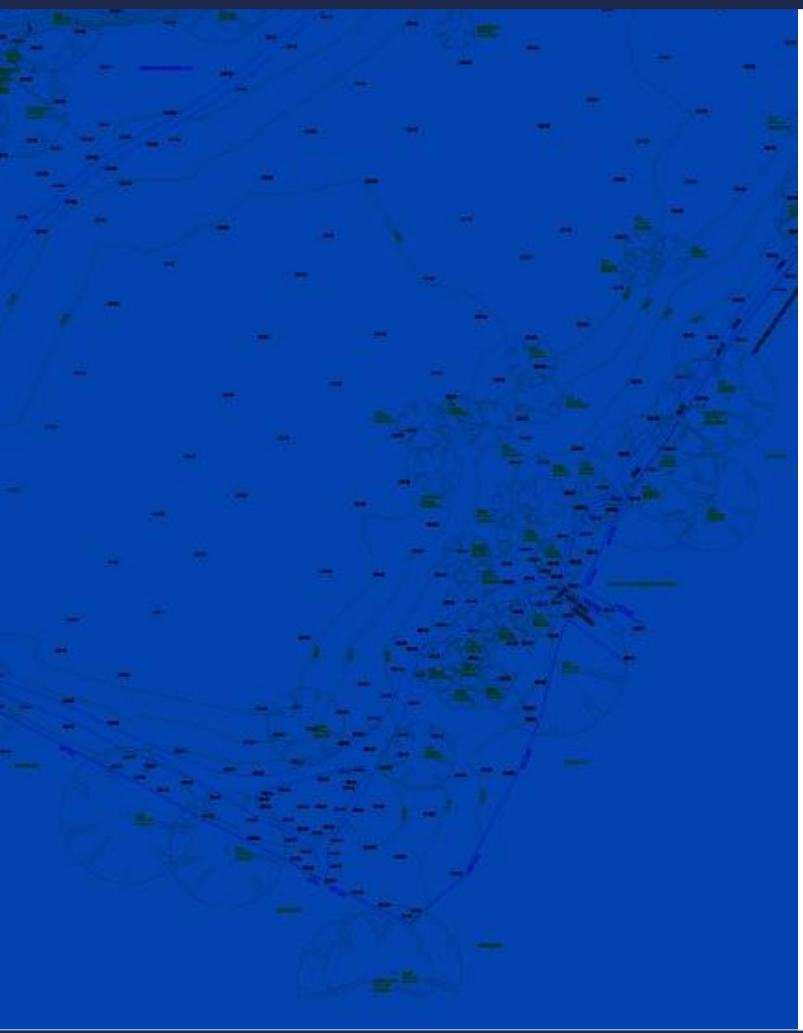

BEAUMONT RIVERS

Pool Meadow Restoration Project

By Beaumont Rivers Ltd.

On behalf of Chipping Norton Town Council

This study was undertaken by Beaumont Rivers Ltd. on behalf of Chipping Norton Town Council, in partnership with the Trust for Oxfordshire's Environment, Thames Water and Wild Oxfordshire.

Chipping Norton Town Council

In partnership with:

toe Trust for Oxfordshire's Environment

Thames Water

Wild Oxfordshire

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Introduction

Beaumont Rivers Ltd. has been commissioned by Chipping Norton Town Council to investigate the feasibility of restoring the area within Pool Meadow to a ponded wetland area with improved amenity benefits. We have found that the project is eminently feasible and offers numerous benefits to ecology, flood risk, geomorphology, archaeology, community amenity, local prosperity and education.

This report identifies the opportunities, costs and benefits of restoring the site and sets a roadmap for the permitting, permissions and construction. This document will accompany the permitting and funding applications to introduce the scheme, summarise the environmental, social and economic benefits, and demonstrate that all available options have been considered.

Photograph 1 - Showing Pool Meadow (centre) and its proximity to the town

The Site

Pool Meadow is a public open space set within picturesque countryside immediately north of Chipping Norton. The site is an open, roughly rectangular area, measuring approximately 180x65m (see photograph 1). The northwest face of the site is demarcated by a stream, and there is a continuous raised bund along the northwest and southwest perimeters with a popular footpath along the top. The footpath is narrow and in poor condition, and erosion from use has led to significant uneven downward erosion of the bund (see figure 9). At some times of year, this makes it difficult to walk down and it is completely inaccessible to pushchair and wheelchair users.

The site is historically significant to the local area and is included within the "Chipping Norton Motte and Bailey Castle, and Fishpond" Scheduled Ancient Monument (Historic England, 1996). It is believed that there was a fishpond within the curtilage of the meadow during medieval times, although our research has identified that the present-day bund is unlikely to be a component of that structure (see figure 12 and Archaeology section). The bund is more likely to be a Georgian remnant of the industrial milling heritage of the area.

Despite the meadow being part of a natural floodplain, the bund separates the area from the surrounding hydrology, resulting in a disconnect between the stream and flood plain. Ground level on the northeast and southeast faces rises naturally to higher ground in the direction of the centre of Chipping Norton, forming a gentle bowl within the meadow (see photograph 1 and Topographical Survey section).

The stream is a relatively small watercourse rising near Over Norton, and flowing through an area of mixed agricultural use before entering into the study area via a 90cm plastic pipe (see photograph 2), set approximately 70cm above the subsequent water level (tail level depends on flow rates). The stream flows the length of Pool Meadow, losing 5.3m of elevation while being joined by numerous minor gullies and tributaries from the farmland to the northeast (Oxford Geospatial, 2023) that significantly increase flow between the extents of the reach. The gully that joins the watercourse immediately upstream of the impoundment structure approximately doubles the flow during summer months, and significantly increases flows in winter (see photograph 5). Despite historic anthropogenic interventions, the stream exhibits some geomorphologically diverse features, including meanders, 3 natural large woody debris dams, pool and riffle formations, mid-channel and point bars, and a diverse range of sediment sizes (see survey mapping in figures 7 and 8 and photograph 9). The banks of the stream are vegetated with mixed deciduous woodland, some reeds, nettles, grasses, and other riparian vegetation, but there is a lack of submerged species and only a small amount of brooklime as emergent vegetation (Lucas, 2023).

There is a combined sewage overflow within the reach (see photograph 10) that discharges after periods of high rainfall when the local waste water network reaches a certain capacity. Any sewage pollution has significant impacts on the chemistry and ecology of a watercourse, and its installation across the Scheduled Ancient Monument will have caused significant damage to the industrial and archaeological value of the area.

Since the pool was drained it has been colonised by Great Horsetail (Equisetum telmateia – see photograph 3), which has out-competed almost all other ecology, leading to poor biodiversity within the meadow (Lucas, 2023). This combination of abundant natural resources and amenity potential offers significant opportunity for environmental, biodiversity and amenity improvements to the local area.

Photograph 2 - Pipe at the upstream end of the meadow (beneath the track from Church Lane)

Photograph 3 - Dominant Equisetum (Horsetail) growing in Pool Meadow

Aims and Objectives of the Project

This project will reconnect the river to its natural flood plain and manage that area for biodiversity and hydrogeomorphological benefit, as well as maintaining and restoring the Scheduled Ancient Monument and improving the amenity and accessibility of the site.

Pool Meadow has great potential to support a diverse range of habitats and species that would contribute towards improved water quality, biodiversity and environmental resilience to climate change. Currently, habitats on site are disconnected from the local hydrology and dominated by an Equisetum monoculture that inhibits the diversification of species and maintains poor biodiversity.

The local hydrology is in declining ecological and chemical condition (Environment Agency, 2021), and is at risk from pollution and climate change. By stopping sewage pollution in the reach and restoring and enhancing the natural hydrology to include a ponded wetland area and geomorphologically diverse stream, we will kick-start ecosystem services that improve environmental health and increase resilience to floods, droughts, and extremes in weather.

There are numerous downstream communities that flood, and this project will improve floodplain storage away from vulnerable areas. As this part of the catchment has not been modelled, it is impossible to quantify the impact on downstream flood risk and drought. Nonetheless, the project offers a significant storage and attenuation capacity for a watercourse of this size, and will certainly increase the lag time between rainfall and downstream peak flows, so it is certain that there will be some flood risk benefits.

The Equisetum monoculture on site is currently preventing other plant species from growing, which has strong detrimental impacts throughout local ecology. The dominance of Equisetum will be challenging to reduce, but through methods identified in this report, it will be minimised and the area re-planted into a ponded wildflower meadow with habitat enhancements such as timber stacks and bird and bat boxes.

Ponds support a broader range of ecology than any other freshwater habitat (Williams et al., 2010), with geomorphological diversity, such as beaches, banks, margins and variable depth providing the perfect range of habitats. This provides significant ecosystem services that improve physical, chemical and ecological health locally and downstream. Despite their importance, research finds that between 33 to 50% of all ponds across the UK have disappeared over the last 50 years, and up to 75% disappeared between 1880 and 1980, due to agriculture, pollution and increased development (Williams et al., 2010).

The site is an important amenity for the growing population of Chipping Norton, and we propose investment in improving accessibility for all, including pushchair and wheelchair users. This requires improvements to the footpath and access routes and adding interpretation boards to connect people with the history and ecology of the site.

The protected heritage and archaeology of the area is under threat by the encroachment of trees on every side and footpath erosion along the top of the bund by frequent traffic. Improving the surface of the footpath and maintaining the pond and wildflower meadow will stop the degradation of important archaeology and protect the site for generations to come.

Scope of Works

To achieve the aims and objectives of the project, this report proposes the following actions, which are each explored in greater detail throughout the report:

- Reconnecting the watercourse to the floodplain via 3 fixed control structures to create a ponded wetland area.
- Installing 2 public access walkways across the new control structures.
- Blocking off the existing unrecorded sewage overflow where it connects with the main sewer.
- Ensuring the culvert at the downstream end of the meadow is blocked and safe.
- Installing 5 large woody debris dams along the length of the stream between the new inlet and outlet to/from the meadow.
- Bringing the Equisetum monoculture under control.
- Re-planting the meadow with a floodplain adapted wildflower seed mix.
- Installation of 3 timber habitat stacks around site.
- Improving 285-448m (depending on funding) of existing footpath surface to include access for all.
- Replace existing kissing gates to improve site accessibility.
- Installation of bird and bat boxes on maintainable structures – bird boxes on trees, bat boxes on a standalone post or tree monolith.
- Installing public safety rescue equipment, edge protection and signage where required.
- Installing 2 interpretation boards to educate people about the history and ecology of the site.
- Litter pick and removal of plastics/litter etc. from the watercourse and surrounding area.

As optional extras for consideration, there is also provision for a picnic area with a permanent barbeque and associated waste bin.

Ecology

To establish an ecological baseline to which we can compare our results and ensure that the works will not endanger any protected species, we commissioned a Preliminary Ecological Appraisal from local ecologist, Frank Lucas (Lucas, 2023). This included a desktop study and field survey, with analysis of results and calculation of a biodiversity net gain (BNG) baseline, against which we can measure the results of the project in future. The assessment confirmed our understanding that the site supports a number of habitat types, which provide some structural and ecological diversity, but none are species-rich examples of their type.

As can be seen in photograph 3, at present, the meadow is dominated by Great Horsetail (Equisetum telmateia), which has out-competed almost all other ecology, leading to poor biodiversity within the meadow.

Despite the site being potentially suitable for a broad range of species, no direct evidence of the presence of protected or notable species was found during the desktop search or site survey, however, the TVERC (Thames Valley Environmental Records Centre) data search did reveal records of such species nearby. It is also likely that Great Crested Newts and nesting birds already utilise the site, but no evidence was found.

The lack of biodiversity can be attributed to the poor condition of the habitats within the site. Restoring the area will encourage the return and subsequent proliferation of protected and endangered species into the surrounding area, which will be facilitated by their current proximity to the site.

The PEA also identified that the proposed works would be likely to result in the loss of swamp/fen habitat to open water and meadow, which would be classified under the BNG Metric 3.1 as an 'unacceptable loss of irreplaceable habitat'. This does not indicate that these works would be detrimental to the environment, but arises in part from the apparent catch-all nature of BNG Metric 3.1 habitat "Fens (upland and lowland)", which includes species rich and poor examples within the same category. The actual fen/swamp habitat at Pool Meadow has been designated "*species poor and re-creatable".* The loss of this habitat to open water and meadow would result in a local increase in biodiversity (Lucas, 2023).

While this does not result in any environmental challenges to the project, to get Planning Permission, we may need to develop the PEA into an Ecological Impact Assessment, including a post-intervention habitat creation scheme to show the overall benefits of the scheme. West Oxfordshire District Council's Planning Team have been contacted for clarification.

Overall, the PEA confirmed that the restoration project will have positive outcomes for the wildlife of Chipping Norton.

The full Preliminary Ecological Appraisal is included with this report.

Outline Design

Wetland Restoration - Option 1

The preferred option is to construct two fixed control structures at the upstream end of the meadow (one in the same location as the existing sewage outfall) to divert 50% of the flow from the stream beside the footpath into the meadow and allow the lower sections to flood and drain through a third fixed control structure at the downstream end. The topography of the area will result in a pond approximately 1m deep at the deepest point and gradually sloping to dry land, through an extensive wetland area (Oxford Geospatial, 2023). The surface of the main pond will be approximately 3799m^2, surrounded by a riparian zone that develops into wildflower meadow with increased elevation. Due to footpath erosion, the bund around the site no longer forms a continuous impoundment level, which avoids the possibility of impounding large volumes that would require registration under the Reservoirs Act 1975.

