Westcountry Rivers Trust

Yarty: River and Floodplain Restoration Feasibility Study

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Westcountry Rivers Trust is an environmental charity established in 1995 to restore, protect and improve the rivers, streams, and water environments in the region for the benefit of wildlife and people.

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Executive Summary

The River Yarty is a special river, which retains some valuable riverine ecology, and provides a crucial role in providing resilience to the River Axe SSSI and SAC. Its complex geology, rich landscape and mixed valley floor land use, means that location specific actions are needed to preserve and enhance the ecology whilst respecting and supporting communities and cultural assets.

Potential showcase sites for restoration of valley wide wetland systems include locations at Tanlake Farm, Lugg's Farm to Stotehayes, and upstream of Case Bridge. Tanlake Farm would provide a valuable example in the headwater sections of the river, it is a discrete and manageable sized to deliver and would provide localised flood risk management benefits. Lugg's Farm to Stotehayes is a much larger scale restoration. It represents perhaps the most deliverable landscape scale intervention within the main valley and would have significant benefits for the landowners. Upstream of Case Bridge, the scale of earth movement would be significant and potentially prohibitive. However, local flood risk management benefits may provide a critical driver for this option.

A landscape scale reconnection and wetting of the floodplain, combined with wider flush and mires restoration, is possible from Lake Farm through to Lower Yarty Ford. Whilst full scale valley wide wetland restoration might not be desirable, rewetting of the land, and localised raising of the river bed, would provide valuable benefits to the riverine and wider terrestrial habitats. If this included modification of the wet meadow system to retain water on the floodplain, plus reduction in land drainage of the local hillslope (allowing where possible flushes and wet mires to develop), there would be botanical, amphibian, bat, owl, otter and over wintering bird benefits amongst other. This may be the potential location for water vole reintroduction.

The impact of channel change on the aquatic vegetation community, and the apparent deteriorating condition of this in the downstream Axe SAC, means that priority should be given to preservation and enhancement of this part of the ecosystem. Aquatic vegetation is itself a crucial habitat for much of the invertebrate and fish species in the river.

WRT have proposed a trial aquatic plant translocation at the newly restored site at Yarty Farm. Results of this should then inform relocation to all future restoration sites. This should include consideration of importing species from the Axe SAC, given that many of the species have been lost from the Yarty, with the exception in some backwaters and drainage channels.

Furthermore, presence of ranunculus beds should be used to help prioritise sites for localised restoration interventions.

There are a series of important structures along the river which act to control bed levels upstream. Higher Westwater Weir is a massive structure which is under threat of being bypassed. Old Beckford Bridge presents a bed control but may also be a flume flow barrier to fish migration in flood conditions. Yarty Farm's weir and road bridge, plus the wet meadow offtake weir between there and Water House farm, present minor controls. Case Bridge's weirs provide a valuable stable length of gravel to support an abundant bed of ranunculus. Longbridge's invert is fixing the channel conditions immediate upstream. Finally, Court Place Farm ford holds the bed in place upstream but depending on flow conditions and whether gravels block the pipes, it may present an issue for fish migration. Care needs to be taken with the management of these.

A management approach for Higher Westwater Weir is urgently required, since the situation there with the weir being bypassed runs the risk of this location almost completely blocking migratory fish access to the rest of the Yarty, or for major channel incision and instability being triggered for the entire reach upstream – eventually extending to Beckford Bridge.

The support that Blackdown Hills National Landscape provide is critical for taking forward these proposals. It is encouraging to see such community interest and support, which is also fundamental for achieving meaningful catchment scale restoration.

Contents

1. Introduction

The River Yarty flows into the River Axe upstream of the River Axe Special Area of Conservation (SAC) that is failing its conservation objectives primarily due to excessive phosphate and geomorphological reasons. The River Yarty and its ecology is similarly under pressure, which also results in erosion impacts for landowners.

The Blackdown Hills National Landscape have commissioned a River Restoration and Floodplain reconnection study to take a holistic view at restoration of the Yarty, inclusive of all river users and riparian owners, to protect property and infrastructure and justify expenditure to funders (existing and potential).

This builds on the previous studies:

- River Yarty delivery project September 2024 – with initial works at Cuckford Farm through to Yarty Bridge
- 'River Yarty Design Plan' August 2024 – by Julian Payne (Environment Agency) for Yarty Farm.
- 'River Yarty Feasibility Study' (March 2023, Westcountry Rivers Trust- WRT), covering Yarty Farm and Waterhouse Farm.
- 'Yarty Farm and Waterhouse Farm Geomorphology Advice Note' November 2022 by Julian Payne (Environment Agency)

The Blackdown Hills National Landscape aims to reverse impact on the Yarty by piloting targeted nature-based solutions (NbS). These include:

- In-channel river restoration by raising/ restoring the bed of the channel and better reconnecting the watercourse to its floodplain
- Associated floodplain enhancement work including lowering any flood banks, creating scrapes, inlets, bunds and swales to temporality hold water (and sediment) at peak flood events

These interventions are to: -

- Restore geomorphological function and 're-setting' the watercourse channel, such that it becomes less incised
- Store water on floodplains for longer, storing phosphate rich sediment on the land
- Reduce the erosive power of the watercourse and slowing the flow, especially if adjacent floodplains are 'rougher'.
- Provide enhanced habitats in-channel for fish, protected species & other taxa.
- Downstream flood risk benefits and other co-benefits
- Provide floodplain restoration opportunities

The works are to be carried out in three packages. A detailed design study of the Yarty Farm and Waterhouse Farm reach; a feasibility of the wider river from the A30 to Yarty

Farm, with an additional section upstream of the A303; and a stakeholder engagement event.

This report represents the second element, the Feasibility Study of the wider River Yarty reaches. The reports include

a. A summary of Landowner engagement and site walkovers.
b. Consideration is given for the benefits from interventions along the full length (multiple reaches) to create a more lasting and positive change in the river's morphology and to reduce erosion
c. Identification of locations of opportunity and multiple interventions (where relevant). Where appropriate recommendations and prioritisation are made
d. Aerial LIDAR survey data is presented, informing understanding of processes.
e. Where possible considerations relating to CDM regs, planning permission, impoundment, abstraction etc are presented
f. Advice is provided on opportunities for funding and considerations for tree planting
g. Costings for landscape scale restoration measures have not been considered as these need to be considered in more detail within site specific feasibility studies.

2. River Yarty Description

The River Yarty is the largest tributary of the River Axe. Whilst it lays outside of the Special Area of Conservation and Site of Special Scientific Interest sites of the River Axe, it is nonetheless crucial for providing resilience to these nationally and internationally important areas.

The Axe is designated for a river geomorphology that supports a rich aquatic ecosystem. The same species should be flourishing in the Yarty. These include: Short-leaved Water-starwort, a nationally scarce species, and stream and river water-crowfoot (*Ranunculus)*; Atlantic Salmon, Bullhead, Brook and Sea Lamprey, as well as both Sea and Brown Trout; a wide variety of habitats for invertebrates including several scarce dragonflies and damselflies, caddis flies, flies and true bugs; Kingfishers, Sedge Warblers, Reed Buntings, Grey Wagtails and Sand Martins; as well as Otters. Water voles might also have been present in the past.

As well as its critical role for the Axe in terms of providing supporting habitat and populations for these aquatic species, the Yarty is also significant in delivering large quantities or cobbles and gravels to the Axe. Without the Yarty, the Axe is extremely limited in availability of the larger stone due to the different geological layers in the upper Axe.

