installation of tree kickers on the outside of bends, the installation of faggot bundles and the use of willow spiling. Spiling is a very robust technique, differentiated from faggot installation by its utilisation of live willow, rather than the dead wood used in faggot construction. Freshly cut willow stakes (diameter >50mm) are driven vertically at centres of <600mm close to the eroded bank, along the affected length, taking care to return the line of stakes into the bank at the upstream and downstream ends. Fine 'wands' of freshly cut willow are then tightly woven between the uprights to form a densely packed 'hedge'. It is again essential to key the ends of the wands into the bank at each end of the spiling. Willow roots will grow into the bank behind the spiling, further strengthening it. In subsequent years, the spiling can be trimmed, or coppiced in order to restrict its height and promote dense growth. Failures of installed spiling can be common. These generally result from either:

- Failure to use freshly cut willow. Any material older than a fortnight from cutting should be ruthlessly discarded.
- Wrong timing of installation. Provided the spiling is installed in the period March-June (inclusive), then strong and rapid growth of the vertical and horizontal elements will result in good establishment prior to the high flows of winter. Installation can be undertaken outside this period, but success cannot be guaranteed.
- Failure to ensure adequate keying in of the structure at upstream and downstream limits can lead to damaging erosion behind the spiling.
- Attempting to retain too high a bank behind the spiling. Where the height of the eroded bank exceeds 1m, the spiling should be undertaken in a number of lifts, creating a 'terraced' effect. This will ensure the structural integrity of the spiling, and maximise the chances of successful establishment.
- Failure to back-fill adequately with soil, brushwood, or a mixture of the two.

Vegetation management

Where aquatic vegetation is particularly barren, it is possible to reintroduce this after appropriate conditions for growth have been created. The most appropriate species is water crowfoot, which occurs naturally within the River Asker at certain locations. A number of techniques have been tried, some with more success than others. Those that have worked include:

- The use of brushwood 'snowshoes'. These are constructed from thin lengths of brushwood (generally willow due to its flexibility), woven into the rough shape and size (0.6m x 0.3m) of a snowshoe. They are fixed a few centimetres above the bed of the river using untreated wooden stakes. Floating weed fragments become entangled on the snowshoe, take root and grow on the structure.
- Simple untreated wooden stakes driven into the river bed in order to leave approximately 150mm protruding act to detain strands of crowfoot, allowing them to root and establish.
- Transplantation. Legally, crowfoot can be taken from a donor site in the wild, provided that the landowners permission is sought and is granted. Where possible, donor sites should be located within the same river, or at least catchment. If this is not possible, crowfoot may be transferred from another river system.