The inlet structure will initially be opened in early Autumn to ensure that we do not start to fill the pond during a low flow event, ensuring enough water for Bliss Mill during the process (see section on Bliss Mill). The ponded area will need all existing non-woody vegetation cut and removed before the wetting process, and there will be no artificial introductions of aquatic plant species. Cutting and removal of existing plants ensures a minimum level of decomposition within the water that would lead to nutrient imbalances and low oxygen levels, which would hamper the development of beneficial ecology. Usually, when creating or restoring a pond, it is advisable to remove the nutrient-rich topsoil and expose the nutrient-poor soil beneath for maximum biodiversity (Freshwater Habitats Trust, 2011); however, as this site is a Scheduled Ancient Monument, that course of action is not available. This process will balance itself out as part of the natural maturing of a new pond, which is usually complete after 2-3 years (Freshwater Habitats Trust, 2011).

On-line ponds are more susceptible to infilling from sedimentation as the flow reaches slow moving water, loses competence and deposits the sediment in the pond. Initially, most sediment will be caught in the pool of the control structure, but when that eventually infills, the sediment will be carried across the meadow before it reaches the pond. This will result in deposition and over a number of years begin to form small landforms, such as braids and meanders, causing the stream to migrate across the area, leading to a continuous process of renewal and succession. Although this is expected to be on a very small scale due to the size of the watercourse, it will be accentuated by variable seasonal flows. Deposition at the upper extent of the meadow will reduce sedimentation within the pond and increase the maintenance periods. There will naturally be some plant matter and sediment from the meadow transported into the pond by the stream, but this is all part of the ecosystem.

The inundation for option 1 has been mapped to establish the extent, area and volume of the pool. Inundation mapping was done to a depth of 154.5mAOD, however, the final impoundment will be 154.4mAOD. This causes minimal changes in the area/extent of the water, but extremely significant improvements in the area of shallow water, which is the most biodiverse part of the pond (see figure 2). This also reduces engineering requirements and improves the feasibility of the project. The pool will gradually fill the southwestern end of the meadow to an average of 46cm deep, with the deepest point 1m deep. The pond will cover an area of 3799m^2, and have a volume of 1771m^3 (see figure 2). There will be an extensive area of marginal habitat between 0-10cm deep, providing rich opportunity for wildlife (see figure 1). Keeping the depth under 1m ensures an ecology resilient to changes in water quality and environmental incidents, as the ecology that prefers deeper water gets progressively more specialised, less diverse and less suitable for an on-line pond.

Figure 1, below shows the different ecological zones that will be created and the sort of ecology that we can expect to see in them.

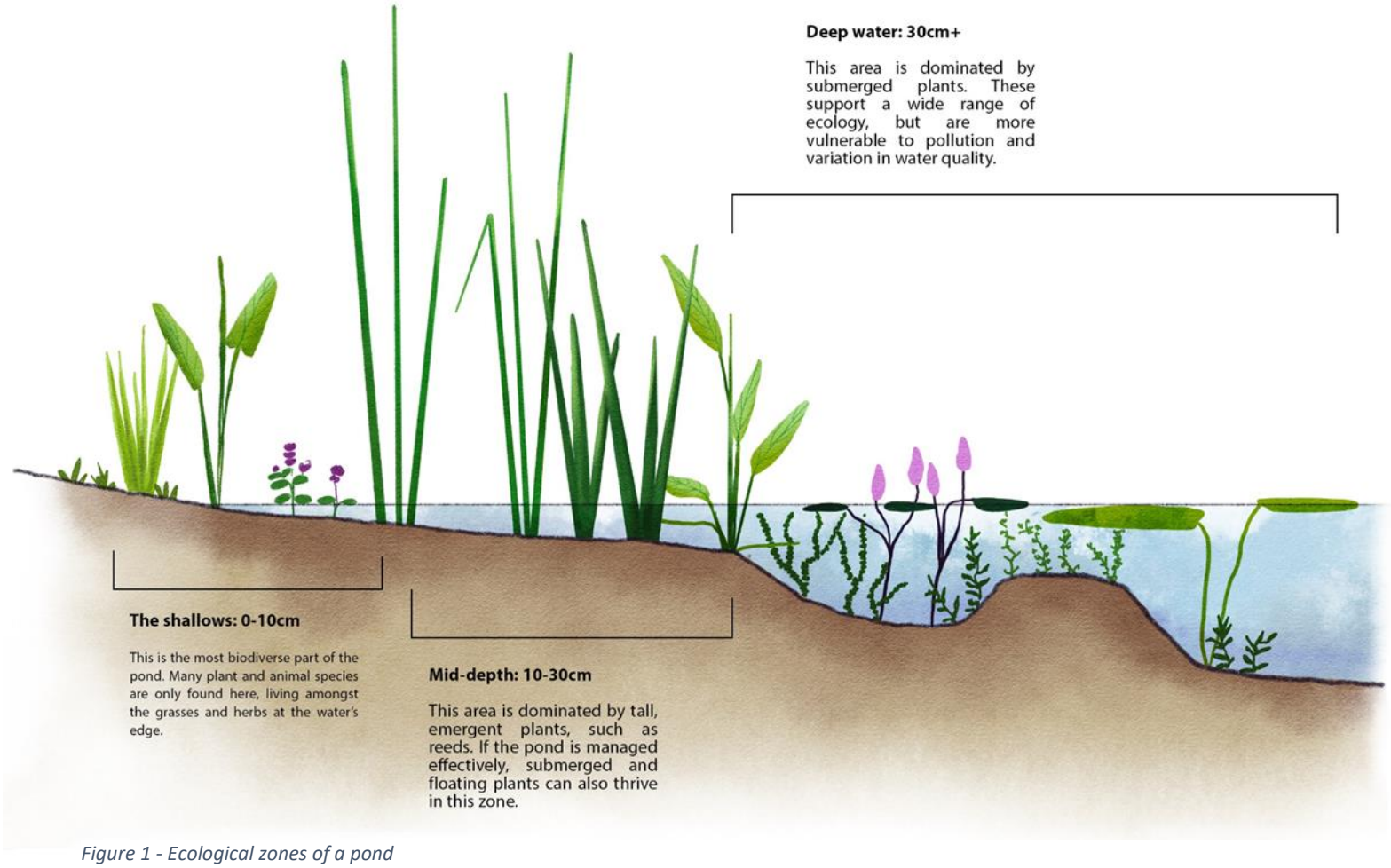


Figure 1 - Ecological zones of a pond

Option 1 Inundation Mapping

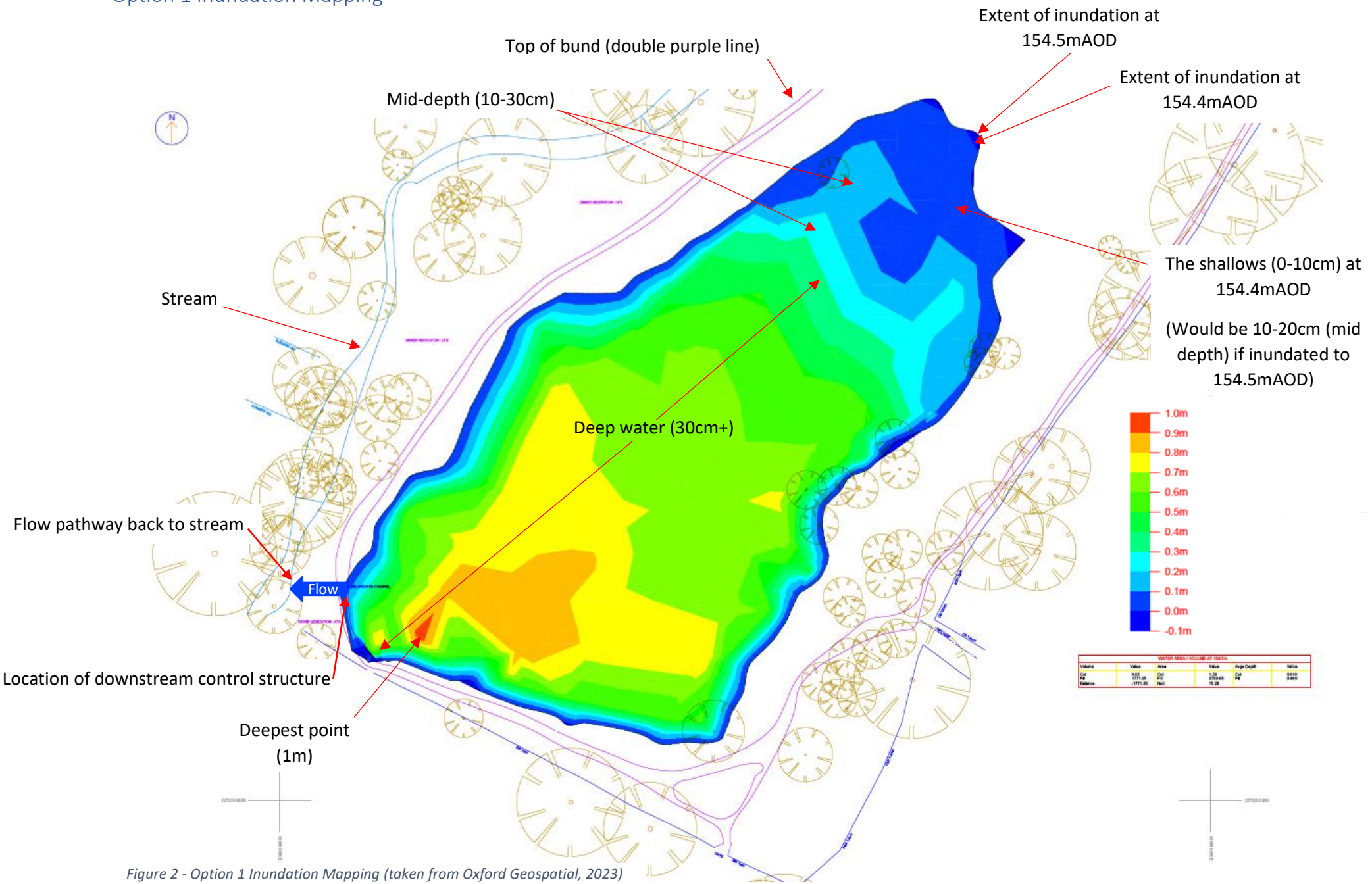


Figure 2 - Option 1 Inundation Mapping (taken from Oxford Geospatial, 2023)

Wetland Restoration - Option 2

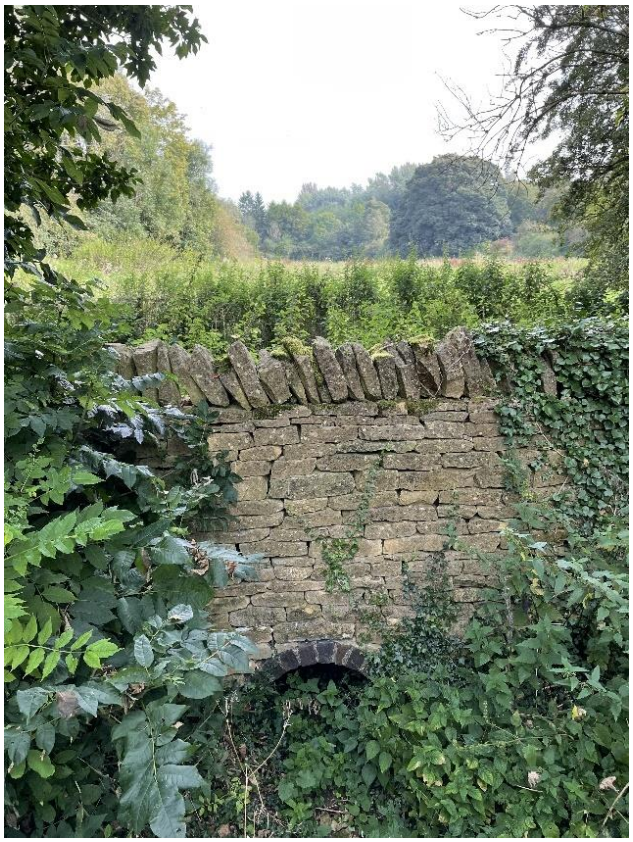
As a backup option or 'Plan B' in case we do not get Scheduled Monument Consent, we could install an impoundment structure to inundate the land beneath the castle, restore the culvert underneath the track (see photograph 4) and create a channel across the top of Pool Meadow to convey the water to the wetland area. This may be how water levels in the meadow were originally managed.

The culvert under the track is partially collapsed and although a small volume of water flows through it after rainfall, it would need restoring to avoid blockage and asset failure. Current flow through the culvert is dissipated into the infilled area at the top of the meadow, so a channel would need to be created to direct the water into the desired part of the meadow.

This would require landholder consent of the adjacent land, but would also offer different environmental benefits. Levels could either be managed by controlling the freeboard of the upstream impoundment structure, or by installing a structure at the downstream end of the site, as per option 1, depending on what's permitted by Historic England.

Hydraulically, this would not be as effective as option 1 as there is a significantly lower, less reliable flow in this location. The water would also need to inundate a greater area of land, leading to greater infiltration and evapotranspiration losses that would minimise the remaining supply to the pond.

As option 2 is significantly less feasible, but not impossible, it is being kept as a backup, but would need further work to achieve.



Photograph 4 - Partially collapsed culvert under the track, with upstream meadow in the background

Flow Control Structures

To supply the pool with water as per option 1 requires the impoundment of the stream at NGR: SP 30940 27453, to 155.5mAOD immediately downstream of a small incoming tributary (see photograph 5, marked as natural spring in figure 3) to ensure maximum water resilience to the whole scheme. This will back up the water level by 83cm to be equal with the new inlet structure into the meadow (see photographs 5, 6 and 7), creating an in-stream pool and splitting the flow 50:50 (see figure 3). The geometry of the inlet structure will be precisely configured to match the discharge across the impoundment structure, in order to achieve a precise bifurcation. Figure 3, below, shows the location and length of the new distributary, with the correct width to be determined by the detailed design.