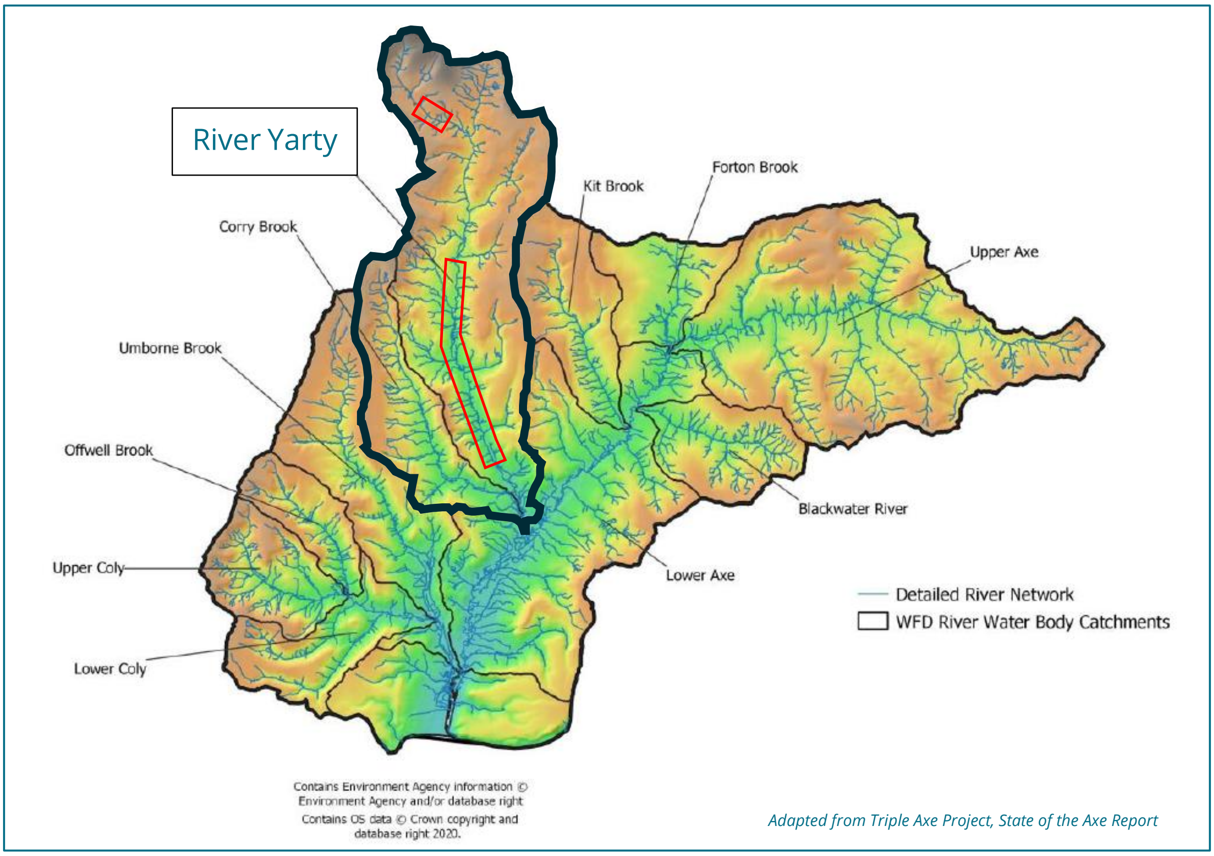

Figure 1: The River Yarty within the overall River Axe catchment, with project area in red

2.1 Geomorphology

The River Yarty has been a cobble bed river that supported salmon, trout and lamprey as well as water crowfoot (Ranunculus) and other floating vegetation species. For these species to flourish, they need the riverbed to be stable, to resist being frequently washed away in floods.

Human modifications over the millennia have included water meadows, mill least and weirs, bridges and ford crossings. In the last couple of centuries, river management pressures have increased focused on land drainage, and hence flow capacity of the river. This involved removal of in channel vegetation and woody debris, gravel and cobble removal and dredging, with some straightening and rerouting.

Furthermore, since the 15th and 16th century, the removal of wooded hillsides and hilltops for agriculture has resulted in releases of large amounts of sediment. This material drops out across the valley floor, increasing the height of the floodplain above the river channel. Before this began the valley floor would have taken the form of a shallow wetland, either wet woods or marsh. These wetland systems have effectively been buried by the released sediment.

Higher flood plains prevent flood waters from spilling out across the valley floor and their energy being dissipated there. Clearance of the channel also increases the velocity of the water. The combined effect is the containment of more flood water in the channel with higher velocity.

As the flood velocities increased over time, the once stable riverbed cobbles became mobile, and the entire bed is now susceptible to erosion. This erosion takes away the stone beds that the fish and the floating vegetation rely on. Erosion, which is now also undercutting historic gravel layers, is causing faster bank erosion and rates of land loss.

Some understanding of the geological setting helps appreciate these pressures, and hence options for managing them.

The underlying geology of much of the River Yarty valley is mudstone, with a band of sandstone mainly along the eastern hillsides. Along the very eastern ridge, from Membury up to the north, there is a small topping layer of chalk.

Crucial to the health of the river, and its ecology, is the overlying superficial geology. Much of the hilltops and valley sides are overlain with clay and flints along the east, and glacial head deposits through much of the central part of the catchment. These layers are a major source of cobbles and gravel for the River Yarty.

Peri-glacial processes, including hillslope failure, have laid layers of cobbles and gravels across the former valley floor. Later, river flooding and stream erosion have provided additional stone to the channel and valley floor.

As such, the River Yarty's health and stability has relied heavily on the presence of a layer of cobbles and gravels laid down at the end of the last ice age. In places these layers can be seen in the riverbanks where the river has now eroded down through them. In a few locations there is evidence of the wetland systems that existed after the ice-age and right through to at least the medieval period.

Whilst fluvial processes associated with side streams cutting through flint and head deposits on the hillsides provide some renourishment of stone to the river, this is not sufficient to replace the amounts currently being lost from the main river by erosion. The stone coming in is also not of a size sufficient to resist being mobilized by the Yarty.

Therefore, now that the river has eroded below the cobble and gravel layer, there is nothing to prevent further erosion down into the underlying mudstones and fine deposits. Without intervention, the river is incapable of healing itself.

We are therefore seeing, and should expect further increases in land loss, reduction in the ecological value of the river (especially its fish population and floating vegetation), and increased pressure on the downstream River Axe SAC (through increased siltation and loss of the supporting spawning grounds of the interest feature fish).

3. Study Reach descriptions and intervention proposals.

The study brief was to cover the river from Case Bridge to the A30 and at a short length of river at Birchwood. This extended previous work looking at the river from Beckford Bridge to Case Bridge. WRT has also included the length from Higher Westwater Weir to Beckford Bridge. This ensures that a complete understanding of the Yarty is presented from this major weir which both controls river processes and impacts fish migration.

The river is discussed for sections of river between road crossings, starting at the upstream location and working downstream.

3.1 Birchwood

Figure 2: Three intervention reaches considered, with a heat map of valley floor drainage features

Birchwood is only 2-3km from the source of the Yarty. It is very much in the steep headwaters. This steep topography leads to a very energetic river.

The geology is a complex mix, with greensands through to blue lias. This produces bed materials of sand through to large slab boulders. Permeable soils also result in significant amounts of spring flow and frequent drainage channels.

The valley form is well defined, with active spring and stream inputs. It includes relics of mill least systems, dynamically adjusting channels and valley bottom wetlands, as well as slumping terraces along the valley side. The channel is now actively incising, although where the road bridge and embankment restrict the floodplain there is rapid accretion of flood deposits across the valley floor.

Figure 3: Complex underlying geology revealed in the eroding river bed

Tanlake Farm represents a valuable site to demonstrate restoration approaches for the upper Yarty. This could include a stabilisation of the existing channel in the upper length which would reconnect it to its floodplain corridor, and valley wide wetland restoration in the lower length.

Short term measures are recommended ahead of the larger scale intervention.

a. In the upper section of the Farm, dramatic incision is destabilising the river. Without prompt action, the river will cut into the hill slope towards the west, this will likely lead to hillslope failure. The deep erosion will also travel upstream and destabilise the river there.

   Bed raising and reinforcing is proposed as the main strategy.

   In the tight, deeply eroded, meander bend the channel should be filled with oversized stone mix to between 0.6m and 1m in depth. The stone infilling should taper down in depth towards the upstream limit of the farm, raising the river bed there by only 200mm or so. The intention of this infilling would be to ensure that small floods are spread across the valley floor, stopping their energy from being concentrated within the channel. This would increase stability, reduce erosion risks to the west, improve fish and macrophyte habitat, and increase water table levels to encourage wetland creation adjacent to the channel. Stone ranges from 25mm to at least 400mm should be included in the stone mix,

   The narrow valley floor to the east should be planted to establish a dense wet woodland (willow, alder, hazel, black poplar and birch). This is needed to prevent the excess flows that bypass channel from cutting a new route. Dead wood should be installed across the width of the valley floor to slow flows whilst the woodland is becoming established.

Figure 4: narrow valley floor to plant as woodland, and eroding bend to infill

b. In the lower half of Tanlake Farm, downstream from the route of the old leat, the floodplain has accreted. A wet woodland is forming at the lower end of this section, with a bifurcating channel. This hints at the nature of the former wetlands of the natural river system. However, knickpoints are developing through this which will lead to drying out of the wetland. The edge of the floodplain is being eroded and a flow path developing to the southwest of the wet woodland.

   A bold restoration is possible here where the entire valley floor adjacent to the wet woodland is excavated down to the same ground levels as in the woodland. Excavated material could be redistributed on the field slopes above to the south and west. The lowered area would need to be planted up with willow, alder, hazel, black poplar and birch. Plenty of dead wood would need to be laid across the floor to slow flows whilst the vegetation became established.

   Attention is needed at the knickpoints (drops in bed level). Below any existing knickpoints, a mix of boulders and oversized stone mix, could raise the channel up (tying in to levels at the next section of shallow stable bed downstream). Alternatively, the incised channels could be infilled with brushwood that is held in place with live willow stakes. This would rely on the wash through of stones from upstream in floods to rebuild the bed.

The combined restoration through the farm would not only create priority wetland habitat, trout and possibly lamprey spawning habitats, but it would also provide flood storage and attenuation benefits for properties downstream – notably Otterford Mill. The road drainage would also be improved, since the outfall into the field is prone to blocking by a significant depth of sediment.