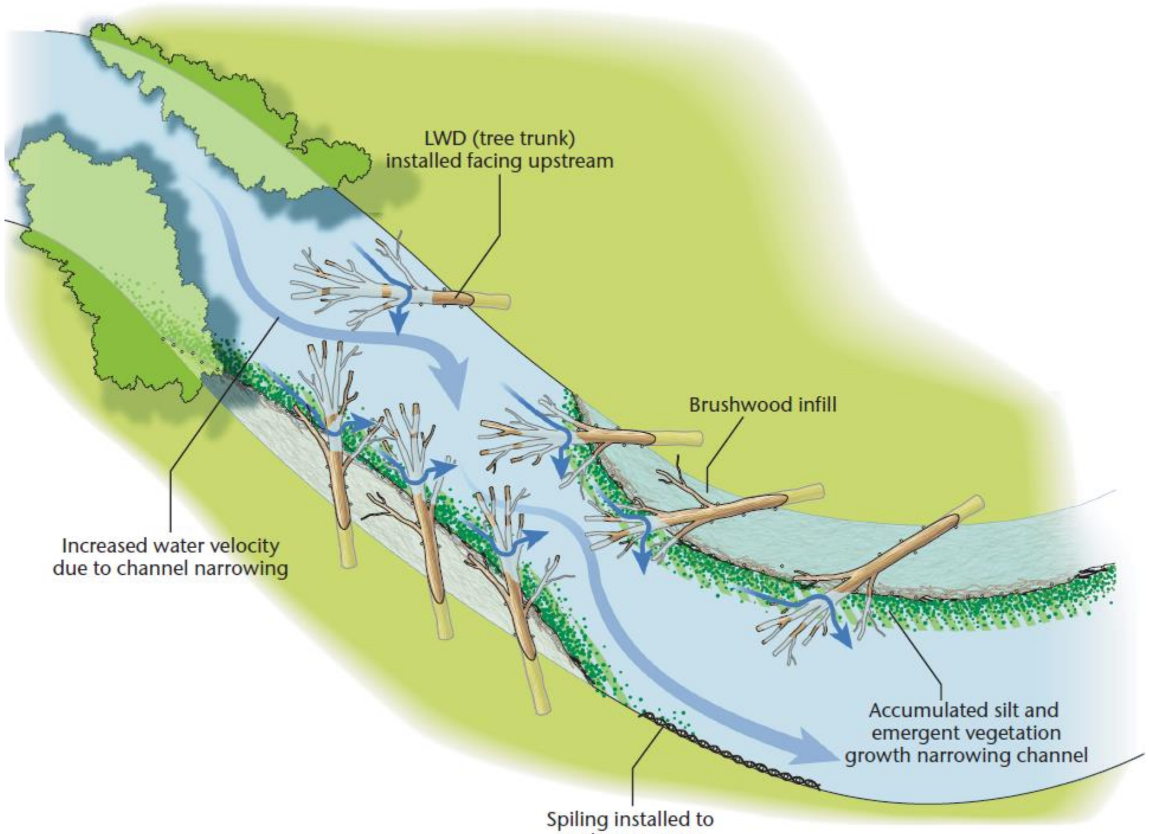

Figure 23: Diagram showing examples of instream structures and their impact on a damaged stream.

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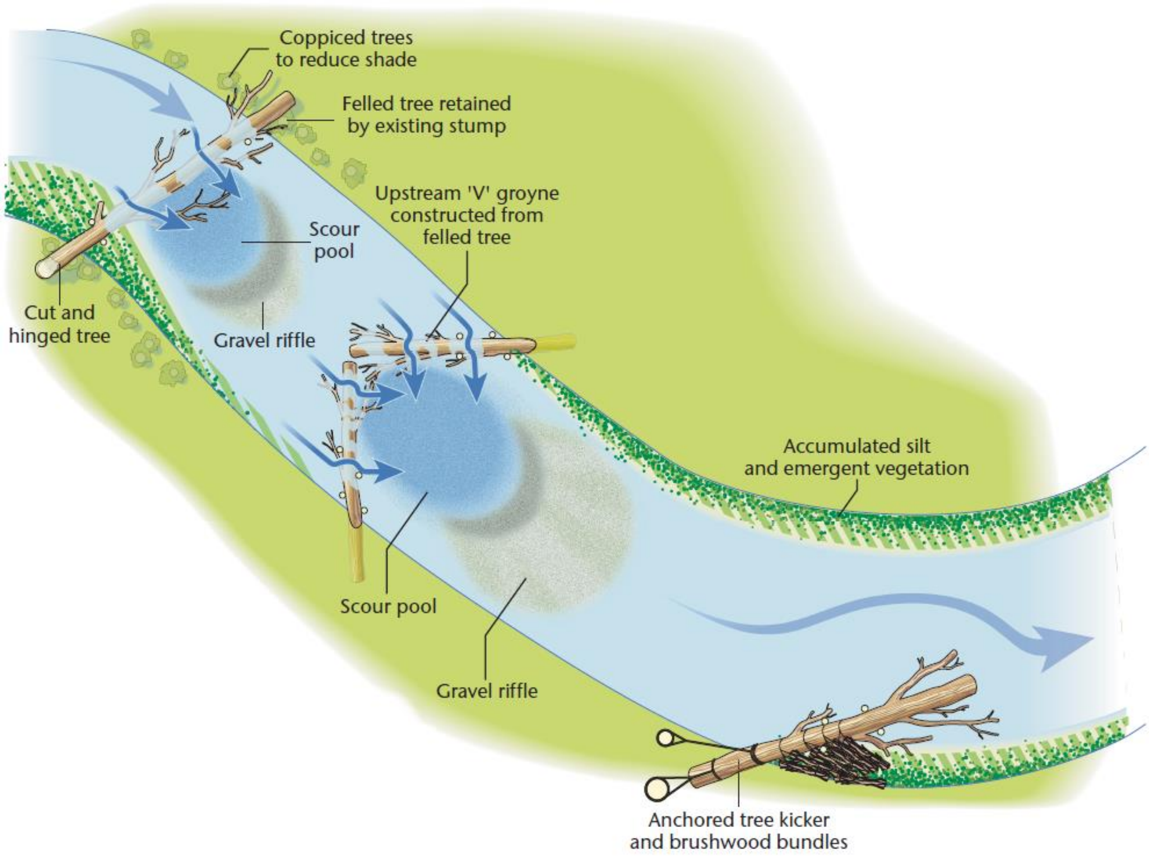

Figure 24: Diagram showing the use of log deflectors to increase variation in depth and sorting of the substrate, creating gravel riffles and scour pools.

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Invasive species[23]

Plants

There are two main invasive species identified within the catchment: Japanese knotweed and Himalayan balsam.