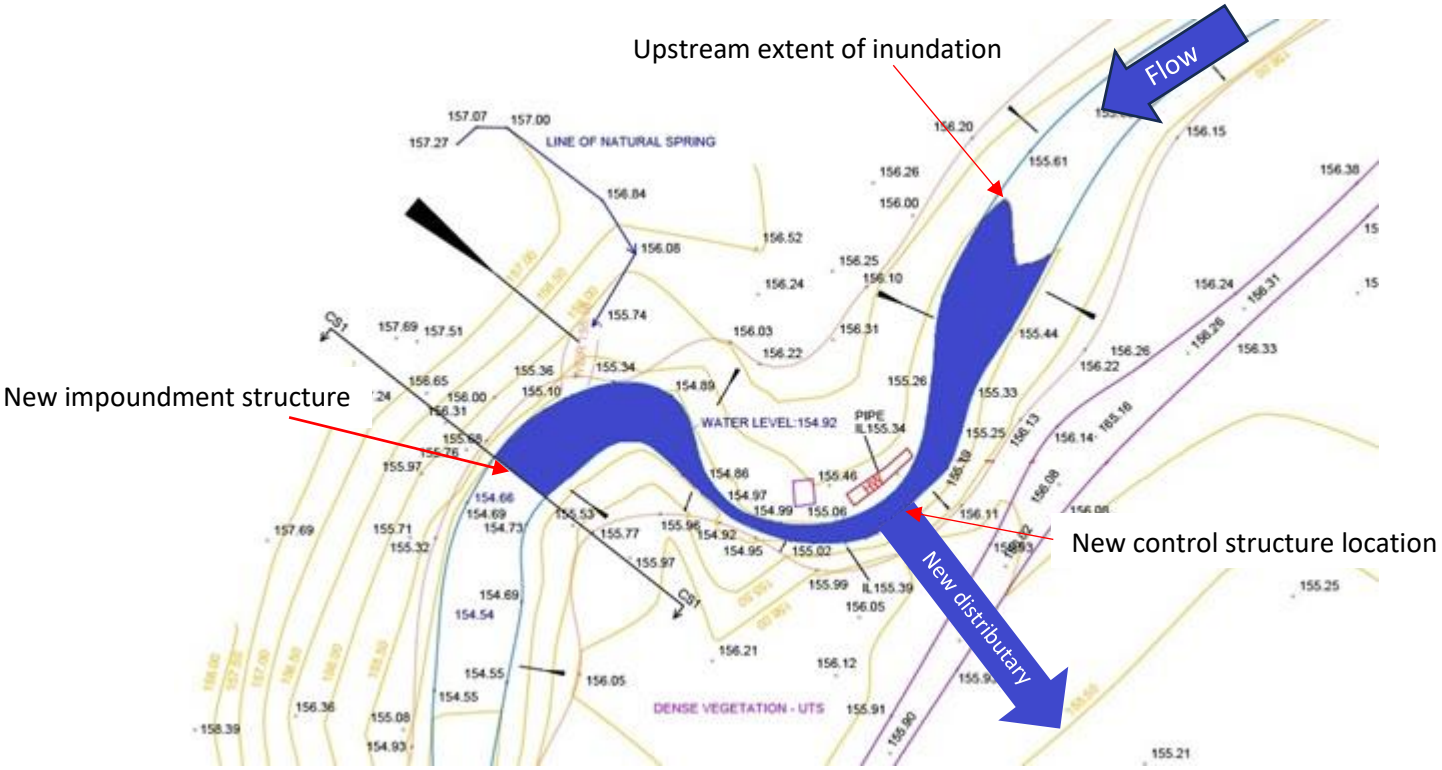


Figure 3 - The in-stream inundation of impounding to 155.5mAOD and indicative length and location of the new distributary.

Constructing the inlet into the meadow will involve removing a depth of approximately 40-50cm of soil across the bank and bund to create a small channel for the water, with a fixed crest of 155.5mAOD. This will be located above the existing sewage outfall to ensure the lowest impact to undisturbed sections of the Scheduled Ancient Monument (see photograph 6). If required for maintenance or flow control, either of the new upstream structures can be shut off by placing sandbags across the crest, which will direct 100% of the flow across the other structure.

The distributary will flow along the central declivity of the meadow into the new wetland area, where it will be impounded up to 154.4mAOD and then flow across a 2-stage weir, down a reinforced spillway (to avoid erosion) and back into the original channel (see figure 2).

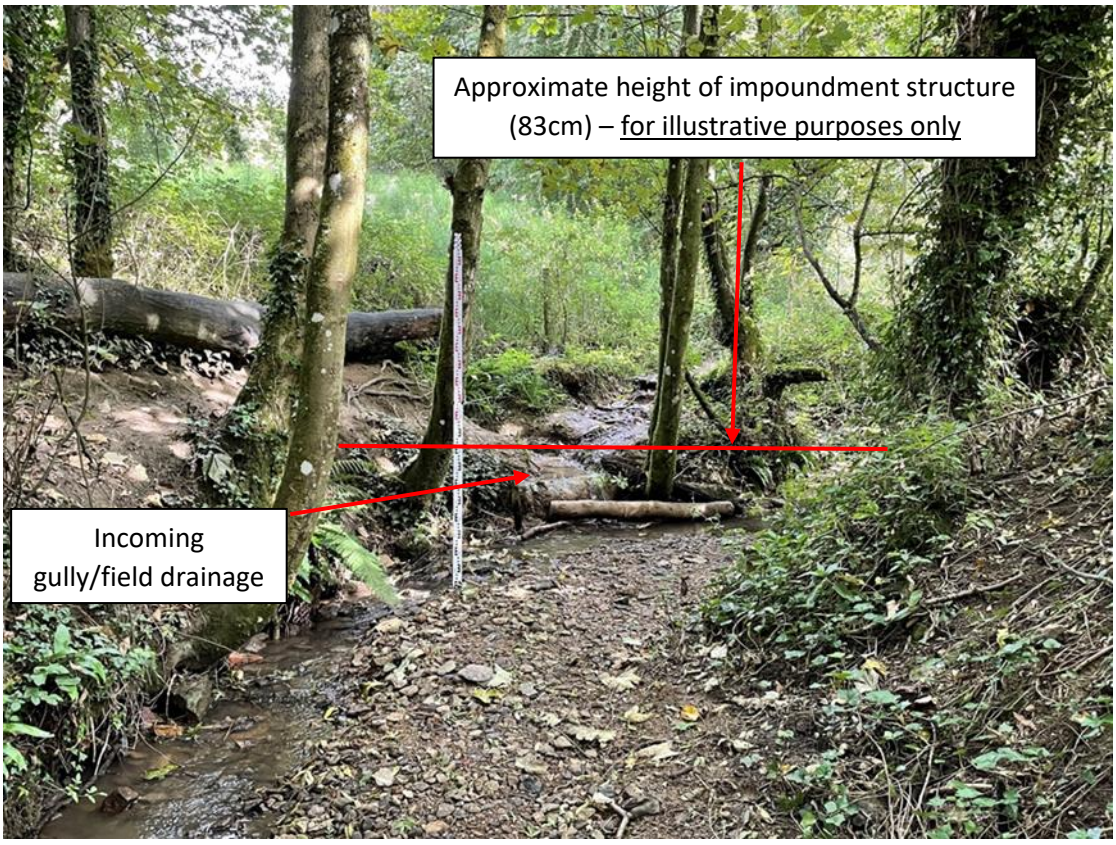
The 2-stage weir is designed to be resilient to blockage; with the second stage acting as a backup/emergency overflow should the first get blocked.

The current level of the bund in this location is 154.39mAOD (Oxford Geospatial, 2023; see figure 11), which allows us to reinforce the bund where it meets the water and build the outflow over the existing historic structure, preserving it beneath modern reinforcements. The modern structure will

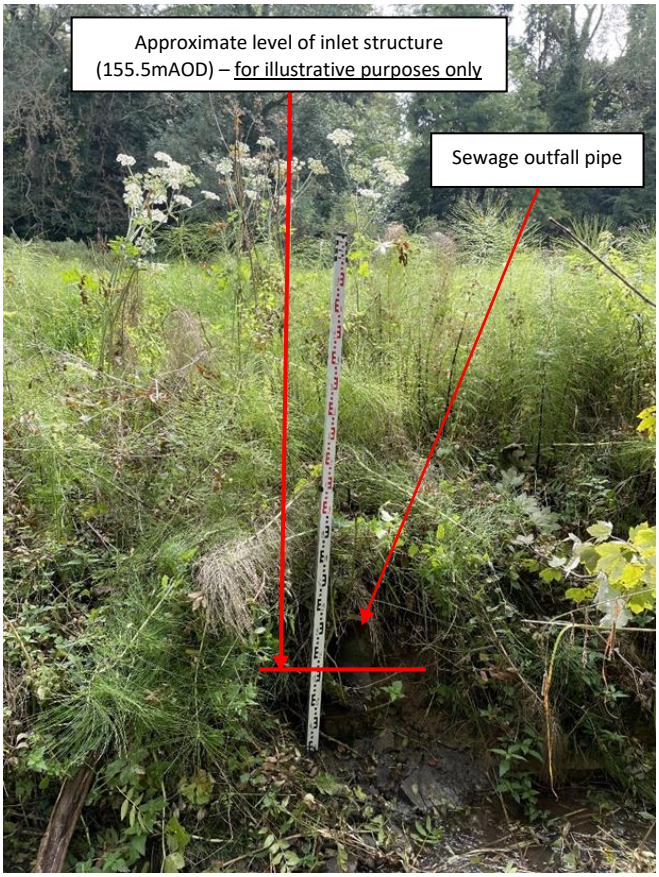
be an earth bund, similar to what's already there, but built to modern standards and capabilities, and tied into the existing structure beneath what will become part of the footpath improvements (see Access and Amenity improvements section).

The weir crest will be further reinforced through subtle use of concrete (or similar) to prevent erosion. This will be tied into the upstream side of the footpath improvements, where it will be covered by the boardwalk over the channel; creating a subtle, but effective control structure. Reinforcement of the downstream slope (into the river – see photograph 8) will be similarly sympathetic, using a non-obtrusive geotextile to avoid erosion that could otherwise cause problems in future.

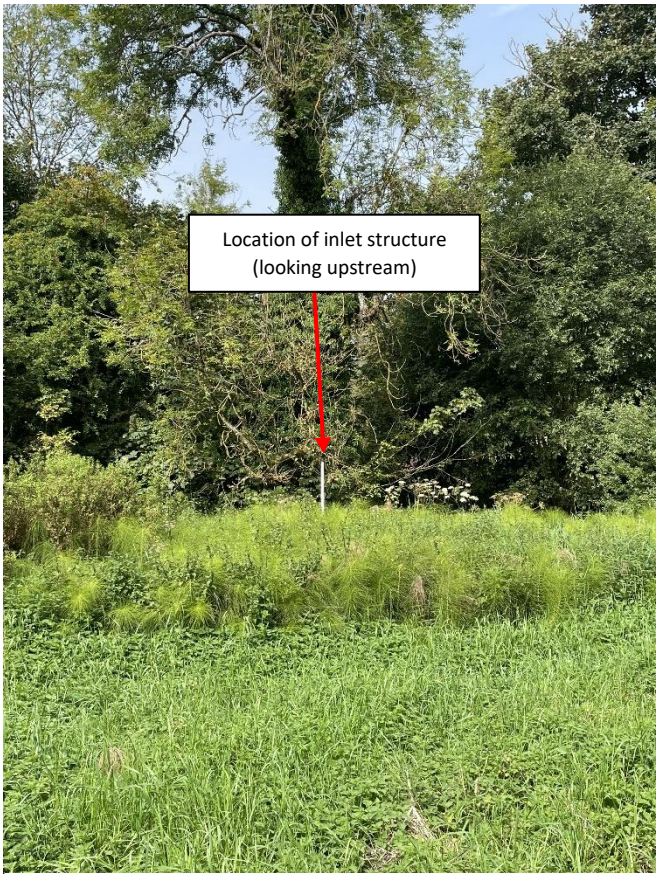
To the casual observer, the outflow will look like the slight raising of ground level inside what is currently footpath, and once complete will be indistinguishable from the historic structure, ensuring the retention of the heritage and rural aspects that make the site special for the community of Chipping Norton.



Photograph 5 - incoming gully joins the stream immediately upstream of control structure location. Measuring staff shows proposed location of impoundment structure (stream flows right to left) with indicative height superimposed. Photo facing upstream.



Photograph 6 - Location and indicative level of inlet structure



Photograph 7 - Location of inlet structure facing upstream

Photograph 8 - location of outlet structure

Leaky Dams

In the reach between the inlet and outfall, the bed level of the stream falls by 3.67m, and flow rates differ significantly between summer and winter levels. This has produced a diverse range of geomorphological features including pools, riffles, active meanders, bars, cut banks and 3 existing large woody debris dams. Along the reach, the stream is joined by numerous natural drains and minor channels.

Leaky dams constructed from large woody debris are a natural feature that can be artificially installed to work with natural processes for a number of ecological and geomorphological benefits (Woodland Trust, 2018). While they can be used for different restoration or flood risk purposes on most types of rivers, the narrow, wooded, steep sided characteristics of the stream at Pool Meadow make it especially well suited to the practice.

Leaky dams create a natural impoundment of water that slows the flow through the structure. This creates a deeper, wider pool of slow-moving water immediately upstream, which causes sediments to drop out of solution, gradually raising the bed level. Due to the difference in levels between up and down-stream, an area of vertical erosion forms immediately downstream of the structure. The eroded material is then deposited as a bar or riffle immediately downstream (Woodland Trust, 2016). The 3 pre-existing leaky dams appear to be naturally formed and have produced the exact geomorphological changes that we would hope to see from a successful installation (see figure 4 and photograph 9).