A feasibility study is recommended to evaluate this option further and determine cost estimates and funding approaches. This may cost in the region of £5-10K. Planning permission may be required for such a scheme, and the feasibility should include pre-planning consultation advice. Following this a detailed design should be worked up for the construction.

The restoration scheme should be able to be designed to align with Countryside Stewardship Higher Tier 'Making room for the river to move' or 'Connect river and floodplain habitats' options. The scale of the woodlands may be too small for England Woodland Creation Offer or Woodland Trust scheme, so funding such as Farming in a Protected Landscape may be important to support implementation.

Due to the time required to develop and implement such a scheme, it is recommended that short term measures are implemented as soon as possible. These would support recovery and avoid deterioration. This should focus on filling the channels downstream of knickpoints with brash ort brushwood that is staked in place with live willow stakes. This would prevent the bed incision from migrating through the existing woodland.

A further immediate measure would be to pack the front of the eroding hillslope with a dense mattress of brash or brushwood. Again, staked with live willow.

Figure 5: Developing wet woodland, set lower than valley floor which might be lowered

Figure 6: Example knickpoint and hillslope erosion where live willow staked brushwood may manage

Downstream of the road bridge, the channel is constrained by the property boundary of Otterford Mill, and high ground to the north east. There is potential here for the river to be rewidened, since it a appears that a sediment berm has built up and become vegetated with trees along the left bank. If the channel width were restored, oversized stone could be introduced to prevent the bed levels from incising and impacting on the proposed wetland upstream, without affecting flood risk to the mill.

Figure 7: left hand side berm might be removed, and the bed reinforced with large stone size mix

3.2 A30 to Court Place Ford

The reach downstream of the A30 varies dramatically in nature. This reflects the changing underlying geology and constrained valley floor, as well as changes in management.

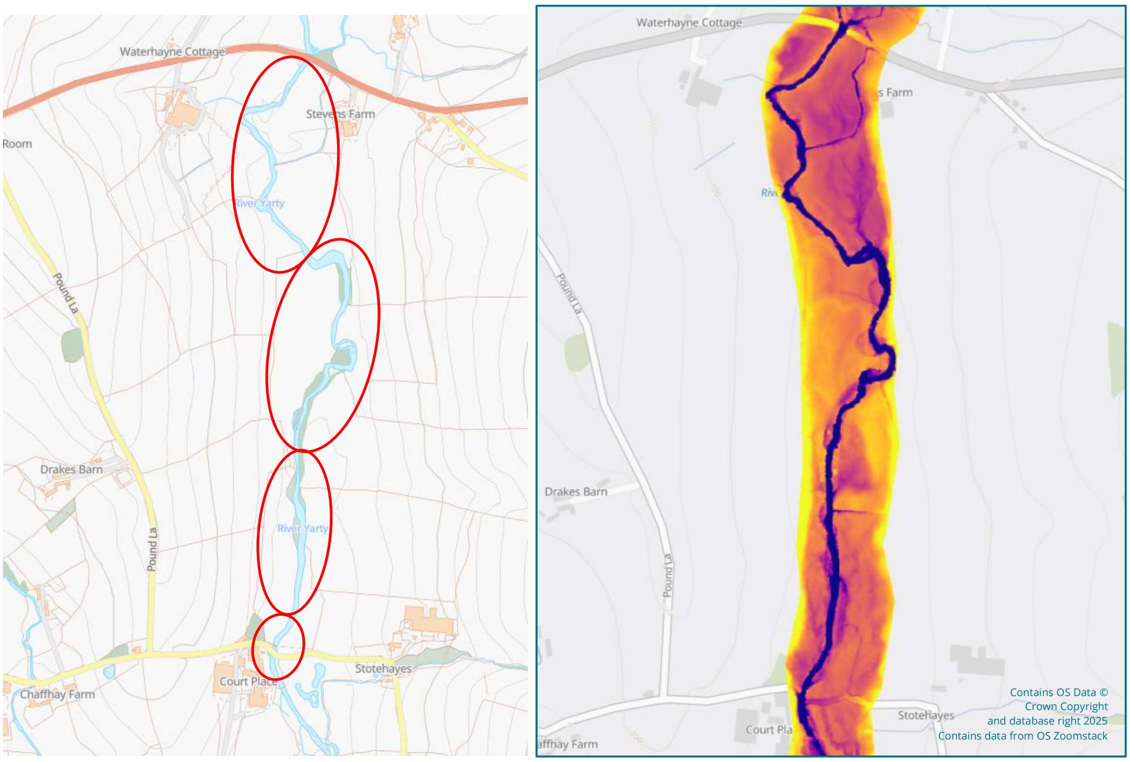

Figure 8: Areas of four changes in river character, with a heat map of valley floor drainage features

For 300m south of the A30, the river follows a well-defined treelined route, with gently sloping valley sides extending to the narrow river corridor. However, as it meanders over to the east of the valley, it cuts deep, with a wide channel abutting the higher ground beyond. The persistence of the instability here is evident in the exposed and broken pipeline at the apex of the bend.

For the next 400m or so, the river cuts a deep swathe through the constrained river corridor. Within this corridor the channel frequently shifts it route. All stable cobble and gravel beds have been lost, with the river cutting into the underlying clays. Deep waters are impounded by temporary accumulations of gravel and cobbles, with heavily silted conditions in between.

Figure 9: the upstream treelined stable channel, and start of the bed incision and instability

Figure 10: Deep incision and instability in the constrained central river corridor

For much of the lower section, the river flows in a shallow channel, with low lying land on both sides. There is a lack of riparian vegetation with past grazing pressure. Midway there is a run of fairly stable gravels and cobbles, which for some reason lack any floating vegetation. This may be linked to the heavy levels of siltation through much of this section, and indications of nutrient loading.

Figure 11: the lower reach is more stable, with shallow channel and stable gravels, but lack of floating vegetation, silt and algae suggest possible nutrient and past grazing and packing pressure.

As the river heads towards the footbridge and ford, it is constrained by the hedge line and driven by the gradient over the ford. The energy resulting from this combination has recently reactivated the channel, such that the footbridge has become undermined, and the flood warning gauge is threatened. Without the ford in place, the erosion and instability would be significantly worse and would be expected to migrate upstream.

Figure 12: The constriction of the hedge bank and drop off at the ford is triggering instability immediately upstream resulting in the undermining of the footbridge.

The upper reach needs to be managed to ensure that erosion pockets do not develop and lead to destabilization. Importing oversized stone mixed into areas of incising bed would help address this. Brash mattresses could be live stakes in against any exposed riverbank sections. Mature trees should be managed to ensure that they do not collapse, so targeted laying of trees against the riverbank, and coppicing should be considered.

A wider vegetated margin, allowing for a secondary row of trees to become established would support the stability of the mature bankside trees.

The central section needs to be addressed at scale, on a reach length basis. Attempting to resolve pressures for individual short lengths at a time is liable to lead to outflanking or undermining of the interventions. This can be seen occurring where trees collapse into the channel and form tree jams, but only with a small number of trees in each location.

An option may be to try to raise the riverbed by a series of rock ramps, with brush wood mattresses infilling the channel in between. The rock ramps may be some 50m apart – although this would need to be determined at the detailed design stage. Further large woody tree jams (ideally using live trees, or trees fixed in place by large live wood stakes) with around 5-10 trees per jam, and tree jams every 10-40m, would improve stability.

In addition to raising the bed through the reach, where the right bank is being cut into, over-sized stone mix revetments might be included. On the left bank where the higher ground to the east is being cut into, dropping in a boulder array may also provide a back stop against erosion.

It is advised that a feasibility assessment is carried out for this central section to develop the understanding of the intervention, construction constraints and any land use implications. Detailed design and construction of this scale of works may well be in the order of £100K

In the lower reach, livestock management and the creation of a robust vegetated riparian buffer would be valuable for restoring the reach. The shallow channel depths and relative stability hint at its ecological value. Investigation of nutrient inputs would be useful to determine if this is affecting the ecology in this reach. Once pressures are managed on the reach, reintroduction of floating vegetation would increase the value here.

Retention of the flood warning gauge and the reinstatement of the footbridge may drive some action at the very downstream of the reach. Due to the pinch point and the gradient here, pressures will remain, although the interaction of these with management of the shoal needs to be explored further.

Works at the footbridge should also take into account interventions being carried out downstream of the ford. If restoration downstream of the ford can be designed to slow flood flows and to raised the downstream water level, then tree planting and live staked brushwood bank works might suffice to stabilise the banks. Reinstatement of former bank lines, such that they funnel flows directly at the footbridge, might also reduce the buildup of gravels here.