Japanese knotweed is extremely hard to get rid of, with the only options being treatment with glyphosate (foliar spray or direct injection into the stem) or digging it out (this requires a 3m buffer to be dug out as well, including downwards, and the waste to be treated at a licenced facility). Only female plants are found in this country, with the plant spreading through fragments as small as your little finger nail (cutting or pulling it is therefore one of the worst things you can do). Technically, all Japanese knotweed plants in this country are identical clones. Treatment of it is best left to professionals. More information can be found here: https://www.gov.uk/guidance/prevent-japanese-knotweed-from-spreading.

Himalayan balsam is shallowly rooted and therefore lends itself well to hand pulling by volunteers, but only at certain times of the year. With seed pods that explode, spreading seeds up to four metres, you can only pull the plants up until late July. Treatment by glyphosate is also possible, particularly where large stands have developed.

Invasive plant species use the river to spread, with seeds and plant fragments floating downstream to colonise new ground. It is therefore very important that a control programme must begin upstream and work downstream. It is important to identify and treat 'hotspots' where there are dense stands of invasive vegetation. Smaller stands of the plants growing along the river corridor can then be tackled with volunteers.

The timing of treatment is crucial and depends on the method adopted for removal. Where hand pulling or cutting of Himalayan balsam is proposed, this must be undertaken prior to the setting of any seed. Herbicide application is very specific, and must follow best practice guidance and manufacturer's instructions

Monitoring is important. Checks on treated areas should be undertaken twice a year, with repeat treatments made where necessary to ensure elimination of all plants. It is also vital to revisit the whole of each reach at least once a year to ensure that plants have not spread. Constant vigilance and prompt treatment is needed to control invasive plants on any watercourse.

[23] https://www.wildtrout.org/sites/default/files/library/Invasive_Plants_Apr2012_WEB.pdf

It would be comparatively easy to establish a working party of a few dedicated individuals in the catchment, who - after receiving some basic training - could monitor and treat (pull or cut) Himalayan balsam. Landowner permissions would need be sought and insurance held: this could be covered if the work was led by Dorset Wildlife Trust.

Animals

There are likely to be two main invasive species that are impacting the water environment. These are north American mink and signal crayfish.

Signal crayfish are an aggressive crustacean that not only outcompetes our native white-clawed crayfish, but carry a fungal plague that kills off our own species. This plague is easily transported by wet wellington boots and fishing equipment etc. It is therefore very important to ensure that all equipment that comes into contact with water is cleaned, checked and dried before moving onto another river system. More information on this procedure is available here: http://www.nonnativespecies.org/checkcleandry/. There is no known effective method for removal of signal crayfish, and it is likely that they are here to stay, much like the grey squirrel.

Ark sites for white-clawed crayfish exist where they are removed from the main river system containing signal crayfish and with barriers that are insurmountable to them. No sites exist within the catchment.

Mink are voracious predators, particularly of our native water vole. Decedents from animals escaped or released from fur farms, they thrive along watercourses, particularly in the south west. Monitoring to see if mink exist within the catchment can be undertaken using a mink raft (this also has the potential to monitor for water voles and otter). Once positively identified, a trap can be set, and once caught, the individual is humanely dispatched. This will not tackle the wider population known in the area, but may be effective at controlling individuals who use the Asker.

Monitoring & education

There is an opportunity in the Asker Catchment to use 'Citizen Science' to monitor the state of the river and the effectiveness of installed habitat restoration solutions. There are several established river-based methodologies, particularly the Riverfly Partnership (www.riverflies.org), Westcountry Rivers Trust Citizen Science Investigations (http://wrt.org.uk/project/become-a-citizen-scientist/) and the Game and Wildlife Conservation Trust's mink raft (https://www.gwct.org.uk/wildlife/research/mammals/american-mink/the-gwct-mink-raft/). With a few dedicated volunteers, a local coordinator and a network of sites throughout the catchment, it should be relatively straightforward to establish a robust monitoring regime. This regime could include several elements:

- Riverfly monitoring, using the Riverfly methodology which feeds data to the Environment Agency.
- Himalayan balsam spotting and monitoring of treated sites.
- Mink raft monitoring (for mink, water vole and otter).
- Water quality assessment, using the equipment available from the Westcountry Rivers Trust:
  - Turbidity tube: these measure how murky the water is. Brown, muddy water is a sign that soil is getting into the rivers.
  - Total Dissolved Solids probe: measuring TDS gives us an overview of the quality of water in the river, by measuring the level of inorganic salts. These salts may come from natural sources, but can also come from sewage or run-off from industry, agriculture and urban areas.
  - Phosphate test kit: Phosphate is a nutrient used by plants, and is often applied to farms and gardens to improve plant growth. However, when it washes off into water, phosphate can cause some plants and algae to grow too much, outcompeting other plants and blocking out light.

It would only need four or five monitoring points along the main channel of the river, with pairs of volunteers undertaking monitoring at each of these sites over the survey season from April to October, combined with a central coordinator who would look after the equipment, book it in and out, and collate the results to run an effective scheme.