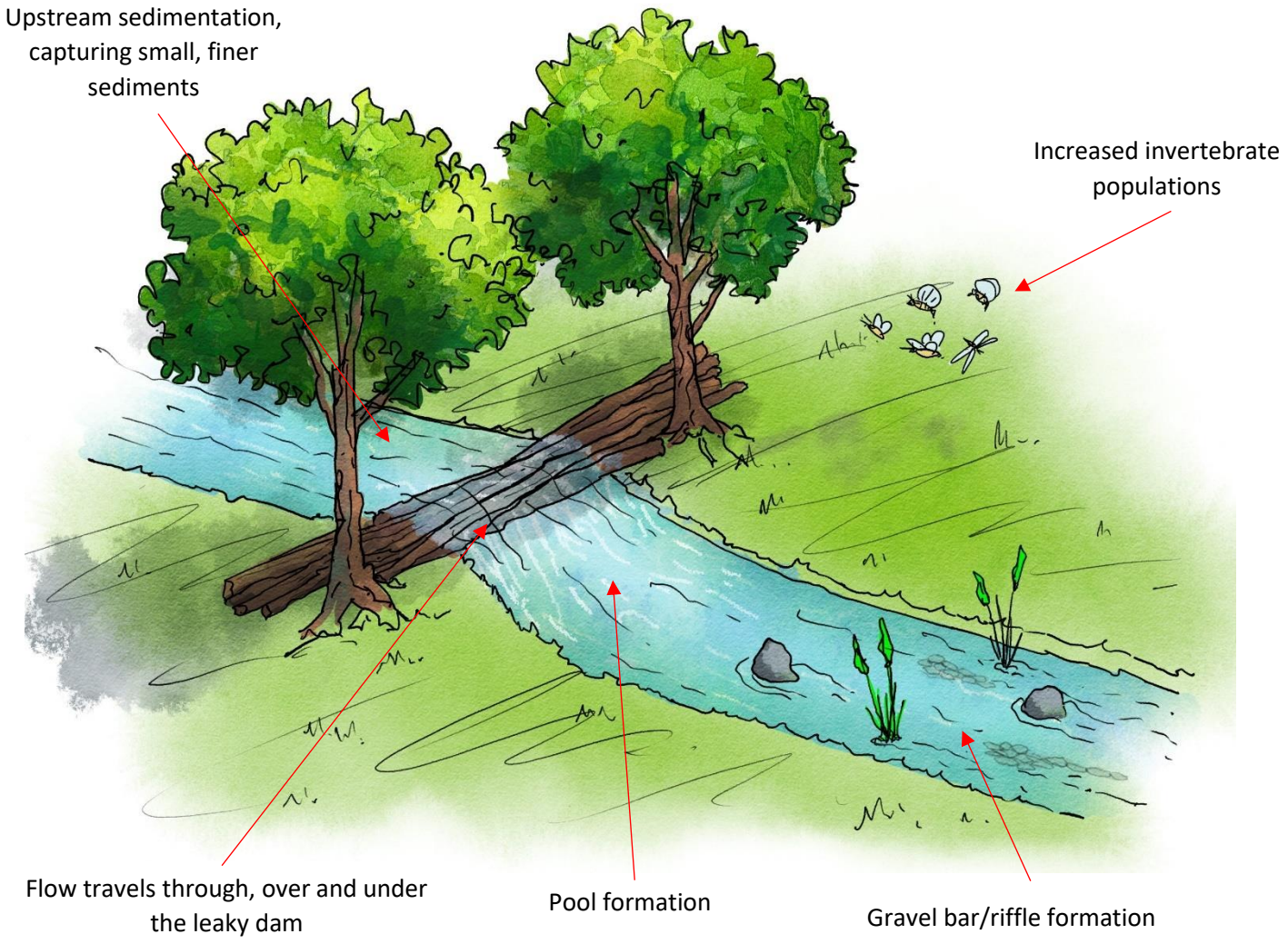
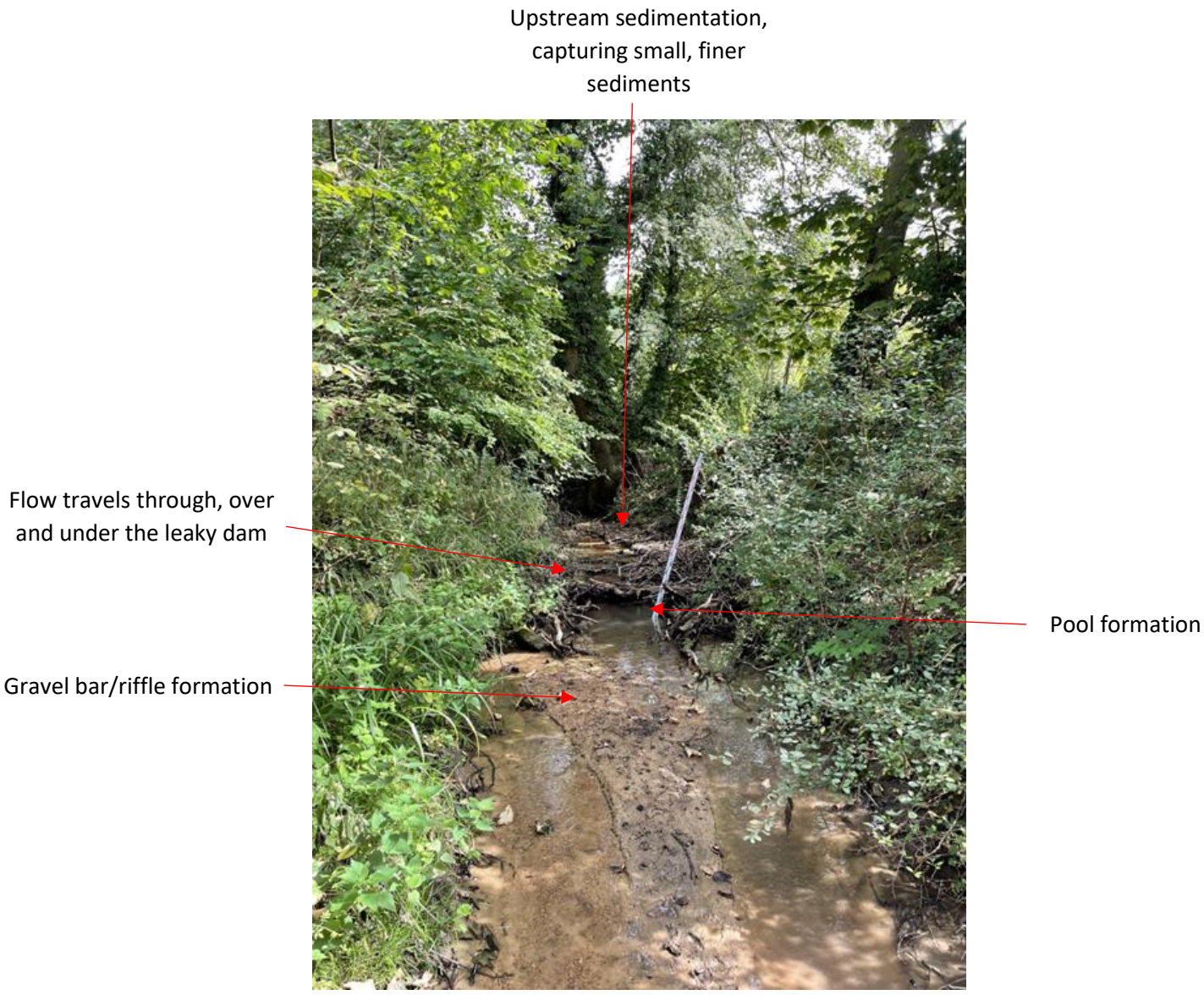


Figure 4 - Geomorphological impacts of a leaky dam



Photograph 9 - Leaky dam on site exhibiting textbook geomorphological impacts

The development of these geomorphological features means that there is a net increase in the volume of water stored within the reach, so the rate of onset and impact of low flows is attenuated through greater storage and more efficient retention of available water (Bentley et al., 2016). The increased sediment deposition and erosion also gives the watercourse the opportunity to remodel itself to a geometry that matches the new flow regime.

Without installation of the leaky dams, reducing the discharge of the watercourse to provide water for the pond could cause it to lose some resilience to low flow events, however, this will be mitigated by the leaky dams, safeguarding the health of the stream and local ecology.

During high flows, leaky dams attenuate the flow by temporarily obstructing flood water and increasing storage capacity of the channel through a higher base level granting access to a greater cross-sectional area of channel capacity (Woodland Trust, 2016). The water is then discharged gradually, rather than as a flash flood, allowing downstream areas time to drain, which reduces flooding (see figure 5).

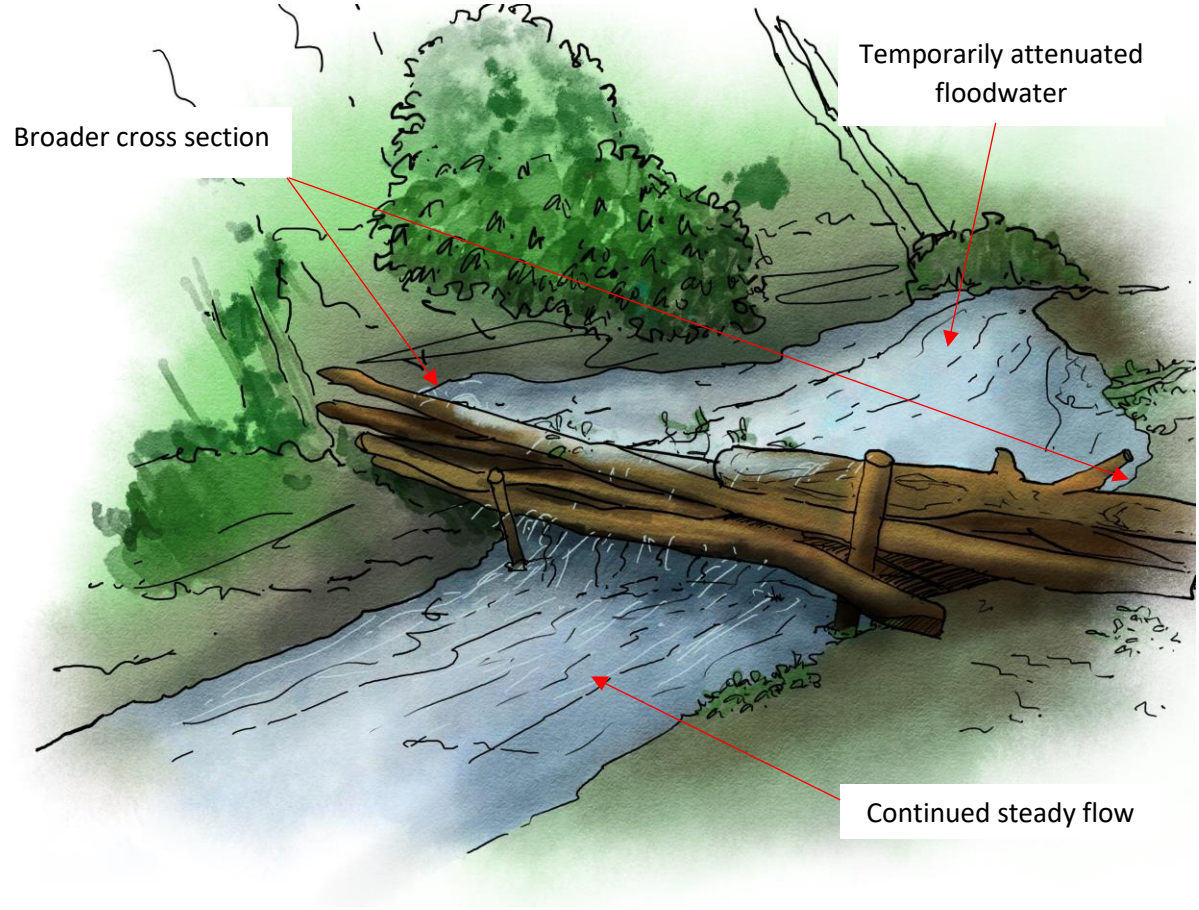


Figure 5 - Floodwater attenuation at leaky dams

Leaky dams need to be spaced effectively to ensure that the head level of one dam does not exceed the tail level of the dam above it, otherwise the intended hydraulic differential will be reduced and the desired effects will not materialise (Woodland Trust, 2016). Figure 6 shows the appropriate spacing for a series of leaky dams. As the bed falls by 3.75m across the reach, to gain the intended results with stable structures, the optimum number of leaky dams is 8, at a height of approximately 45-50cm each. As there are already 3 in the stream, a maximum of 5 more should be installed along the reach.