3.3 Court Place Ford to Long Bridge

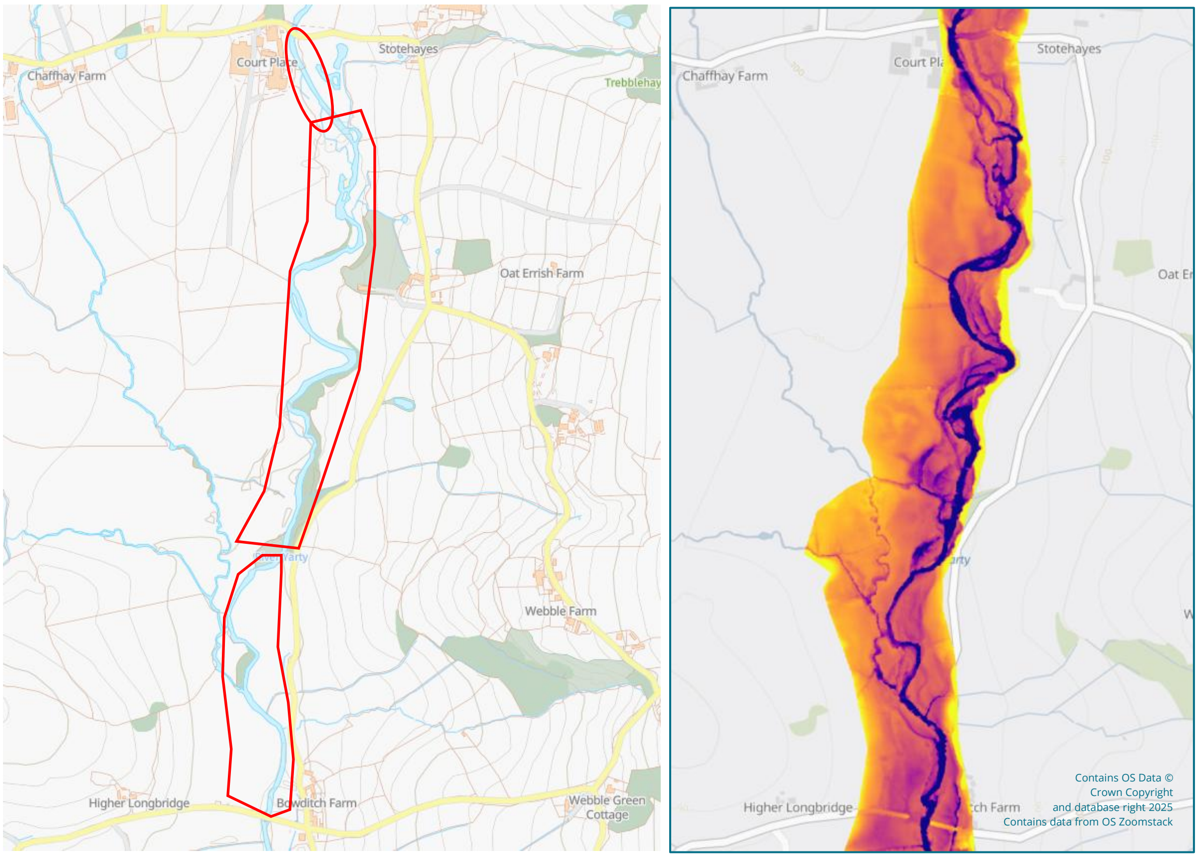

Figure 13: Three intervention reaches considered, with a heat map of valley floor drainage features

The reach is considered from the piped ford. When the pipes are blocked with river gravels, the ford acts as a weir. The connection to the floodplain upstream is obstructed by the hedge banks running from the ford to high ground in the east.

The eastern floodplain appears elevated compared to the channel. It is not clear whether this has been raised in the past, covered by terrace material, or if the river has been moved to the west and subsequently cut down. Aerial surveys suggest that a channel may well have flowed where the southern pond is located, with an even older route against the eastern valley slope and the location of the northern pond. It is possible that the river was moved to use these ponds for power or for water meadow systems.

Downstream of the ford the channel has been modified with the inclusion of large boulders on the right bank installed as bank protection, to the naturally higher ground to the west that supports the farm buildings.

The combination of the above features has resulted in a fixed river set within a constrained river corridor.

Within 100m of the ford, the floodplain and river start to become less constrained. The channel shows signs of active incision. Its route is clearly meandering across the entire width of the valley floor.

This meander migration and incision is causing significant erosion pressure on the east, where access routes and the steeper eastern valley hillslopes are being threatened. There are signs of some pressure on the western bank developing. If these are left untended the erosion will gain pace and scale.

The resulting wet woodland in this central area of change does include rich habitats; however, the instability remains a persistent threat to these.

The southern 450m of the valley has been in reasonably stable pasture, although midway down earlier bank protection measures are now being exposed and eroded.

The principal pressure in this southern section is associated with the lowering of the riverbed. This increases erosion energy locally and undercuts the riverbanks. The start of rapid instability and lateral movement of the channel is now underway, which threatens the extent of pasture and access through it.

There are areas of wet grassland in the upper part of this section, appearing to be associated with a former river channel route. This gives an indication of potential to establish ecologically rich floodplain grazing marsh habitats. This part of the river also includes a short length where the river channel is notably shallower, which would be a target condition for restoration.

3.3.1 Interventions for the ford and 100m downstream

For the initial northern section, consideration should be given to the ford crossing and whether it should be modified or replaced. In higher flows, with the pipes blocked, there appears to be some fish passage on the western side. However, in lower flow conditions, and potentially with the pipes free flowing, fish passage will be more restricted. As noted in the report section above, however, the presence of the ford does at least prevent bed incision from migrating upstream.

The boulders placed downstream of the ford dissipate some energy but are themselves contributing to localised scouring of the riverbed. The channel remains deep on this western side, threatening the toe of the steep bank upon which the farm buildings are located. The channel downstream is incising, no doubt partly in response to changes in the central section downstream.

As this incision migrates upstream, the western bank will be destablised again, releasing the ad hoc bank protection works and threatening the farm buildings. Furthermore, fish passage issue at the ford will be exacerbated.

Raising and protecting bed levels at the downstream of the length of river should be the starting point of consideration. This might be to import a loose array of boulders, around 500mm in diameter for the downstream 50m. As a loose array, and ideally set slightly into the bed, they should start to trap and accrete gravels and cobbles that are washed in from upstream. This will then naturally raise the bed in normal flow conditions whilst resisting incision in flood conditions.

Figure 14: Flows pass over the pipe ford, with flows and bed incision concentrated on the western side

From the ford for the next 50m, consideration should be given to reconstructing the right (western) river bank. By creating a new wide bank, extending 3-5m into the current channel, the river will be forced back to its former route to the east (and where there is now a vegetating exposed gravel bar). The form work of the new bank could be large stone mix with large live willow stakes in. Reinforced soil, fronted with live willow stakes into the bed, or staked in live trees, might be an alternative.

These works might be delivered and funded separately, such as through Farming in a Protected Landscape, so that the farm building is secured. Alternatively, this might be delivered in combination with a wider scheme for the central section. As a standalone project, costs may well be in the order of £10-20K.

3.3.2 Interventions for the central section past Lugg's Farm

This section includes the most dynamic river form. Wide channels are cutting into the banks and even the valley side, leaving woodlands to develop on flood deposits.

There are a couple of places where the right bank is being eroded, with threats of loss of farmland (the upstream most pocket, once started in earnest is liable to cause significant impacts). On the left bank, there are three sections of erosion which are of concern; the most upstream will develop further to threaten the access down from Lugg's Farm at the north; the second has almost entirely cut access along the valley floor and may reach and threaten the hillslope beyond; the southern cutting is eroding the valley side and is compounded by hillslope failure from above.

Within the valley floor where vegetation has established on flood deposits, there is a mix of wetlands and wetwoods. Further ecological assessment of these habitats is required to understand their value and any constraints on measures here. However, otter prints confirm their presence.

Figure 15: Upstream left bank erosion; the banks are formed of terrace fill above underlying clay geology layer

Figure 16: Upstream right bank pocket erosion, will develop quickly into the field; downstream eroding bend – extent of erosion demonstrated by the exposed land drain to the right of the photo.

Figure 17: Middle left bank erosion threatening access; and the eroding cliff downstream

Figure 18: Dynamic wet valley bottom habitats.

Localised, short-term measures may well be required to stabilise the river banks throughout this section of the river, if further loss of land and access is to be avoided. Given the scale of the processes, however, localised measures will only provide temporary relief. They will be prone to undercutting or out flanking in the longer term.

It is therefore suggested that a large landscape scale restoration of the river and valley floor is also progressed as a priority. Given that that this area of the valley floor is not in productive agricultural use, it offers the chance to create a bold demonstration valley wide reset restoration.

a. Short term bank erosion measures

All the erosion locations, other than the eroding cliff, might be addressed by installing a barrier revetment, to streamline the river bank and protect the eroding bank. Three types of approach are considered below.

- For greatest stability and resilience, an oversized stone mix revetment, with large live willow stakes might be constructed along their length. The mixed sized stones lock together to give resilience, the largest sized of the stone mix should be at least up to 400mm in diameter. Live stakes buried within this material will break up flows and reduce velocity along the stone bank. The stakes themselves should stick out into the flood flows, however, once they sprout, the branches will further dissipate local velocities.
- Alternatively, a more cost effective, but potentially less resilient option would be to use brushwood to create the sloping revetment instead of stone. In this case the live willow stakes would need to be fixing the brushwood in place; some additional ties may also be required to hold this in place.
- A further option would be to import live willow trees, fixing them in place along the length of the eroding bank. The trees should include their canopy (to dissipate local river velocities) and should overlap each other with trunks placed upstream and canopy downstream.