An indicative equipment list would include:

- Thigh waders x 2
- Sampling net x 2
- Sorting trays, spoons, lenses etc.
- Mink raft and clay pad x 2
- Water quality kit x 2
- Identification keys x 4

The river could also be used as part of an outdoor classroom for Loders CE Primary School, where children could learn more about their local river, its history, wildlife and the role we can all play in protecting rivers for the future. Sessions run by the Wandle Trust (https://www.wandletrust.org/education/), which could be adapted for delivery on the Asker, allow children to take part in a wide range of sensory activities and games on the riverbank, all linked to the national curriculum. Activities can include river dipping for invertebrates, measuring river speed, wildlife-eye spy, map and compass work, and lots more.

These outdoor sessions come under four main themes:

- The River and its Wildlife
- Water Quality and Pollution
- Mills, Industry and History
- Geography and Fieldwork

CATCHMENT OPPORTUNITY MAPS

Over the summer of 2018, surveys were carried out, where land owner permission was secured, along the length of the River Asker and its tributaries. The following section presents maps that illustrate the findings of these surveys. The survey sections are outlined in Figure 24. The maps should be viewed in conjunction with the previous sections.

The purpose of the walk-over was to identify issues linked to the issues described in 'Catchment Pressures' and identify feasible opportunities for tackling these through solutions described in 'Catchment Opportunities'. The survey gives are not exhaustive, as resources did not allow for this approach. However, it highlights general areas of concern and opportunity and more details will be gained prior to undertaking any solutions.

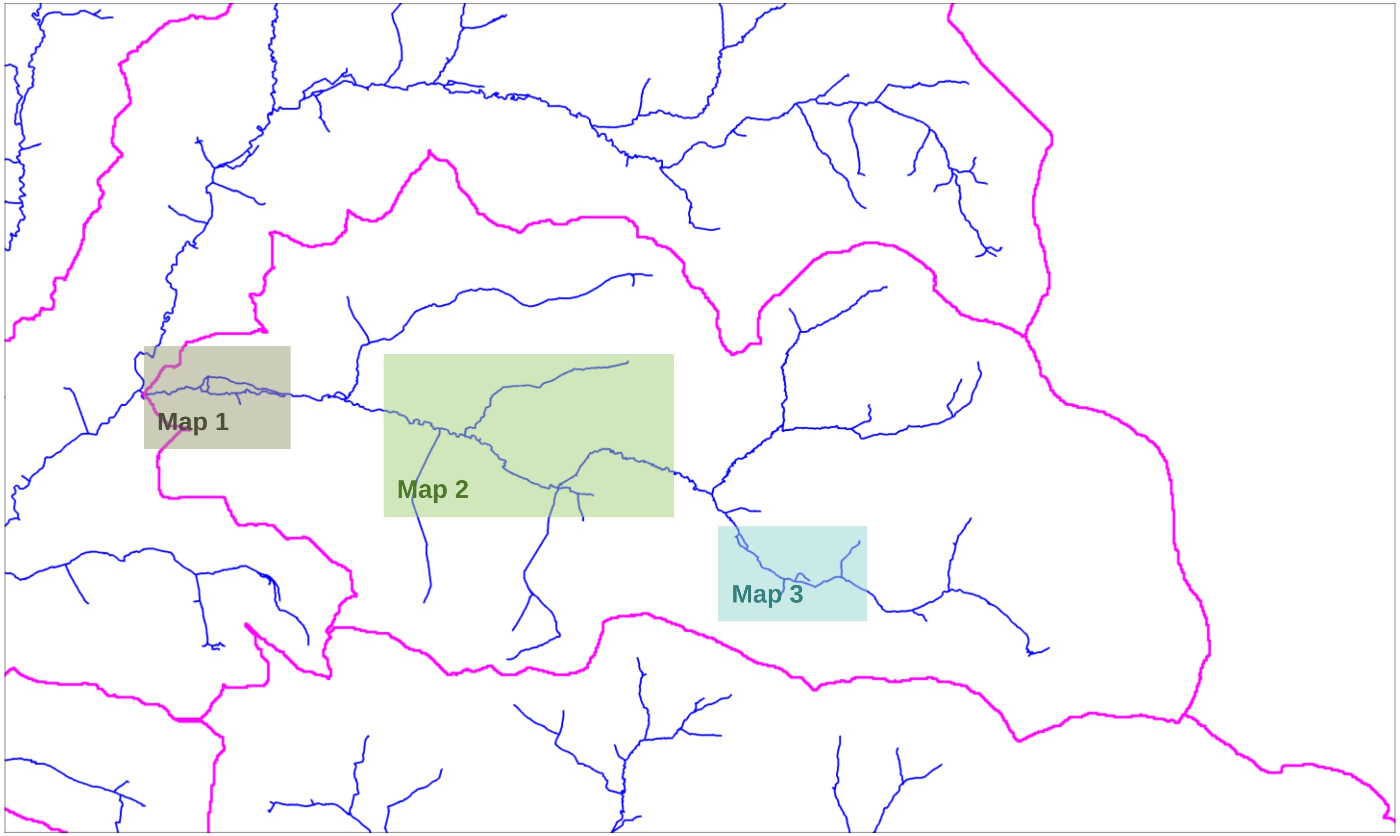


Figure 25: Map showing the reach maps for the sections of the River Asker and its tributaries, surveyed in 2018.