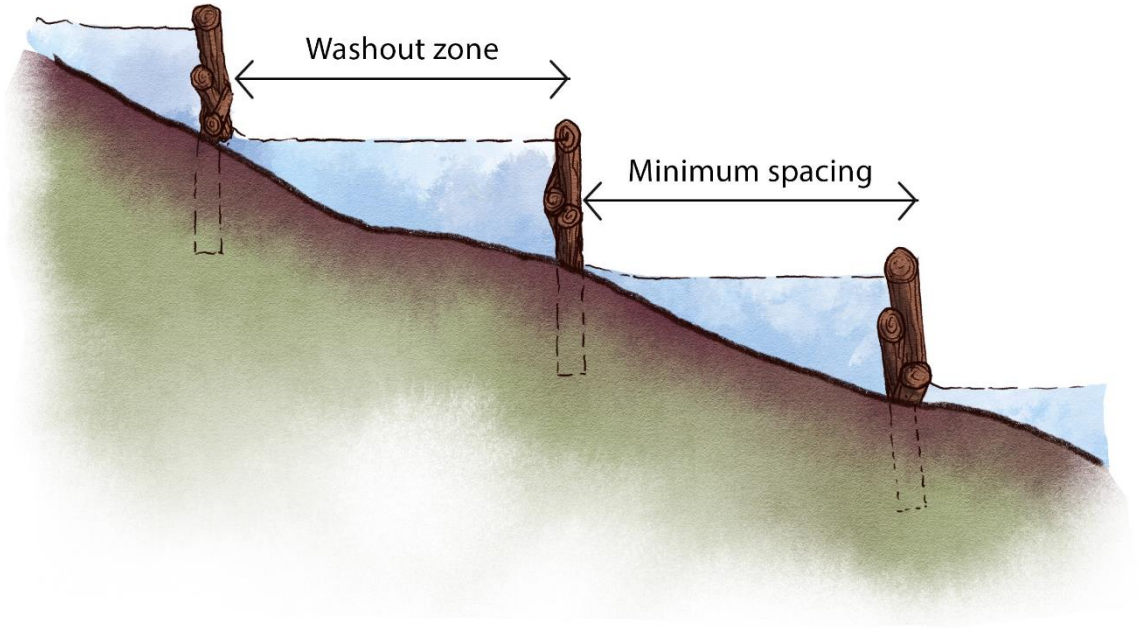


Figure 6 - Appropriate spacing for an effective series of leaky dams

In addition to the hydrological benefits, the increased geomorphological diversity will be reflected in increased ecological diversity that contributes to the wider aims of the project. Leaky dams provide stable, varied habitats for species to develop in, which particularly benefits macrophytes, invertebrates and fish (Woodland Trust, 2018).

It is worth stating that the leaky dams designed for Pool Meadow differ from the concept of man-made beaver dams. Beaver dams use rocks, mud, silt, and other material to improve their watertightness, which our dams will not. In beaver dams, the mud and other materials get washed away as the water flows through it, which is why beavers spend around 12 hours a day maintaining their dams. Our dams will be much lower maintenance and will rely only on stable materials to achieve results. They will naturally build up and lose debris, including sediment and plant matter, in a continuous process according to sediment load and flow regime.

Blocking the Sewage Overflow

The location for the intake was chosen based on existing geomorphology and minimising the impact on the Scheduled Ancient Monument. There is currently an unrecorded (by Thames Water) combined sewage overflow (see photograph 10) that discharges after periods of high rainfall when the local waste water network reaches a certain capacity. Any sewage pollution at all will be having a significant impact on a watercourse of this size, and it would be severely detrimental to the ecological and chemical status of the future pond. It also presents health and hygiene risks for people and their pets enjoying the amenity of the site.

The pipe is an unrecorded and extremely minor part of the local sewage network that is probably a relic of previous infrastructure, most likely responsible for discharging waste water from the nearby house The Mount before the modern sewage network was constructed. As a result, disconnecting it from the system is not foreseen to have any implications for wider infrastructure. With authorisation from Thames Water, the existing pipe will be blocked off where it meets the main sewer on the north-eastern side of the site to ensure that it stops polluting the watercourse.

The outfall into the stream has an invert level of 155.46mAOD, so will need to be removed for the extent of the new channel, which will be dug to 155.5mAOD (see photograph 6). This has the benefit of allowing us to excavate an area of bank without causing further damage to the historic structure; as that section was already excavated and backfilled during the original installation of the pipe.

Photograph 10 - Combined sewage outfall at Pool Meadow

Creating the Wildflower Meadow

To ensure this project achieves maximum impact, the dominance of the Equisetum needs to be reduced to a point where other species have the space and light to germinate and thrive. The wetted sections of the meadow will see a natural change of plant species to favour macrophytes and riparian species, however, the remaining terrestrial (dry) sections of the meadow will need more direct interventions. Before the area is re-wetted, the Equisetum is to be rolled and then sprayed with herbicide (see Use of Herbicide section below), and then put on a maintenance schedule of mowing in early spring to inhibit spores from developing and dispersing, and then throughout the summer/autumn to remove the surface structure and deplete the rhizome base. This will not completely eradicate the horsetail, but it will make enough space to establish a balance with more beneficial species. At the time of writing (Sept. 2023), the Green Gym have cut back a significant area of Horsetail, which has resulted in an encouraging proliferation of other species, including nettles and grasses. Future cuttings should be left for a few days to release any seeds, and then removed and disposed of off-site. This will gradually lower the fertility of the soil and improve the natural biodiversity (see maintenance section).

Before the works in 2024 (timeline subject to permitting and funding), the horsetail will need to be allowed to grow (no cutting) so that it can be treated effectively.

Once the site is prepared, the areas that will not be inundated will be sown with a wildflower meadow mixture suited to areas around wetlands with the following composition:

Wild Flowers 20%

Achillea millefolium – Yarrow

Centaurea nigra – Common Knapweed

Filipendula ularia – Meadowsweet

Galium verum – Lady's Bedstraw

Leontodon hispidus – Rough Hawkbit

Leucanthemum vulgare – Oxeye Daisy – (Moon Daisy)

Lotus corniculatus – Birdsfoot Trefoil

Plantago lancelata – Ribwort Plantain

Primula veris – Cowslip

Ranunculus acris – Meadow Buttercup

Rumex acetosa – Common Sorrel

Silaum silaus – Pepper Saxifrage

Succisa pratensis – Devil's-bit Scabious

Taraxacum officinale – Dandelion

Traopogon pratensis – Goat's-beard

Vicia cracca – Tufted Vetch

Grasses 80%

4% Agrostis capillaris – Common Bent

4% Anthoxanthum odoratum – Sweet Vernal-grass

4% Briza media – Quaking Grass

54% Cynosurus cristatus – Crested Dogstail

4% Deschampsia cespitosa – Tufted Hair-grass

10% Festuca rubra – Red Fescue

These works will significantly improve the habitat for pollinators and insect species that reproduce in ponds, wetlands and wildflower meadows, and provide a much wider variety of plant species for animals that specialise in diet or habitat, resulting in knock-on impacts throughout the food chain. Furthermore, as can be seen in photographs 11 and 14, trees are gradually encroaching the meadow on every side, which puts the archaeology of the Scheduled Ancient Monument at risk. By creating and maintaining the wildflower meadow proposed, we will stop the degradation of important archaeology and protect the site for generations to come.

Photograph 11 - Equisetum monoculture and encroachment of trees within Pool Meadow

Use of Herbicide

Although every effort to avoid using herbicide has been made, use under carefully controlled conditions is still required to reduce the current dominance of horsetail on site, so that a more biodiverse species mix can grow and support animal populations.

Horsetail is incredibly difficult to control due to its resilient rhizome base that can permeate down to 2m below the surface. It also has an unusually thick waxy cuticle and low surface area on the leaves, which minimises the absorption of herbicide. To overcome this, we will roll the meadow to break down the waxy cuticle, and then apply a specially formulated glyphosate-based herbicide, which the plant will transport to the rhizome. This will then be followed by the implementation of a mowing schedule (see maintenance section), reducing the plant's ability to grow and photosynthesise, and depleting the carbohydrate reserves found in the remaining rhizomes over a number of years. This will never completely eradicate the horsetail, but it will make enough space to establish a balance with more beneficial species.

Glyphosate is a broad-spectrum herbicide used widely across the UK, both in domestic and agricultural settings; it is best known as being one of the active ingredients in "Roundup", which also includes a number of other chemicals, including surfactants, which break the surface tension of fluids for better ingestion into plants. Roundup is used by farmers all around Chipping Norton to control weeds and "spray off" crops shortly before harvest.

Herbicides are well known to be toxic to animals and there is widespread concern about the global impacts on pollinating insects, particularly bees. The actual impacts to bees, ecology and human health are not fully understood because herbicides are made up of a number of chemicals that can lead to mortality and sub-lethal effects in different or indirect ways; for example, glyphosate can deplete the gut biota of bees, leading to increased susceptibility to pathogens and difficulty maintaining the temperature of the hive, resulting in individual mortality and/or loss of the colony (Motta et al., 2018). Other studies have identified cognitive impairment in bees from ingestion of glyphosate and surfactants, leading to issues foraging and navigating, but the mechanism is not understood (Farina et al., 2019). Animal testing of different Roundup formulas found that mortality rates in bees are unaffected by the presence of glyphosate; with death theorised to be occurring due to surfactants and other chemicals matting the bee's hair, blocking gaseous exchange, leading to suffocation, rather than the ingestion of toxic substances (Straw et al., 2021).

A lack of understanding of the full impacts and mechanisms involved, as well as the economics of global food production account for why the use of many herbicides and pesticides are still permitted around the world (Nargi, 2021). Understanding these risks in context to the desired outcomes and specific environment of the Pool Meadow Wetland Restoration Project allows us to make an appropriate judgement on whether we can effectively mitigate the risks enough to use herbicide on this project.

Consultation has been undertaken with local farmers and beekeepers, and a risk assessment has been carried out to establish the risks and mitigations required. These chemicals are applied liberally across the UK countryside without any mitigations on a regular basis, including the areas surrounding Chipping Norton, making spraying an area the size of Pool Meadow a statistical insignificance. Horsetail is not a flowering plant, and its dominance within the meadow means that there are few attractions to bees or broader ecology in the immediate environment (hence the restoration project). Bees do not fly or collect pollen at night, and are most at risk from herbicides before they dry, so undertaking these works after dark on a warm, dry night will allow the herbicides to dry before dawn and thus protects the bees from harm. Use of a specialist contractor ensures the

right equipment to avoid overspray or excess chemicals impacting the surrounding environment, particularly the stream. Local bee keepers will be informed of activities before the area is sprayed so they can keep their bees in if they see fit.

Although there are risks associated with this work, it is affecting a very small area with appropriate mitigations. The long-term impact of the effective use of herbicide on this site will be a biodiverse proliferation of life that far outweighs the negative impacts of spraying.

Habitat Enhancements

There are a number of simple ways that we can maximise the ecological outcomes of this scheme, including habitat stacks and bird and bat boxes.

Habitat stacks are piles of dead wood that provide habitat and refuge for mosses, lichens, fungi, insects, small mammals and amphibians. There are already a number of habitat stacks of varying sizes with an excellent range of material that are benefitting the local environment on site (see photograph 12), and a total of 3 additional habitat stacks are planned; 2 in the wildflower meadow, and one slightly within the wetted margin of the pool. Timber will be sourced from the felling and maintenance of the hawthorn and blackthorn scrub near the bund at the downstream end of the site, and from any local tree works. This will provide a range of timbers of different sizes and species in wet, dry, sunny and shady locations, to allow a biodiverse population of inhabitants.

The exact locations for the habitat stacks will be decided during the works; the most important thing is that they are spaced out across the different wet and dry habitats found within the meadow.

Bird and bat boxes would complement and enhance the other biodiversity improvements. Bird boxes are easily installed on trees around the site and can be done either by contractor or by local volunteers, such as the Green Gym.

Bat boxes, however, need careful selection of their location. Bats are protected under the Wildlife and Countryside Act (1981) (as amended) and the Conservation of Habitats and Species Regulations (2010), which make disturbing bats or their roosts a legal offence. This means that if you install a bat box on a tree or other structure that needs future maintenance (i.e., bridges or buildings), the maintainer will be required to employ an appropriately licensed ecologist to undertake a survey and potentially take further steps for the proposed maintenance to comply with the law. This is both expensive and deeply impractical. It is best to install bat boxes on structures that require minimal maintenance and have low impact should they ultimately fail, such as standalone posts or stable tree monoliths. The inclusion of standalone posts is precluded by the site being a Scheduled Ancient Monument, so it is therefore suggested that bat boxes are only installed on stable tree monoliths produced by ongoing tree safety/maintenance works around the site that fall outside the scope of this project. The actual installation of bat boxes can be done by volunteers at any time, or by tree surgeons while creating the monolith.

Photograph 12 - One of several existing habitat stacks on site

Access and Amenity Improvements

In addition to improving biodiversity, this project aims to improve the accessibility and amenity of the site. Public accessibility around the site is currently poor, with the footpath averaging between 0.45 and 0.6m wide and very uneven (see photograph 13). At some times of year, this makes it difficult to walk down and it is completely inaccessible to pushchair and wheelchair users.

The footpath runs along the top of the bund, which is protected as part of the Scheduled Ancient Monument. The topographic survey identified that frequent traffic over many years has led to significant footpath erosion along the top of the bund (see figure 9). By improving the surface of the footpath, we can stop this progressing any further and protect the site for generations to come.

As Chipping Norton has a growing population and this project has a high level of public engagement, ensuring access for all is an important factor in developing amenity. Improved technology and accessibility of all-terrain wheelchairs means that investment in providing accessible outdoor spaces offers significant returns in equity, diversity and quality of life for the community. The desire for the footpath to be improved is frequently mentioned by local people when discussing the project.

In the early 1990's, the footpath was rebuilt to approximately 1.5m wide and has since been eroded away and encroached by vegetation. To improve access, we plan to rebuild the footpath to a minimum width of 1.5m, as per guidelines set out in the Equality Act 2010. Construction will require a geotextile base beneath a compacted type 1 surface with timber or recycled plastic edging strips. Depending on funding, we have two options: We could either build a path all the way round the site, totalling 448m, or we could go half way round to formalise the existing footpath, which would total 285m and cost substantially less, but also offer reduced amenity benefits.

There are three access points to the site, two of which offer access through kissing gates, and the third is a series of steps that continue toward the recreation ground. It is proposed that the kissing gates are replaced with pushchair and wheelchair friendly infrastructure. This will also need to ensure no unauthorised vehicular access to site, but maintain the facility for emergency service access.

The new flow control structures will direct water across what is presently footpath. To ensure continued dry accessibility, boardwalks will span the channels to provide a continuous surface. These will be very short and constructed of resilient, low-maintenance materials. They will also have edge protection to mitigate risks identified in the Public Safety Risk Assessment below.