For both the middle, the left bank erosion, and the two right bank erosion areas, some encroachment into the current channel may well facilitate creation of a more streamlined and resilient bank alignment. In all cases, ensuring that the protection extends well beyond the main point of erosion is important. Otherwise, the protection will be prone to failure either through undercutting, or erosion cutting away at the upstream and downstream ends of the works.

b. Short term measures for the eroding cliff

The cliff has two failure mechanisms occurring. Along the toe of the cliff the erodible clay geology is being cut into by the river, taking away the foundation of the cliff. The upper part of the cliff is terrace deposits. The terrace deposit's collapse is driven by both the undermining of the toe, but also seepage and hydrostatic pressures from the hillslope above. This feasibility study can only consider management of the river's erosion of the toe. Further geotechnical advice is required to manage the stability of the upper part.

A detailed assessment of the bend will be required to determine the most appropriate means of keeping the river from cutting at the toe of the cliff. Such designs will need to consider the length of the works, the depth (to manage risks of undercutting), and the alignment. Significantly the length of time that these works are liable to be in place before a larger scale intervention is carried out will be an important factor in the design.

There are risks that if too small or too insubstantial a measure is put in place, it will fail and lead to increased localised erosion of the river bed and the cliff's toe. In so doing it could exacerbate the problem.

Solutions such as a willow spiling hedge bank, a mass stone, or a rip-rap (a stone mix) revetment may be feasible. As noted, it is important that these extend along the full length of at-risk bank line. They may be constructed into the existing channel, however, careful consideration of the alignment of this is needed to avoid increasing bed erosion.

c. Landscape scale valley wide restoration

Stability of the river and valley floor corridor are controlled by the underlying geology, the stone size range in the river bed, the relative height of the valley floor to the channel, the widths of the channel and valley floor, and the overall roughness created by the vegetation and the complexity of the river and valley form features.

In this reach, the floodplain is not as deep as it is in much of the Yarty valley. The floodplain is fairly narrow though. There are areas of woodland that do slow flood flows, however, there are significant open areas. Indeed the woodlands are not especially dense and they do not contain much fallen timber. The cobbles and gravels within the channel are all excessively mobile.

A valley wide reset approach would therefore be:

- to lower the floodplain further, to create a valley wide wetland with an elevation perhaps only 250mm above the river bed levels,
- to create multiple small-scale channels through this valley wide wetland, and

- to significantly increase the density of tree cover through tree planting. The initial restoration phase would also require importation of large numbers of trunks and ideally live trees with root balls intact. These should be staked in place. They would replicate the complexity of a mature woodland system and protect the newly planted trees whilst they become established.

The valley wide reset should ideally start within the Stotehayes curtilage - from where the channel first switches from the west to the east of the valley floor (around ST 2561 0679). It should extend down through the length of Lugg's Farm. Consideration needs to be made in the design for the transition to Bowditch Farm downstream.

Figure 19: View from east (left bank) at Stotehayes where the valley wide reset should begin

As part of such a major restoration, the channel and land form at the toe of the eroding cliff could be reworked. By routing the channel away from the cliff, space would be made to create a terrace in front of the cliff. The terraced would reuse the excavated material from the valley wide reset. Use of geotextile wrap would aid forming the terrace. This terrace might be 10-20m wide. The front face of the terrace would need to be designed to resist erosion, options such as stone mix facing or live willow trunks buried into the fill may be appropriate depending on the overall design of the valley wide reset landscaping.

Details of such a valley wide reset should be developed in a detailed feasibility scheme. An initial feasibility scheme study may well cost around £20k. From this a detailed design can be worked up for the construction. The scheme should be able to be designed to align with Countryside Stewardship Higher Tier 'Making room for the river to move' or 'Connect river and floodplain habitats' options. England Woodland Creation Offer funding might also be an option to support such a scheme. Planning permission may well be required for such a restoration scheme.

3.3.3 Interventions for the southern section to Long Bridge

Pressure on this length of the river is primarily driven by gradually incising river bed levels. Much of the bed shows signs of having lowered in level by at least 300mm. This incision is leading to undercutting of the gravel strata within the banks and an increase in river gradient which drives faster velocities with more erosive power. These two impacts combine to increase the rate of bank failure and channel movement.

Around 150m downstream of the boundary with Lugg's farm, however, there is a shallow section, where there has been limited incision below the gravel strata in the bank (Figure 20b). This provides reference conditions for restoration. Upstream, of this, the incised channel is impounded by this shallow section, resulting in silted conditions during lower flows (Figure 20a).

Figure 20: Bed incision a) upstream 150m with silted bed, b) limiited shallow incision below first meander, c) undermining former gabion bank protection, d) incision dropping below gravel strata

The central section of this section of the river is most dynamic, with large meander bend migration. This change is, however, being driven by the more significant river bed incision of the channel downstream. The lower bed levels downstream are effectively driving the energy of the river, which is then able to create the dynamism at the upstream bends. The access along the field at this point of maximum bed incision is also being threatened. This area has been at risk in the past, with former bank protection measures now being exposed and undercut.

Long Bridge forms a control for the river at the downstream end, with its causeway constraining floodplain flows. Past incision at the bridge has been addressed by construction of a stone invert (constructed river bed) under the bridge. This has helped reduce bed erosion in the immediate section of the river upstream.

The floodplain in the northern half of this reach is notable for the wetland grasses (especially soft rush) that follow the paths of former river channels. The retention of these wetland species is no doubt supported in part by the limited channel incision at the upper location (Figure 20b). But it is also supported by spring feeds from the eastern hillside draining into the historic landscape feature. The presence of these grasses gives an indication of the more species rich grasslands that could be developed here.

Approaches through this section will need to balance grazing need and uses against the scale of restoration of the river and floodplain. Inevitably any form of increased channel resilience will increase wetting of the floodplain, both by raising of the water table and increasing the depth and frequency of flooding.

Figure 21: The upstream meander, with shallow bed and wetland in former channel route

Figure 22: a) Reworking of the meanderis exposing past bank protection, b) fresh and accelerating channel migration is driven by bed lowering downstream

Figure 23: a) Erosion starting on right bank in response to lowering bed levels downstream, b) erosion to the left downstream exposing and undermining old bank protection.

Figure 24: Past and continuing channel migration upstream of Long Bridge

The priority for intervention in this reach is in the central section. This is needed to manage the reactivating meander upstream, the new channel migration just north of the field boundary hedge and ditch, and the significant bed incision downstream which is likely to be driving the former two issues.

For the interventions to be effective, it is important that bed levels are raised in elevation for as far down as where the access along the field is being restricted (Figure 23b), and so south of where the former bank protection measures are being undermined. This would need to be through rebuilding the riverbed with over-sized sone mix, which incorporates a boulder array for added resilience. The target for bed raising should the top of the gravel strata revealed in the bank line (Figure 20 d). Costings for this need to be assessed in a design study, bed armouring alone may need to cover up to 1,500m^2 of channel to some 400mm in depth.

In the short term, brushwood or mix stone revetments might be imported where the channel is migrating to the north of the field and ditch line (Figure 22b), but also on the right bank erosion pocket immediately downstream (Figure 23a). These should re-establish more streamlined bank lines. In the area of channel migration, it might be acceptable to restore several metres of floodplain. Introduction of large live willow trees might also be an option to achieve this. Costs of this will depend on availability of local won material, as well as the extent of floodplain restoration.

The further necessary short-term measure is where the access along the field is being constrained, and the historic bank protection undermined. Here the bed has lowered by around 400mm. Boulders of 400-600mm might be placed in an array across the bed, starting at the downstream riffle and working up to at least the field boundary. The bank should also be protected, again live staked brushwood, mix stone revetment or live willow trees might be used.

Interventions proposed for the upstream 150m of the river, are bed armouring and raising.

- If increased wetting of the floodplain is to be avoided, this would be achieved by introducing either an over-sized stone mix or boulder array to the bed, such that the bed is raised only by 300-400mm.
- If wetting of the floodplain and enhancement of the floodplain grazing marsh is pursued, then the bed may also be raised. This might then include brash filling of the bed and importing the oversized stone mix on top of this.

In both cases, once the bed has been stabilised, tree planting and live staking along the toe of the bank should be carried out, especially on the left bank.

At the southern end of the reach, the river corridor has widened through past channel movement. Works here would manage future migration and especially land loss to the east. One of two approaches might be considered.

- A small-scale approach might be live staked brushwood might be installed along the bank line.
- For larger scale protection and land restoration, a dense array of willow stakes might be driven into the river bed, extending up to 4 or 5m into the existing channel. The intention of this would be to create a dense willow stand where eastern half of the river channel currently is. Velocities will be reduced through this, and sediment should build up. The river channel should then move back towards the west. These works risks being washed out in a major flood during early years of installation, but measures such as this have been seen to be effective downstream of Beckford Bridge.