Map One: Loders

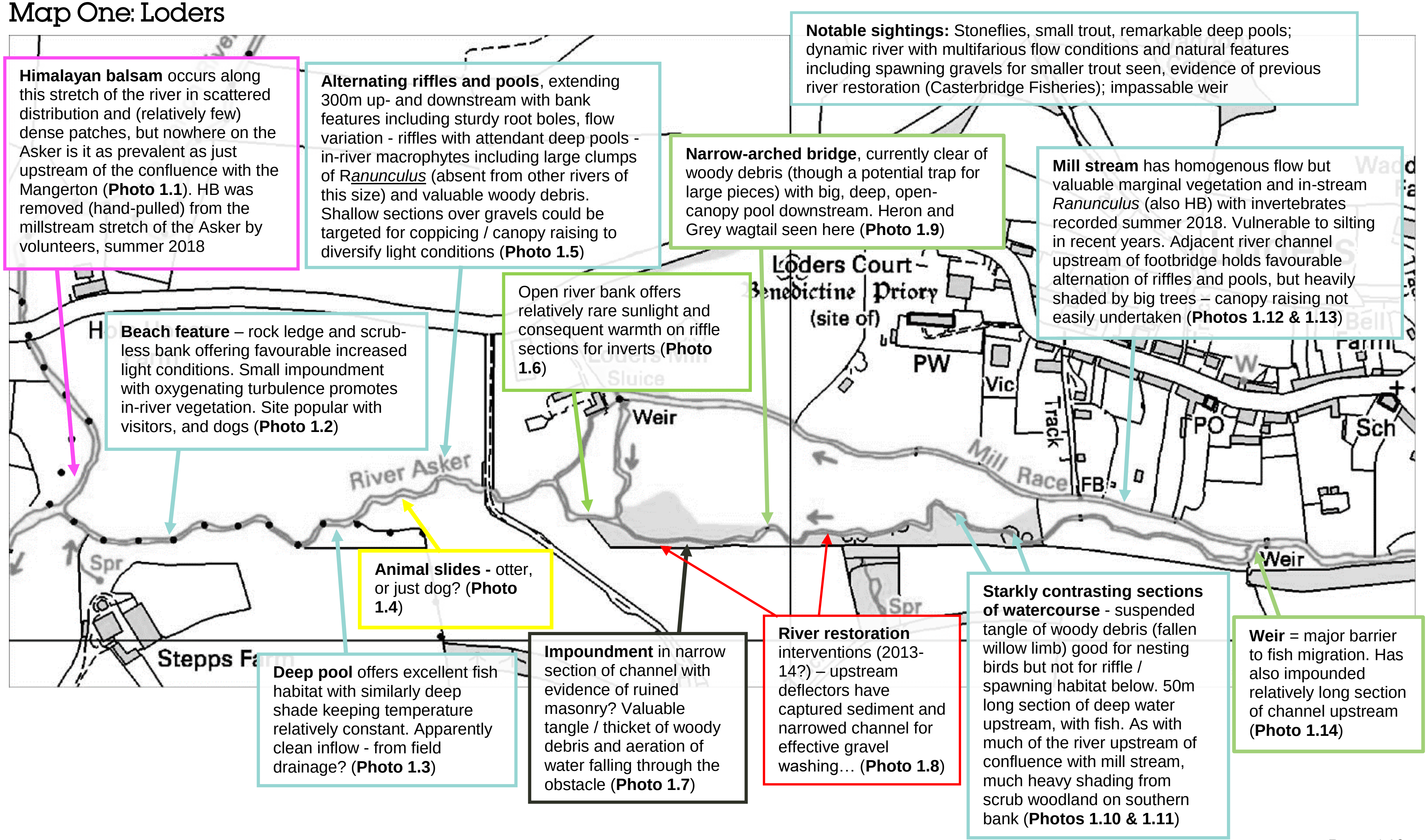


Photo 1.1 Detrimental occurrence of Himalayan balsam at confluence of Asker and Mangerton

Photo 1.2 ‘Beach’ feature

Photo 1.3 Deep, shaded pool (c. 1m at deepest): excellent resting habitat for fish, followed by riffle with nice woody debris tangle