The track that runs from Church Lane to Pool Meadow is uneven and will require surface improvements to allow equal access to the meadow. During heavy rain, the track is inundated by a significant volume of surface runoff at a high velocity. This erodes the fines and destabilises the hardcore substrate to form gullies. Repairs to the area will include drainage improvements to minimise this occurrence and reduce future maintenance. The track is privately owned and contact has been made with the landowner, who is supportive of the proposal.

Picnic Area

There is the potential to clear some undergrowth (not trees) from an area of high ground at the north-eastern end of the site (see photograph 13) and provide picnic benches and associated infrastructure amongst the trees, including bins and potentially a permanent barbeque for the community to enjoy. This proposal is subject to discussions, project funding, and strategy of the Town Council.

Interpretation Boards

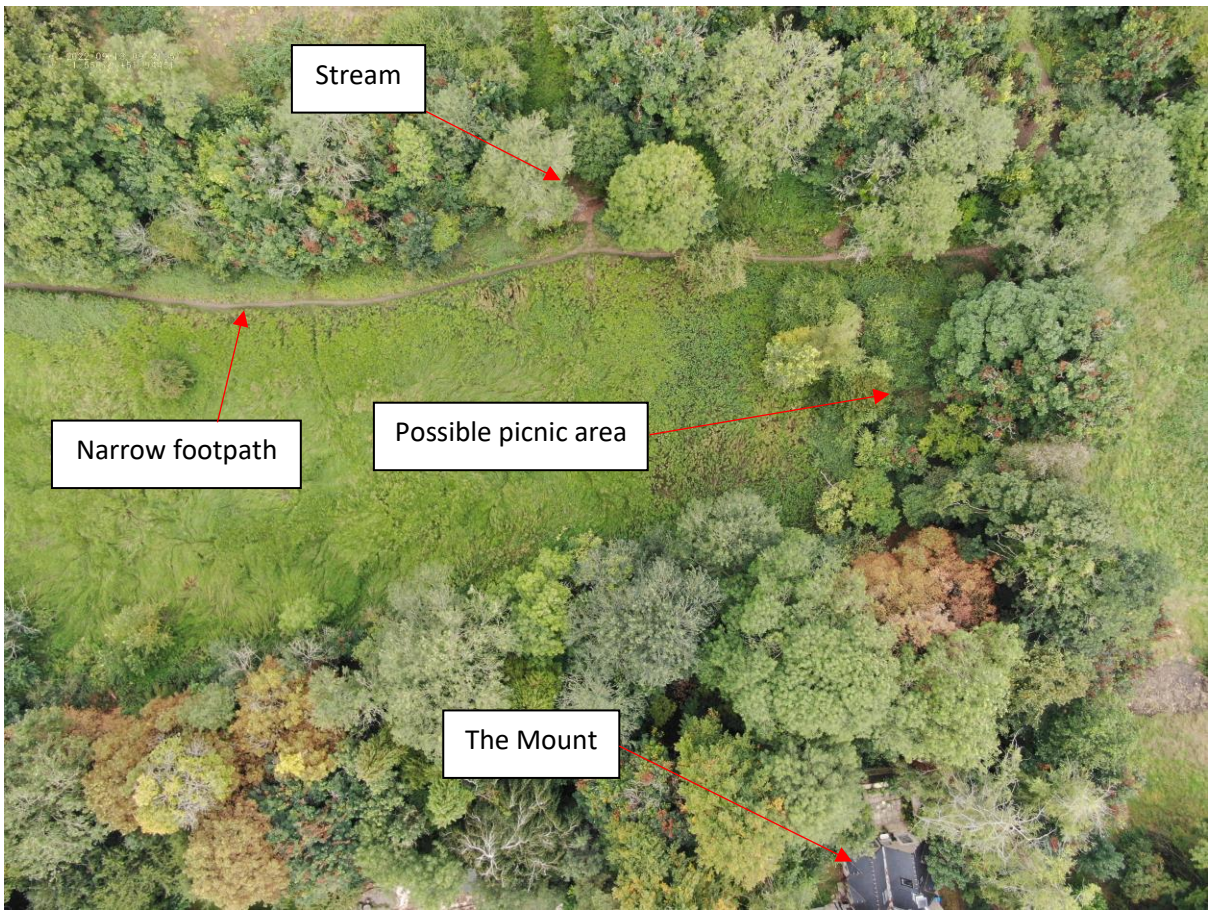
As part of the project, we propose the installation of 2 permanent interpretation boards. One board will tell people about the environment and ecology of the site, and the second will connect people with the fascinating history of the site. This is particularly important to the community as the site of the castle is inaccessible to the public and its history remains an under-utilised community asset. A local artist will be asked to produce an interpretation of the site in medieval times for the history board.

Information boards will also be used to display the names/logos of contributors to the project as an acknowledgement and thank you, and also to raise awareness of the important work that those organisations carry out.

The public safety risk assessment (see section below) highlighted the requirement for certain safety information for users of the site which will be displayed in an appropriate corner of the interpretation boards. Emergency rescue equipment, comprising of a life ring and throw line will be installed to hang beneath the nearest interpretation board to the pond.

Litter Pick

Following construction works, there will be a litter pick across the site. Pool Meadow is an important amenity for young people from the surrounding area and there is a remarkable amount of litter to be found on site, including within the stream. The environment at demobilisation will be exemplar for restoration projects.



Photograph 13 - Drone imagery showing the upstream end of Pool Meadow, highlighting potential picnic area, narrow footpath and nearby landmarks.

Discounted Options

Due to the archaeological significance of the site, it is not feasible to dig a new pond and let it fill with groundwater – Historic England ruled that out during pre-application consultation due to the damage it would cause any archaeological remains beneath the surface.

This also means that the area is not suitable for tree planting, or the installation of freestanding structures, such as posts for bat boxes, and so on.

Topographical Survey

To assist the outline and detailed design, a topographical survey was commissioned from Oxford Geospatial, with 2 cross sections of the watercourse and a cut and fill model that calculated the area, depth and volume of the pond (see figure 2). The results of the survey helped identify:

- The most appropriate locations for the control structures.
- The levels and dimensions that the control structures need to be.
- Condition, dimensions and inclines of the bund and footpath.
- Flow pathway from inlet to outfall.
- Area, depths and volume of water.
- Area of land for terrestrial ecological improvements.
- Hydrogeomorphological features, processes and dimensions of the watercourse.
- Locations and levels of historic infrastructure.
- Baseline surface levels for future maintenance works to operate from.

We also installed an Environment Agency specification (Environment Agency, 2021a) E6 control point that physically identifies a level within the area so that construction, maintenance and monitoring works can be aligned to the existing survey data.

Results from the survey can be seen for illustrative purposes below, with the full survey data included with this report.

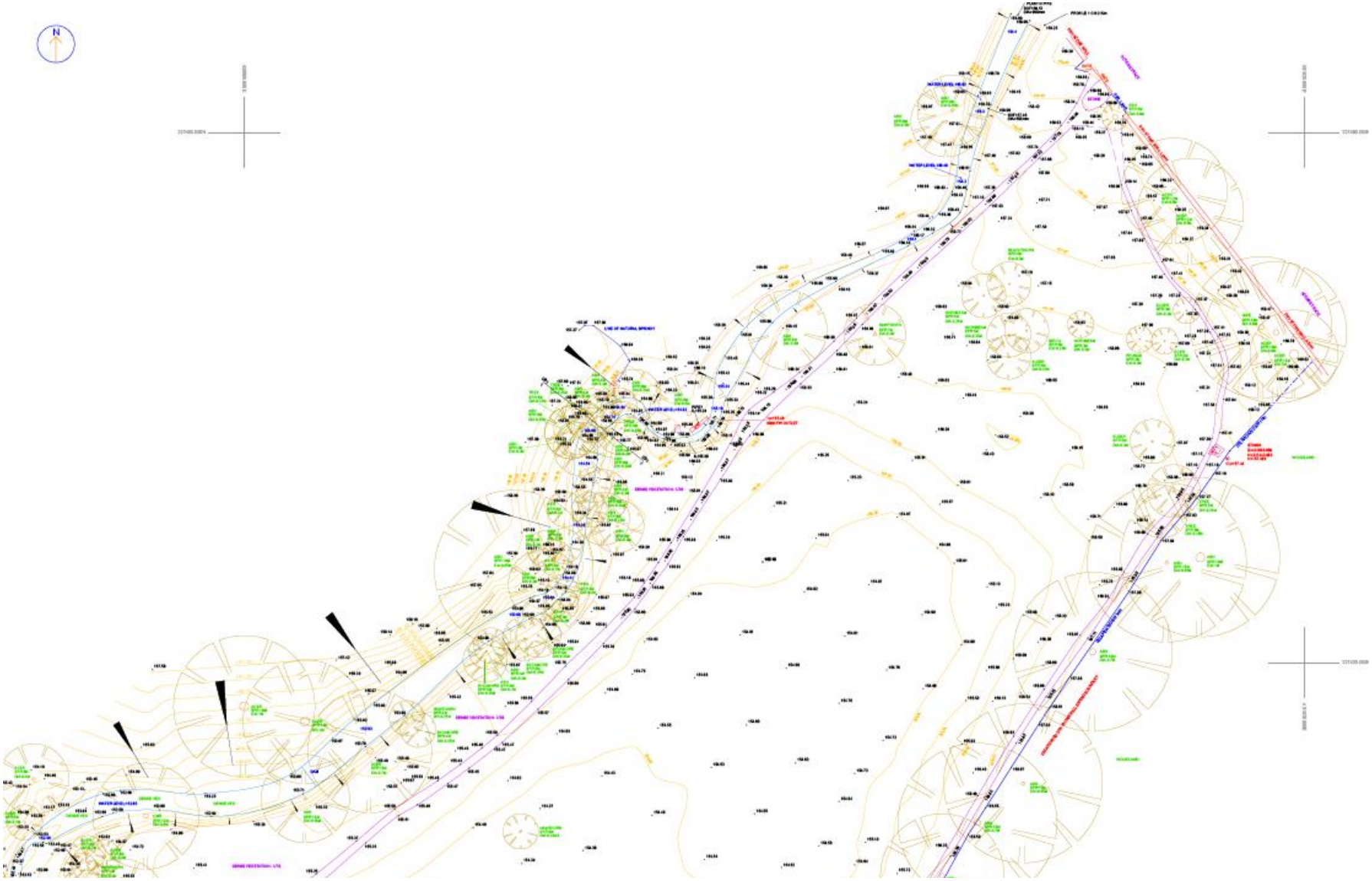


Figure 7 - Topographical survey of upstream end of Pool Meadow (taken from Oxford Geospatial, 2023)

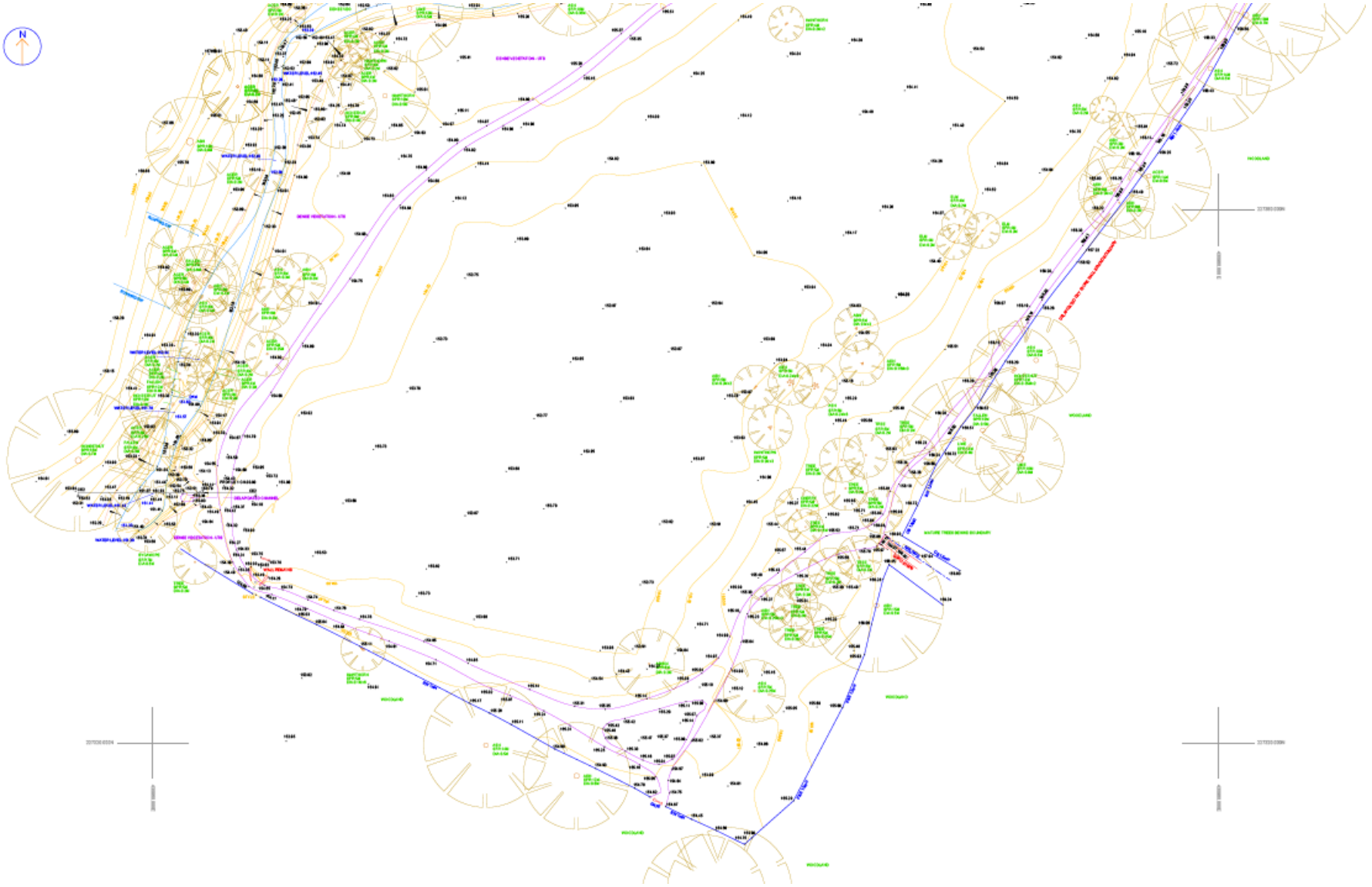


Figure 8 - Topographical survey of downstream end of Pool Meadow (taken from Oxford Geospatial, 2023)