With all these options, the more the channel is narrowed by vegetation, and the higher the bed is raised, the more that floodplain grazing marsh habitats and species rich habitats will develop. Sustainable farming Incentive payments such as create scrub and open habitat mosaics, manage priority habitat species rich grassland, manage rough grazing for birds and 12m habitat strips next to watercourses may be applicable. Funding such as Farming in Protected Landscape may support delivery of capital works.

3.4 Long Bridge to Case Bridge

The river transitions through four main sections in this reach. The initial length below Longbridge is deeply incised, but the waters are impounded by a shallow riffle at the downstream end. The river then flows through some open fields, with limited riparian vegetation and pockets of developing incision and land loss. The central section is less heavily grazed and retains significant features and influence from past wet meadow workings. Incision takes control in the southern length down to Case Bridge.

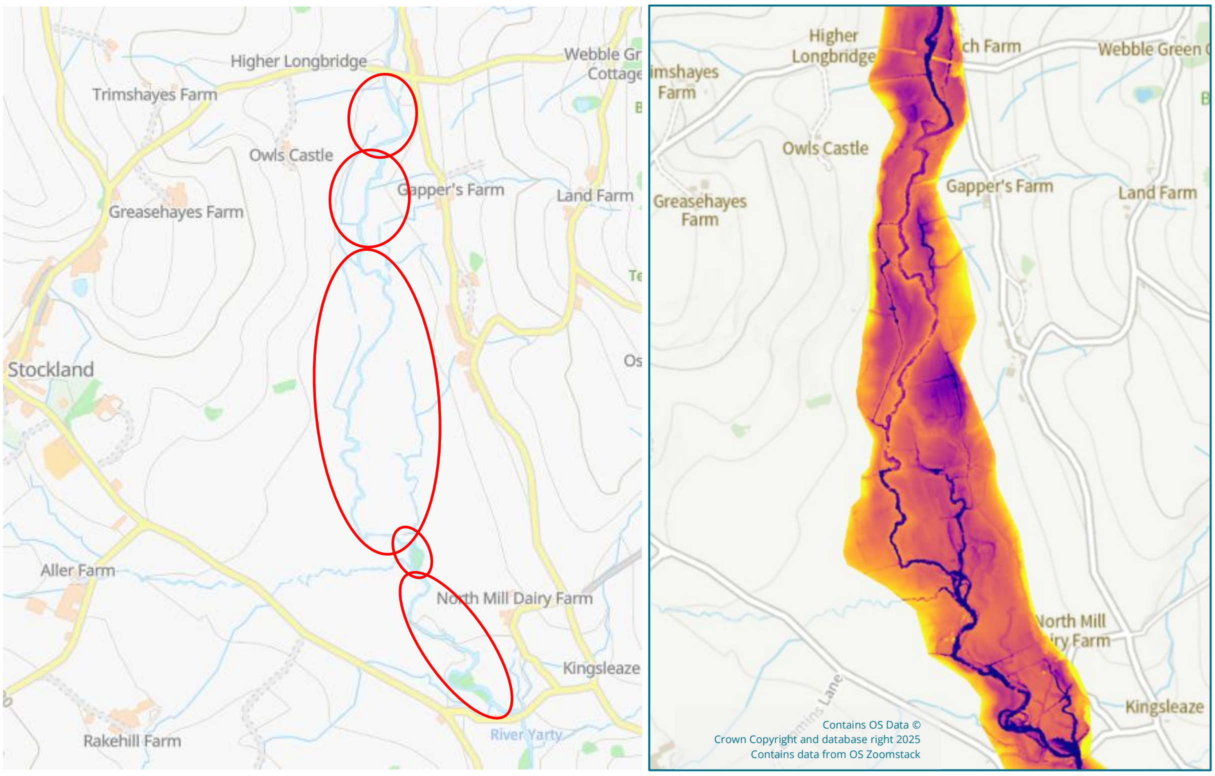

Figure 25: Five intervention reaches, with a heat map of valley floor drainage features

3.4.1 River downstream of Long Bridge

The upstream 250m, from Long Birge to the bend just east of Owls Castle, is highly incised into underlying clays. It is deep and slow moving in low flows to the riffle at ST25505 05248. There is the clear remains for a former meander bend that may have been artificially cut through. The floodplain to the east is saturated with spring flows from the backing hillside, and there are numerous land drains becoming exposed in the eroding river bend.

The cut through of the former meander bend increased the river gradient and so increased the velocities and erosion along this reach. The section then being impounded in low flows by the riffle at the downstream which retains the more natural bed level.

Figure 26: Natural shallow depths at the downstream riffle, impounded deep incised section upstream

Reinstating the former meander channel and raising the bed level (with over-sized stone mix) would reduce the erosion pressure on the southern river bank. This may, however, have an impact on land drainage.

Without reinstating the meander bend, bed reinstatement would require the importation of significantly oversized stone mix, which incorporates an array of boulders, to counteract the steep channel gradient. Some 900m^2 of bed would need to be protected. Once the bed has been protected, lighter touch bank protection might be feasible.

If neither of these two approaches is taken it might be possible to manage erosion and land loss by importing large willow and alder trees, staking them in place along the entire line of the southern bank. The intention of the trees would be for their canopy and subsequent regrowth to reduce the velocity of the water against the bank and at the bed close to the toe of the bank. Given the depth of bed erosion here, the trees may well need to be installed two or three deep. It may also be possible to include some alders set across the channel. Alder is preferred for this due to its resistance to rotting. If sufficient are installed, they may encourage accretion and raising of the bed levels. If too few are installed, they may exacerbate erosion.

3.4.2 Reach to the west of Gapper's Farm

The following 200m or so, to the south, the river flows through open fields with limited riparian vegetation. There are a series of deep scour holes cutting into the bed and banks. Between them are riffles, some of which support beds of aquatic vegetation.

There is a small meander bend which may have either broken or been cut through. Gravel extraction may also have been carried out. Cattle poaching of the bed is also evident with the lack of fencing. All of these will have increased pressure the bed and channel stability.

Priority should be given to infilling the scour holes, along with an over-sized stone bed armour layer, so that the upstream riffle bed habitats with their stable gravels and ranunculus beds are protected. Not only will this support ecological recovery but will also reduce the threat of land loss from channel migration. Where possible the banks should be planted along with live willow stakes driven in to the bank at water level.

Ideally cattle should be managed to reduce grazing pressure of riparian vegetation, and to reduce poaching of the river bed habitats. Sustainable farming initiatives should be available for provision of wide riparian strips alongside the river.

Consideration might be given to either infilling the cut through of the small meander, or planting or driving in live willows stakes or alders across the channel to encourage the river back to the former meander route.

Figure 27: Example of deep scour hole downstream of riffle with floating vegetation, this scour hole needs to be filled, and the bed reinforced to protect the riffle habitat

Figure 28: The small cut through meander and further example of deep bed scour threatening further land loss

3.4.3 Central section past Lake Farm

The landscape transitions to a more complex river corridor setting, with more riparian vegetation, a mix of deposition areas. There are similar eroding bends with ranunculus beds upstream. However, overall, the riparian vegetation is reducing the risks of channel migration and the speed of change.

Furthermore, the floodplain becomes more complex with drainage features which may appear to relate to former water meadow management. These back channels, where not impacted too much by flood flows, provide valuable slack water habitats for the overall valley ecosystem. Many of the wider range of aquatic plants that previously existed in the main channel are retained here. These features also provide habitats for amphibians and eels, as well as wider invertebrate communities.

In the lower lengths of the reach, the river has till now retained a more fixed route, with erosion being focused on the bed. As such, the channel gets progressively deeper, even though it retains its narrow width in many places.

Cattle grazing of the banks and poaching of the bed has been, and remains in a few places, a pressure on the river. In the lower reaches this pressure appears to have triggered erosion on the land opposite the access point.

Figure 29: Ranunculus beds are retained in stable cobbles, but under pressure from cattle access, increasing vegetation complexity is slowing but not removing erosion pressures

Figure 30: Former wet meadow channels provide valuable refuge habitats in the place of natural backwater features.

Figure 31: Channel incision is beginning to threaten banks that have previously been protected by riparian trees, rapid bank erosion is liable to follow.

A balance between land use and restoration ambition needs to be decided for this section. With the network of floodplain channels, and the complexity of the remaining channel, there is a potential to carry out a largescale valley floor restoration that focuses on re-wetting and reconnecting the floodplain. The existing wet meadow channels would need to be modified to reduce their conveyance in flood conditions and to raise water tables across the eastern floodplain. Ideally, the drainage network from the hillslopes should be obstructed to create a mosaic of wetland flushes, transitioning to mire and then floodplain grazing marsh.

For such a major restoration, bed raising where erosion and incision is taking hold should be reversed. This might be through the importation of stone mix and boulders. Alternatively, very largescale introduction of woody material, brushwood packing of scour holes, and live staked brash river bank protection might achieve a cheaper and more sustainable approach.