Photo 1.4 Animal slides

Photo 1.5 Diverse river morphology creates valuable flow variation and wildlife features inc. *Ranunculus*

Photo 1.6 Open river bank lets light into the channel

Photo 1.7 Impoundment with ruined masonry feature

Photo 1.8 River restoration interventions – upstream deflectors to narrow the flow and increase scour of the bed

c.200m upstream

Photo 1.9 Narrow-arched bridge

Photos 1.10 Suspended woody debris

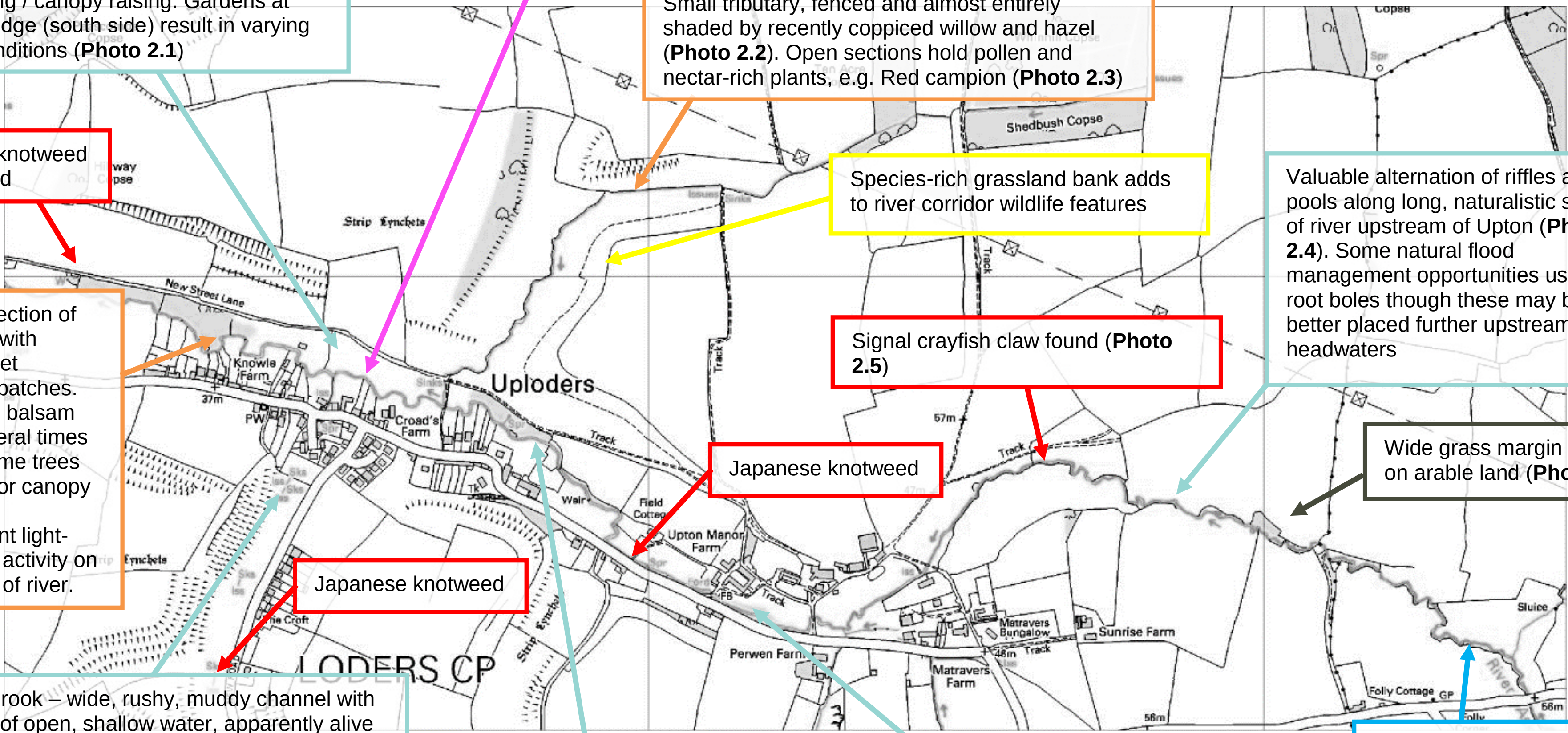
Photos 1.11 Suspended woody debris and long deep section of channel

Photos 1.12 Millstream.

Photos 1.13 Millstream.