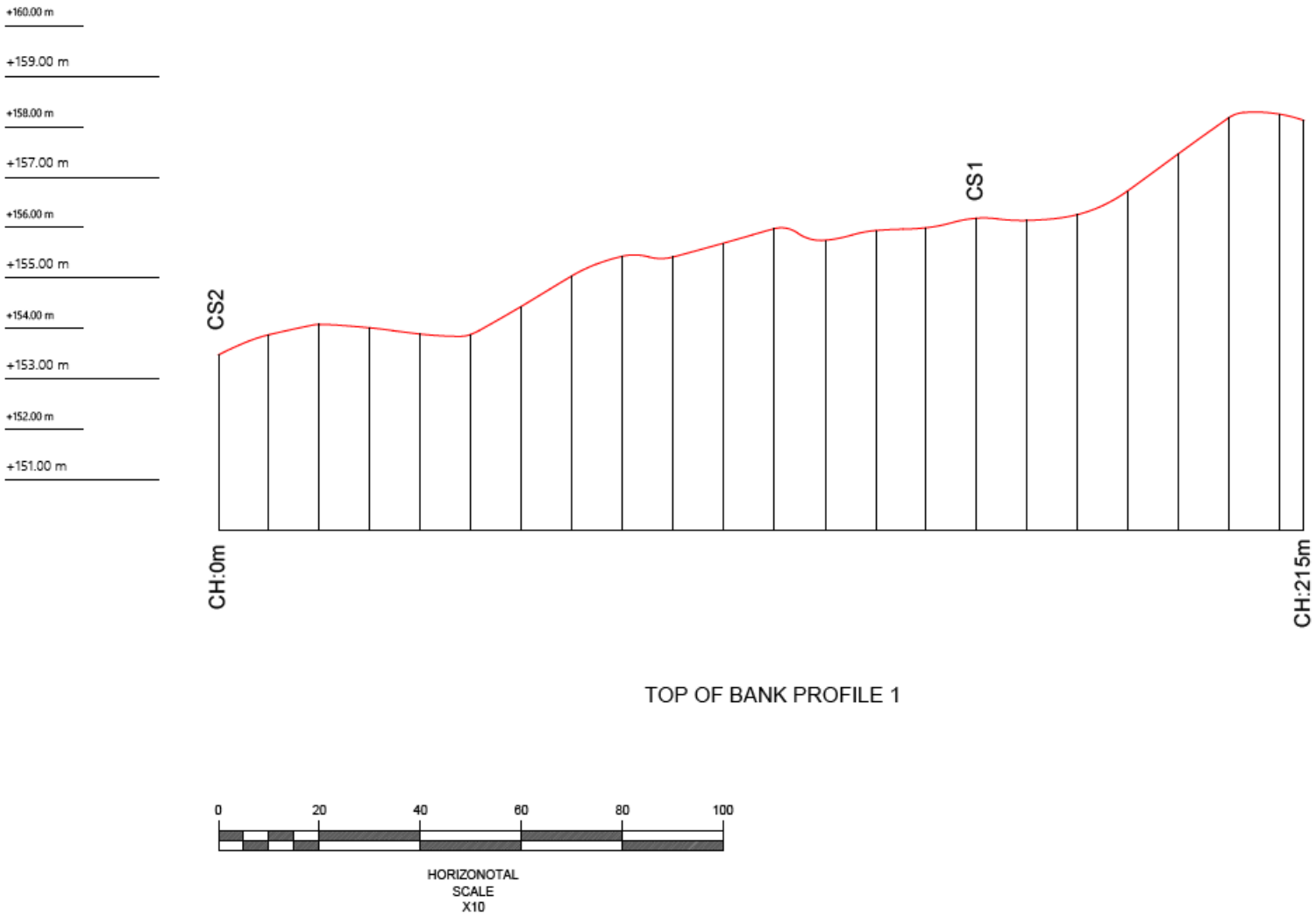


Figure 9 - Long profile of the elevation of the bund (taken from Oxford Geospatial, 2023)

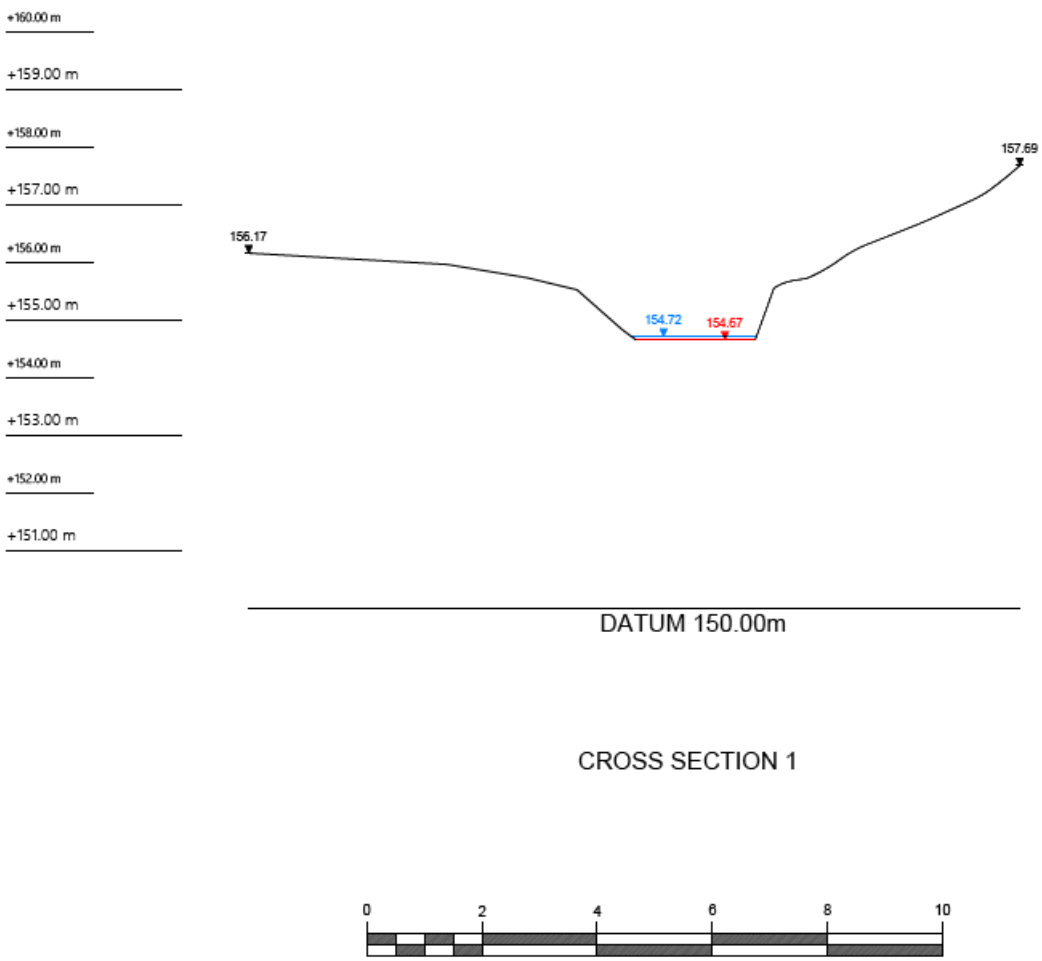


Figure 10 - Cross section of the location of the upstream impoundment structure (taken from Oxford Geospatial, 2023)

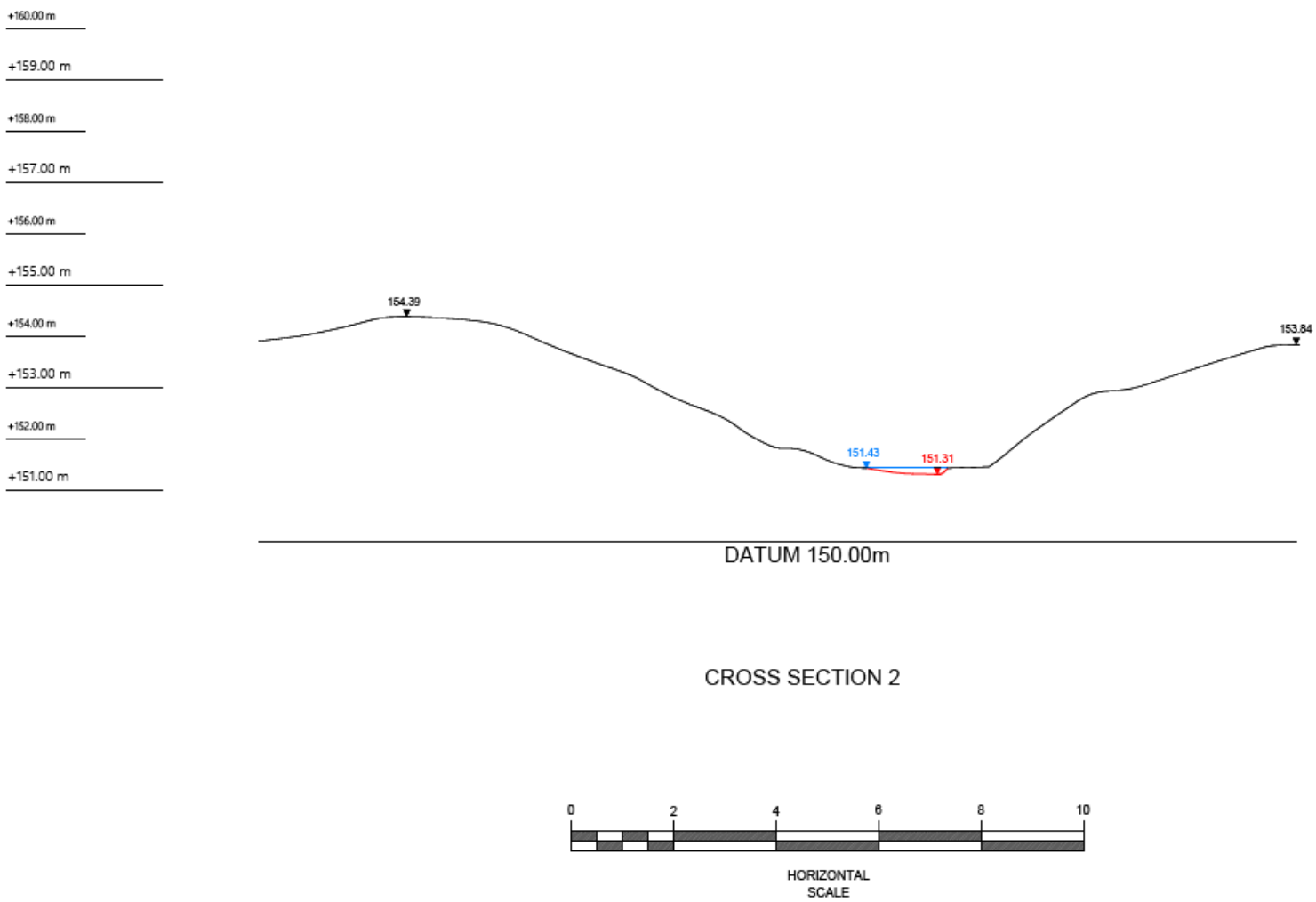


Figure 11 - Cross section of the location of the downstream outlet structure (taken from Oxford Geospatial, 2023)

Site Services Search

A desktop utility search and site walkover were undertaken to identify any buried services that might impact the designs. This was initially carried out using an online utility search service (Linesearch Before-U-Dig) that contacts individual utility owners (such as Thames Water) and requests details of their local infrastructure. Utility companies provide this information to avoid the risks of service strike to their infrastructure, people, and the environment. Private services, such as non-mains water, electricity supply and waste water pipes are not recorded, and therefore do not appear on utility search results (Linesearch Before-U-Dig, 2023).

The desktop utility search highlighted a sewage main running along the southeastern face, but no buried services that would impact the feasibility of the project.

The site walkover identified the unrecorded sewage outfall at the location of the pool inlet structure (option 1), which is not marked on the Thames Water asset register. Thames Water were made aware of the pipe and visited the site to assess pollution risk. This information contributed to the design of option 1, the analysis of environmental benefits of the project, and the analysis of archaeological significance in that location.

Each utility search is valid for a period of 3 months to maintain up-to-date information, so these checks will need to be repeated prior to construction. Construction work will also be preceded by a CAT and Genny (Cable Avoidance Tool and Generator) survey before breaking ground.

Archaeology

Pool Meadow is part of the “Chipping Norton Motte and Bailey Castle and Fishpond” Scheduled Ancient Monument. Undertaking any works on the site needs Scheduled Monument Consent from Historic England, which requires the undertaker to assess the impact of the project on heritage and archaeology. GW Heritage were commissioned to undertake a Historic Environment Desk-Based Assessment (included with this report) to identify what is known about the site, and what the impacts of this project would be.

The heritage and archaeology of the area is under threat by the encroachment of trees (see photograph 14) and footpath erosion along the top of the bund by frequent traffic (see figure 9). By improving the surface of the footpath and maintaining the pond and wildflower meadow proposed, we will stop the degradation of the archaeology and protect the site for generations to come.