Such as restoration should be able to be designed to align with Countryside Stewardship Higher Tier 'Making room for the river to move' or 'Connect river and floodplain habitats' options. Funding such as Farming in Protected Landscapes might be more appropriate for the smaller landholdings and may offer the opportunity to maximise habitat gains and in terms of attracting greater biodiversity (from species rich grasslands, mire and marsh mosaics, and overwintering bird interests). Planning permission may well be required for such a restoration scheme.

A detailed feasibility study should be carried out to develop this towards detailed design. The approach would benefit from being applied across more than one landholding, ie Lake Farm through to Lower Yartyford. The detailed feasibility study would be able to estimate costings for such a restoration, and lead to a design and construction phase. Costs of the detailed feasibility study may be in the £10-20K range.

In the short term, and for more limited restoration, focus should be aimed at points of bed incision, where this is threatening to expand into the adjacent farmland, and where there is a shallow stable bed with ranunculus growing on it upstream. For these locations, importation of an oversized stone mix, with an included boulder array would form the basis of the bed protection. To resist bank erosion, approaches such as live willow staking along the water line, fixing in live willow or alder trees against the bank, or live staking in brushwood should be considered.

Where former wet meadow channels are acting to drain the floodplain or provide additional flood conveyance routes, these could be intermittently blocked, to create a series of still waters or linear ponds.

3.4.4 Riparian woodland northwest of North Mill Dairy Farm

A small woodland (at around ST 256 0413) extends along some 60m of the river corridor. The woodland is not sufficiently dense or well developed to entirely achieve a dynamic equilibrium. However, it does demonstrate the range of habitat conditions that are possible within this part of the river system and how these can counter channel incision.

This also gives guidance for reference conditions for the restoration intent elsewhere, in line with the higher paying Countryside Stewardship Higher Tier options.

Figure 32: A rare example of anastomosed channels within developing wet woodland

3.4.5 Upstream of Case Bridge

The southern 750m of the river runs through a well vegetated riparian corridor. However, there are signs of erosion and bed incision throughout.

Where the bed erosion and bank failure has cuts beyond the riparian treeline, the river has rapidly cut a wider channel whilst retaining the depth.

In many cases there are sections retaining the stable cobble gravels that support the aquatic vegetation. However, these are often short sections with deep cut erosion downstream starting to threaten these once stable river beds. In one location the post peri-glacial valley wide wetland layer was found to be visible.

The duration of the change is evident from past attempts at resisting the erosion processes. These interventions are now failing, in part due to their localised nature. IN other locations tree jams and tree stands are slowing the rate of change, but the density of these is not sufficient to counter it.

The most resilient and abundant ranunculus bed is in the 20m or so upstream of the weir at Case Bridge. This artificial bed control is providing stability that was once likely present throughout the river. This allows the vegetation and the ecology to thrive. However, within only 20m upstream, the bed is eroding. A similar distance upstream again, a section of former river bed is now collapsing and a deep incision in the bed is leading to bank erosion upstream. This demonstrates influence of gradient and energy on the system and the need to work over large distances to be effective.

Figure 33: Channel incision eroding beyond the treeline (left), and from downstream threatening the stable cobbles and ranunculus upstream (right)

Figure 34: A weir formed of oversized stone holds the bed intact upstream, whereas downstream the deepen channel is smothered in fine sediments

Figure 35: a rare example of dark organic rich layer of the former valley floor wetland survives, the bed nearby remains close to the original levels, but downstream incision has occurred

Figure 36: former bed and bank protection measures are failing as they are undermined, even large tree jams are unable on their own to stop the erosion processes entirely

Figure 37: A vibrant river bed community is sustained by the weir at Case Bridge, but within 50m the river bed is cutting through former river bed levels and eroding the bank

Interventions along this stretch of the river might be focused on short lengths, based on locations of remaining stable river bed sections. Prioritisation should be given to those that support the ranunculus beds. A balance may need to be placed on giving stability to the river channel and avoiding the increase in flooding especially to the low-lying property on the east upstream of Case Bridge and to winter crops on the western floodplain.

Works should raise the bed through incised bends and erosion pockets. This might be through the importation of oversized stone mix with included boulders. For larger sections of erosion, importation of substantial numbers of large live willow and alder trees might be considered, along with supplementary live willow staking and tree planting. This should be designed to slow flows enough to encourage accretion.

Where the channel has widened, narrowing back to former channel widths should be acceptable, provided that the channel depth is also reduced. Without doing this, the channel will undermine the narrowing works. An alternative is again to introduce substantial amounts of live woody material, to try and recreate an attenuating wet woodland feature.

A bold valley wide reset restoration option might be developed extending from Case Bridge to upstream of North Mill Dairy Farm. This option would look to reduce flood risks to the property on the east of the valley floor, whilst significantly enhancing the river and valley habitats. A valley wide reset option should restore levels of the valley floor back towards those of the valley wide wetland. This might require removal of around half a metre of soil from the eastern floodplain.

By reducing the ground by such an extent across the eastern valley floor, the capacity of the floodplain to both store and pass flood waters would be increased. This would reduce the level of floodwaters for any given flood and hence provide protection to the low-lying property.

For the river environment, this would allow floodwaters to dissipate across the valley floor, reducing the energy within the river channel. The river channel habitats would become more resilience, stabilising them and providing refigure for aquatic species.

Even in drought conditions, with such lowering, the valley floor would be in much closer connection to the water table. This would support a rich and diverse wetland habitat to develop. More frequent and persistent winter inundation would also attract wildlife such as overwintering birds.

The scheme should be able to be designed to align with Countryside Stewardship Higher Tier 'Making room for the river to move' or 'Connect river and floodplain habitats' options. Funding support from the likes of Farming in a Protected Landscape might also be a delivery option. Planning permission may well be required for such a restoration scheme.

A detailed feasibility study is required to assess this option, leading to detailed design and construction. This study would need to consider disposal options for large volumes of alluvium, including market options for selling topsoil.

3.5 Case Bridge to Beckford Bridge

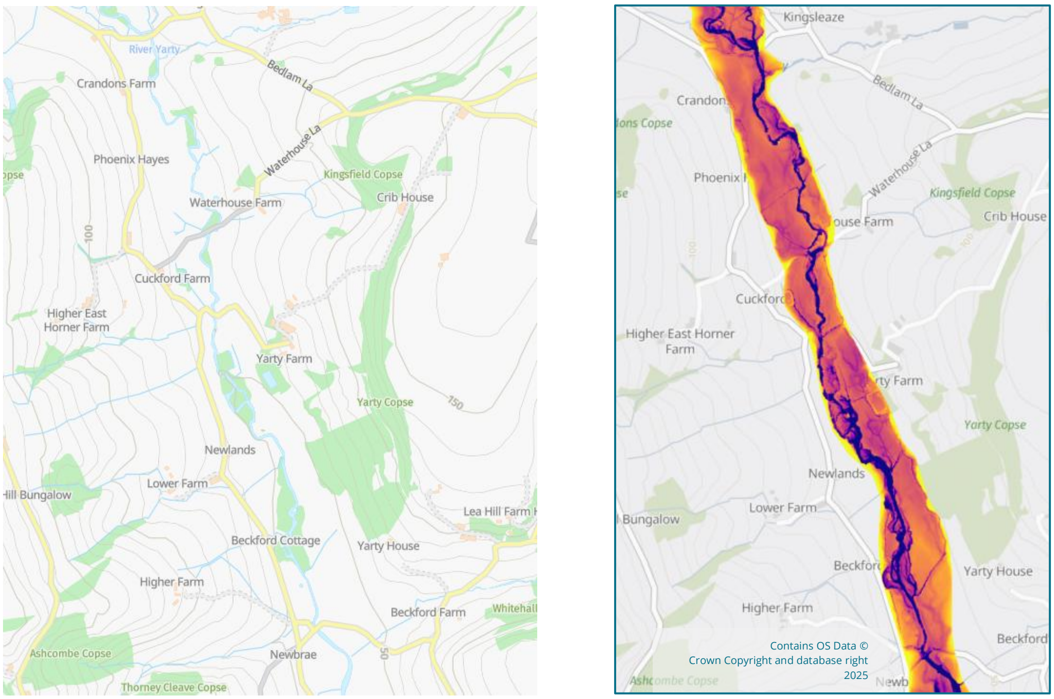

Figure 38: Reach covered by the Design Rreport, with a heat map of valley floor drainage features

This reach has been reviewed in the "Yarty Farm and Waterhouse Farm Geomorphology Advice note - November 2022" (Environment Agency) and River Yarty Feasibility Study – March 2023 (Westcountry Rivers Trust). Works to address erosion pressures was started in September 2024. Further guidance is presented in the Design Report.