Photo 1.14 Weir – a major barrier to fish migration

Map Two: Uploders



Alternating riffles and pools, with abundant bank features, flow variation and valuable woody debris – root boles with attendant deep pools and shallow sections over gravels which could be targeted for coppicing / canopy raising. Gardens at river's edge (south side) result in varying light conditions (**Photo 2.1**)

Himalayan balsam scattered along the river bank and in woodland -pulled annually by local residents

Small tributary, fenced and almost entirely shaded by recently coppiced willow and hazel (**Photo 2.2**). Open sections hold pollen and nectar-rich plants, e.g. Red campion (**Photo 2.3**)

Japanese knotweed in woodland

Species-rich grassland bank adds to river corridor wildlife features

Valuable alternation of riffles and pools along long, naturalistic section of river upstream of Upton (**Photo 2.4**). Some natural flood management opportunities using e.g. root boles though these may be better placed further upstream in headwaters

Wooded section of river bank with valuable wet woodland patches. Himalayan balsam pulled several times a year. Some trees identified for canopy raising to complement light-increasing activity on south side of river.

Signal crayfish claw found (**Photo 2.5**)

Japanese knotweed

Wide grass margin along river on arable land (**Photo 2.6**)

Japanese knotweed

Jordan Brook – wide, rushy, muddy channel with sections of open, shallow water, apparently alive with invertebrates and foraging birdlife. On balance, livestock impact noted as positive. Appealing, grazed valley and floodplain with marginal vegetation on strip lynchets contributing to wildlife food sources (**Photo 2.9**)

Unusually open section of river – bountiful sunlight has resulted in abundant channel vegetation and associated invertebrates (**Photo 2.8**). Suspected Water vole activity but no evidence recorded.

Sections of engineered channel along road with culverts, subject to recent hard engineering. Also, valuable floodplain lakes and ponds.

Otter spraint on in-river boulder – prominent marking (**Photo 2.7**)

Photo 2.1 Woody debris with shallow section and riffle downstream

Photos 2.2 Coppiced canopy shading small tributary; bushy, nectar-rich marginal vegetation

Photos 2.3 Coppiced canopy shading small tributary; bushy, nectar-rich marginal vegetation

Photo 2.4 Appealing, naturalistic channel with alternating riffles and pools

Photo 2.5 Signal crayfish claw

Photo 2.6 Wide arable margin along river

Photo 7 Otter spraint

Photo 2.8 Open, macrophyte-rich stretch immediately upstream of Uploders

Photo 2.9 Jordan Brook – wide 'channel', impacted by livestock but alive with foraging birdlife

Map Three: Askerswell

Possible Natural Flood Management - large woody debris (LWD) dam to attenuate river flow above millstream divergence. Modest pool upstream, fallen trunk nearby to provide material

Bank erosion adjacent to major waterfall – construction of a brash mattress (in conjunction with nearby canopy raising) could help to alleviate erosion. (**Photo 3.2**)

Crayfish: might the Asker headwaters be a refuge for our native crayfish, protected from alien species by the major waterfall barrier below Washingpool Green? Surveys could be undertaken to establish the suitability of existing habitat, presence or absence of crayfish and feasibility of re-introduction if appropriate.

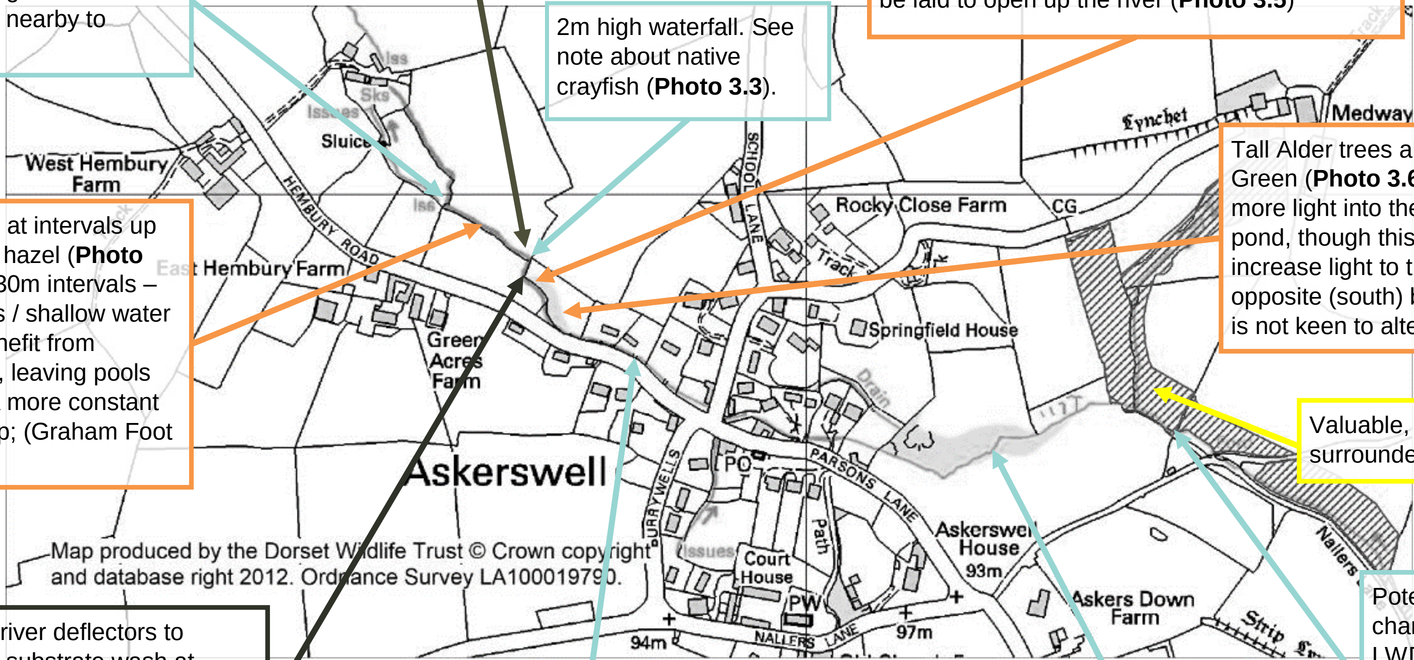
Hedge at west end of Washingpool Green could be laid to open up the river (**Photo 3.5**)

2m high waterfall. See note about native crayfish (**Photo 3.3**).

Potential for canopy raising at intervals up this length of river – mostly hazel (**Photo 3.1**). Coppice trees at e.g. 30m intervals – preferably adjacent to riffles / shallow water where invertebrates will benefit from increased light and warmth, leaving pools under canopy to maintain a more constant temperature for fish to lie up; (Graham Foot & Sean Webb)

Tall Alder trees along river in Washingpool Green (**Photo 3.6**). Could be thinned to let more light into the site and particularly the pond, though this would not necessarily increase light to the river as thorn thicket on opposite (south) bank is dense and landowner is not keen to alter this.

Valuable, wet, tussocky SNCI grassland surrounded by big bushy hedges



Potential bank works or in-river deflectors to alleviate overland flow and substrate wash at times of high flow (**Photo 3.4**); (Graham Foot). Also potential to pollard ash tree at south end of footbridge to prevent it toppling and thereby maintain bank integrity

Engineered channel between SY52759287 and SY53079275 channels river rapidly through the village – little potential for restoration works (**Photo 3.7**). Question as to whether this kind of water environment is suitable for crayfish?

Appealing, naturalistic channel with alternating riffles and pools, flanked by open, grazed woodland with several beautiful mature and over-mature oak trees; (Geoff Barrett). Some bankside coppicing could diversify light conditions (**Photo 3.9**)

Potential NFM site – river channelled between old wall where LWD could create temporary wetland and attenuate high flows in major rainfall events. Specialist opinion should be sought (**Photo 3.8**)

Photo 3.1: Hazel canopy shading the river downstream of the waterfall.

Photo 3.2: Bank erosion adjacent to waterfall – potential for a brash mattress using arisings from nearby canopy raising.

Photo 3.3: Approximately 2m high waterfall under footbridge at West end of Washingpool Green – useful downstream barrier to protect crayfish?

Photo 3.4: Overland flow and substrate wash, SY52729292

Photo 3.5: Potential hedge-laying stretch at west end of Washingpool Green

Photo 3.6: Tall alder copse on riverbank in Washingpool Green

Photo 3.7: Engineered channel / fast flowing water along roadside through the village

Photo 3.8: Potential NFM site at SY53359277 – LWD dam could be built alongside adjacent wall

Photo 3.9: Naturalistic channel with healthy alternation of riffles and pools – some coppicing could diversify conditions

SUMMARY

Despite the Environment Agency's classification, the overall condition of the Asker appears to be relatively healthy. It is, however, suffering a similar fate to many lowland streams in England. With signs of agricultural runoff, abandonment of riparian management leading to increased shade, sedimentation in areas of impoundment, as well as significant issues regarding fish passage; the main reason that the river is classified as poor.

Many of these issues can be tackled by low-tech solutions. For example, managing the impact of shade by canopy raising, restoring natural channel processes by instream improvements as well as improving management of the wider catchment by working with land owners and managers. If time and resources permit, then the issue of fish passage could be tackled, but this would be a major undertaking. Many of these solutions could be delivered with the help of volunteers from the local community.

As well as improving the condition of the river environment, there are also opportunities to improve the flood response of the catchment, again through work with landowners and managers by altering land management techniques at sensitive locations and slowing the flow through the installation structures and creating areas to hold water that can reduce the intensity and duration of flood events.

This report is a snapshot in time, bringing together information that is currently known about the state of the River Asker and identifying opportunities to improve its condition. More information may come to light in the future and new techniques may be developed to help deliver what we want for the river. However, the most important thing is to use the findings of this report, and the new and developed contacts made as a result of preparing it, to help plan action to enhance the environment and create a stronger connection between people and place.