3.6 Beckford Bridge High Westwater Weir

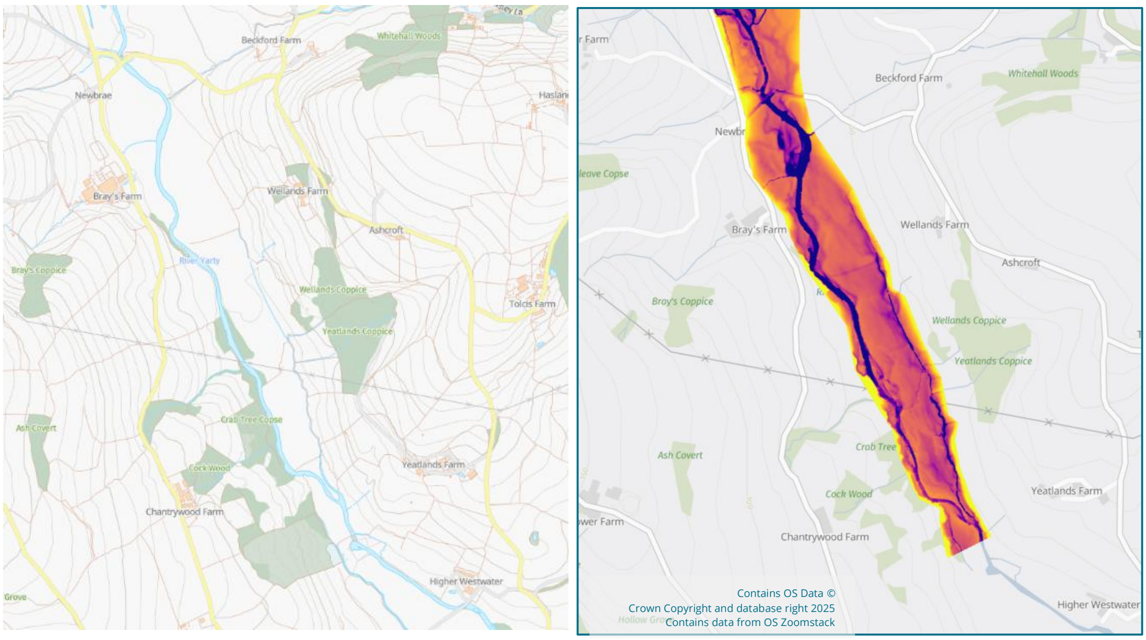

Figure39: , with a heat map of valley floor drainage features

The changes at Beckford Bridge illustrate issues for consideration of the management of structures along the river. The previous old road bridge was being undermined from downstream and its raised invert with pipe discharges was a barrier to fish. It did, however, hold back flows and the bed at old Beckford Bridge. In the current arrangement, the new road bridge no longer presents a barrier, whilst the concrete invert to the old Beckford Bridge, now provides the bed control for the upstream river.

The flume effect of the bridge and removal of the downstream bed control has, however, resulted in deep scouring of the river bed downstream. The invert may present a barrier to fish in low flows. However, especially with the deep holding pool downstream, it shouldn't present significant issues in higher conditions, that is until flood flows result in excessive velocities.

Figure 40: Alterations at Beckford Bridge affecting bed levels and fish passage

For the next half a kilometre downstream, the river has undergone huge shifts in channel route and been subject to a range of interventions. The changes were no doubt driven by drops in river bed level migrating upstream, to eventually leave the old Beckford Bridge with its elevated invert. Drops in bed level are still occurring, with an outstanding need to reinforce the bed.

Large live wood interventions have been carried out which have reduced lateral erosion and even created accretion and restoration of floodplain. These do not control the bed levels though. Further live wood introduction but combined with and array of boulders across the channel in deeper sections and downstream of knickpoints would be beneficial.

Figure 41: Bed incision is still migrating usptream and threatening shallow channel sections.

Figure 42: Massive lateral movement in 2014 controlled to some extent by live wood introduction.

The river is eroding the toe of the scarp slope of the valley side to the south of Brays Fram. Without intervention, this will continue to result in land loss at the top of the slope. Intervention could be the construction of a mass stone berm, some 1-2m high. This may be enhanced with live willow stakes includes within its construction. A wide berm of brushwood, held in place with live willow stakes may also function, it this was created several metres deep and 1m, or more, high.

Investigation of the ground conditions of the bed may inform design, notably if there is bed rock at depth below the bed which might then prevent live stakes being driven in.

Some raising of the bed levels downstream with over-sized stone mic would also be valuable, especially in the deeper part of the channel abutting the hillslope.

Figure 43: Bed incision and toe erosion along the hilslope, leading to mass failure

Further south, the river appears generally more stable, although there are signs of bed incision and long-term channel movement. The eastern floodplain appears to be increasingly elevated further south, rising above the bottom of the hillslopes to the west.

The LiDAR levels do suggest a history of channel movement in the western strip of the valley floor, and a channel on the very far eastern side of the valley. South of the power lines, there are signs of drainage in the east and centre of the floodplain, draining this area. There is also a well-defined backchannel joining from the eastern edge of the valley at Yeatlands Farm. This does in combination suggest that wet meadows may have been operated on the eastern side of the valley, with works to control the river away from this, and resulting accumulation of sediment raising levels. This combination may well be linked to bed incision, which has then migrated north impacting the land there as described above.

Figure 44: The eastern floodplain is elevated above the west, triggering bed incision

Figure 45: A lower river corridor to the west where channel movement has occurred, vegetation is provide some control on this

The eastern floodplain is evidently intensively farmed, so measures here need to avoid impacting on the land use. However, creating a dense woodland through this river corridor may well slow flows and increase stability, whilst also creating a valuable wet woodland. It appears that a strip up to 800m long may be possible, and that this could be up to 20m wide. As in Figure 44, where the bank is exposed and cutting into the floodplain, a brushwood revetment, held in place with live stakes, would fit with the approach.

England Woodland Creation Offer funding or Woodland Trust funding should be available to support this, depending on the scale of woodland creation considered.

Figure 46: Probable former water meadow outlet joing the rievr, where the main channel is incising into underlying clays

At the southern end, floodplain levels equalise across the valley and a significant channel along the east of the valley slope may be the remains of the water meadow system. Despite the comparatively lower floodplain and the presence of the weir downstream, the channel is nonetheless incising.

The weir is a very significant structure and holds back a large height difference. Although it is not considered a particular barrier to fish, this relies on the effectiveness of the fish pass. Both the weir and the function of the fish pass, are however, now being threatened by a bypass channel developing to the east of the weir.

As the bypass channel develops further, it will begin to compromise the fish pass. The weir will then become a barrier to fish migration. This would continue until the bypass channel developed sufficiently far to become the dominant flow channel for fish. This development in turn will lead to a drop in river bed level upstream of the location of the weir, and major erosion and instability would be triggered in the channel and floodplain upstream.

A detailed assessment of the options here is required. These options should include blocking or restricting the bypass channel; reinforcing the bed of the bypass channel, so that as it develops, it does not bring down bed levels upstream of the weir; or preparing for full natural adjustment of the channel with the weir bypassed and bed levels lowered upstream.

This assessment should include options for management of the channel upstream. This may include floodplain lowering to create floodplain grazing marsh. Rock ramps might alternatively be considered to support raising of the channel and wetting of the floodplain habitats in that way. Decisions here will have an impact on the reaches of the river upstream.

Figure 47: Higher Westwater Weir and fish pass

Figure 48: Developing bypass channel

3.7 Aquatic vegetation restoration

Throughout the River Yarty there are pockets of ranunculus bed remaining on areas of stable cobbles and gravels. A wider range of aquatic vegetation including water-starwort and willow moss are evident in some of the back channels and drains. These suggest a greater abundance of species and coverage in the past.

The abundance and range of species is not as great as in the downstream River Axe, and this may well be due to the deterioration of the river in more recent times.

Some of the interventions proposed, would involve significant disturbance or rebuilding of the river bed. There are some areas where siltation, nutrient loading and potential grazing and poaching pressure may have reduced the presence of aquatic vegetation.

It is therefore proposed that to fully support river restoration of the Yarty, that a programme of aquatic vegetation reintroduction is carried out. This should be included in any physically restoration works where a new river bed is constructed, or existing floating vegetation risks being smothered.

We have reviewed guidance on floating vegetation relocation and propagation, and consulted with Natural England about approaches to reintroduce plants form the River Axe. This review is presented in a standalone document "Yarty: River and Floodplain Restoration - Macrophyte Translocation Proposal".

The report includes a proposal for a trial translocation into the recent restoration works area at Yarty Farm. We would encourage that this is commissioned this spring, so that the lessons from the trial can be learnt for works next year.

4. Conclusions

The River Yarty remains a vital part of the River Axe ecosystem, whilst having a unique character of its own. This character shifts quickly down its length. This means that there is no single strategy that can be applied uniformly down its length.

Some interventions have been identified as priorities. These relate to areas where most environmental gain can be achieved, where existing features require protection and enhancement, and where foreseeable change and damage needs to be avoided. Some of these interventions will require more detailed feasibility studies to be carried out. Some more immediate actions can be taken straight to detailed design. We have also recommended a trial of aquatic vegetation relocation, which is important for the overall health of the riverine ecosystem.