Photograph 14 - Drone imagery showing the narrow footpath and progressive encroachment of trees onto the archaeological site

Chronology of usage is unclear in parts, but during medieval times, there may have been one or more fish ponds within the curtilage of Pool Meadow (Historic England, 1996). Popular belief is that the raised embankment is a remnant of this medieval structure; however, the Historic Environment Desk Based Assessment found that the embankment was likely to be a more recent addition to the landscape, with fish ponds usually much smaller and excavated into the surface, as opposed to impounded above ground level. The existing embankment is far more likely to have formed an impoundment reservoir to ensure consistent flow to the mill(s) that have operated on/near the site of the existing Bliss Mill since at least the 1700’s. Records show that during drier years, production had to be moved to a mill at Swinbrook on the River Windrush (GWHeritage and Robinson Wild

Consulting, 2022; Bliss, c.1877, cited in Victoria History Society, 2022). Therefore, the requirement to ensure a reliable flow of water by constructing an impoundment reservoir would have been the obvious long-term solution for the viability of local industrial development. We have been unable to find records of the construction or maintenance of the embankment, but it appears on all recorded maps of the site, including the first OS Map of the area surveyed in 1880 (Ordnance Survey, 1885).

Two structures appear for the first time in the 1922 mapping of the area (surveyed 1919) (Ordnance Survey, 1922), which remain today (both now derelict). One is a sluice at the downstream (southwest) corner of the meadow that drained the pool through what is now a collapsed culvert and back into the stream. From the downstream end of the sluice, it can be seen that some water still flows through the structure during wetter periods. This structure is likely to have been an emergency drawdown added in response to emerging reservoir safety legislation that was being developed at pace around that time after a series of reservoir safety incidents. If the embankment was a defunct medieval structure with no present economic benefit, this comparatively expensive, high-maintenance, carefully-engineered structure with a rebuild of the surrounding embankment is unlikely to have been installed in preference to a simple and more reliable surface drain to keep the reservoir empty. The area wasn't protected as a Scheduled Ancient Monument until 12th July 1949 (Historic England, 1996), which means that any works wouldn't have been legally required to obtain permitting or carry out such sympathetic reconstruction as was undertaken, furthering the evidence that it was still in use and financially viable to maintain to a high standard.

Toward the upstream end of the meadow is a second structure constructed from the same blue engineering bricks. This structure was originally a headwall for the combined sewage outfall identified in the site services walkover. Since installation, the watercourse has eroded behind the headwall and detached it, so that the sewage now drains from an exposed terracotta pipe, with the redundant headwall on the opposite bank. Where the outfall and pipe were installed, the embankment above them has been carefully reconstructed, again indicating continued value in use.

Although written records of any construction work and reservoir use are lacking, we have evidence that the site was flooded to bankfull either on occasion or continuously until at least the 1940's. There is anecdotal evidence that refers to it being flooded on occasion into the 1960's, but there are conflicting reports and no hard evidence that has come to light. The last evidence of the site being flooded is a photograph of three locals ice skating, reportedly taken around 1949. A high-resolution scan confirms the location by revealing features of the landscape and either the church or The Mount in the background (we believe the church). As 1949 was a relatively warm year (Manley, 1974), it is likely that the photograph was actually taken in 1947, which was a notably cold winter (Royal Meteorological Society, 1948) that hit Chipping Norton particularly hard (Ffrench, 2010).

Photograph 15 - Ice skating in Pool Meadow during the mid-late 1940's – see either the Church or Mount in background

As the embankment was impounding in the photograph, it can be safely assumed that it was maintained in accordance with reservoir safety legislation at the time. This further strengthens the theory that it is a comparatively modern (Georgian/Victorian) structure, as a medieval structure would be unlikely to be constructed to design specifications capable of holding that volume of water for hundreds of years without significant, expensive work.

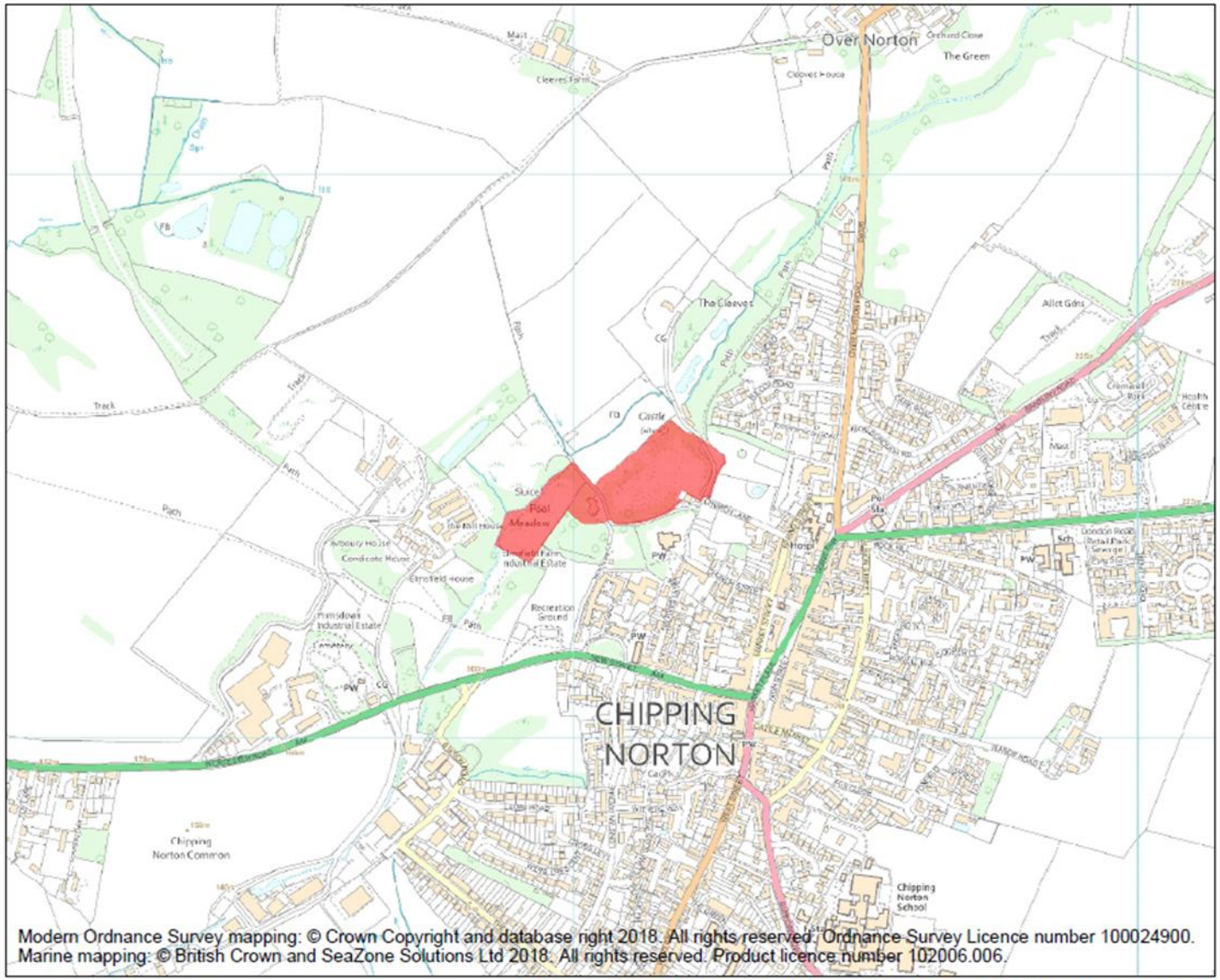
It is believed that the site was inundated by operating a sluice or makeshift dam immediately upstream of the present track from Church Lane, to channel the water into the field, then through the now collapsed culvert beneath the track and into Pool Meadow (see photograph 4). A modern interpretation of that has been used to formulate outline design option 2.

During and after the construction of the railway (opened in 1855), an area downstream, closer to Worcester Road/A44 was also flooded on occasion, and there are often differing reports about which site was flooded when; however, research and procurement of the Historic Environment Desk-Based Assessment (GWHeritage and Robinson Wild Consulting, 2022), has clarified the chronology and usage of Pool Meadow to the extent required.

At some point in history, the northeast (upstream) extent of the site was partially infilled to form the existing high ground. The exact circumstances and reasoning of this are unclear, but it is being assumed that it is inert building waste from the town and being treated as a regular part of the landscape. Burying waste in this manner was common practise before the Control of Pollution Act 1974, and agricultural pollution controls in that legislation were indistinct, so farmers were able to bury waste of all sorts in ponds/fields etc. until the Water Act 1989 came into force. As these dates are shortly after the peak use of asbestos in UK construction, undertaking any excavation in this area would require contaminated land testing to establish the risks to contractors, the public and the environment. This is not being proposed.

To undertake the proposed works (option 1) will involve excavating a section of the bund (see flow control structures section and photographs 6 and 7). The proposed location of the inlet structure was selected on topography and hydrology, and also because the installation of the sewage outfall beneath will have significantly disturbed any archaeological remains and reduced the significance of that location. This allows us to excavate through the bund while ensuring the lowest impact to undisturbed sections of the Scheduled Ancient Monument. Doing so in the presence of an archaeologist will offer the chance to identify new evidence that could prove or disprove the medieval or post-medieval origins of the asset and gain a greater understanding of the historic construction, use and significance of the area.

The downstream control structure has been designed to be slightly higher than the level of the existing bund, so we can construct it by adding material to the historic structure, rather than excavating into it (see photograph 8).



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Name: Chipping Norton motte and bailey castle, and fishpond

Heritage Category: Scheduling

List Entry No : 1014747

County: Oxfordshire

District: West Oxfordshire

Parish: Chipping Norton, Over Norton

Each official record of a scheduled monument contains a map. New entries on the schedule from 1988 onwards include a digitally created map which forms part of the official record. For entries created in the years up to and including 1987 a hand-drawn map forms part of the official record. The map here has been translated from the official map and that process may have introduced inaccuracies. Copies of maps that form part of the official record can be obtained from Historic England.

This map was delivered electronically and when printed may not be to scale and may be subject to distortions. All maps and grid references are for identification purposes only and must be read in conjunction with other information in the record.

List Entry NGR: SP 31065 27430

Map Scale: 1:10000

Print Date: 18 July 2022

Historic England

HistoricEngland.org.uk

Figure 12 - Historic England Map of the Scheduled Ancient Monument

Alignment with the Water Framework Directive

The Water Framework Directive (WFD) is a legally binding legislative framework for the protection and improvement of surface water and groundwater bodies. It was originally implemented in 2000 and is currently enacted in England and Wales through the Water Environment (Water Framework Directive) Regulations 2017, which superseded The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003.

For surface water bodies, the objectives of the Water Framework Directive are to:

- Prevent deterioration of the status of each body of water.

- Protect, enhance and restore each body of water (other than an artificial or heavily modified water body) with the aim of achieving good ecological and chemical status (see table 1), if not already achieved, by 2027. Other targets are used on occasion where there are reasonable justifications.

- Protect and enhance each artificial or heavily modified water body with the aim of achieving good ecological potential and good surface water chemical status.

- Aim to reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances.

Under the regulations, the regulating authorities (in this case, the Environment Agency), were required to produce River Basin Management Plans. These look at the metrics that the WFD uses to determine the health of a water body and assess the current state of the river and ongoing trends, set targets for improvement, and detail how the aims and objectives of WFD are to be achieved.

The condition for each of the metrics used is ranked from 'high' to 'bad' (see table 1 below), with the overall status reflecting the worst performing component of the water body (so if one element is bad, and the rest are good, the whole water body has failed to meet WFD objectives).

Status	Definition
High	Near natural conditions. No restriction on the beneficial uses of the water body. No impacts on amenity, wildlife, or fisheries.
Good	Slight change from natural conditions as a result of human activity. No restriction on the beneficial uses of the water body. No impact on amenity or fisheries. Protects all but the most sensitive wildlife.
Moderate	Moderate change from natural conditions as a result of human activity. Some restriction of the beneficial uses of the water body. No impact on amenity. Some impact on wildlife and fisheries.
Poor	Major change from natural conditions as a result of human activity. Some restrictions on the beneficial uses of the water body. Some impact on amenity. Moderate impact on wildlife and fisheries.
Bad	Severe change from natural conditions as a result of human activity. Significant restriction on the beneficial uses of the water body. Major impact on amenity. Major impact on wildlife and fisheries with many species not present.

Table 1 - WFD rankings and their definition

The channel through Pool Meadow is part of the Cornwell Brook and Tributaries (Source to Evenlode) water body (Environment Agency, 2021). This water body has a moderate ecological status and is not achieving good status due to pollution and its impacts, both from sewage and the agricultural sector. These issues worsen further down the catchment where there are large sewage outfalls, but the Pool Meadow project will restore natural processes that remove pollution from upstream agriculture and stop sewage pollution on-site, resulting in a significant improvement of ecology in and around the watercourse. This results in cleaner, less polluted water flowing from Pool Meadow, with a greater, more diverse volume of reproductive material to support downstream populations. Flow rates will also be more regular, preventing damage from low flow events and chemical buildup.

These changes will contribute to the following WFD aims:

- Prevent deterioration of the status of the water body by improving resilience to climate change and pollution.

- Protect, enhance and restore the water body to support the aim of achieving good physical, chemical and ecological status.

- Reduce pollution from sewage and improve natural capability to remove already present agricultural pollution through natural processes.

The installation of a weir at the upstream flow control structure would not normally align with the aims of the Water Framework Directive due to the impact on river continuity, geomorphology and species migration; however, in this case it is mitigated by the wider benefits of the project and the presence of another weir immediately upstream (see photograph 2), so any migratory species would be unable to pass anyway. At present, no aquatic migratory species have been recorded on site.

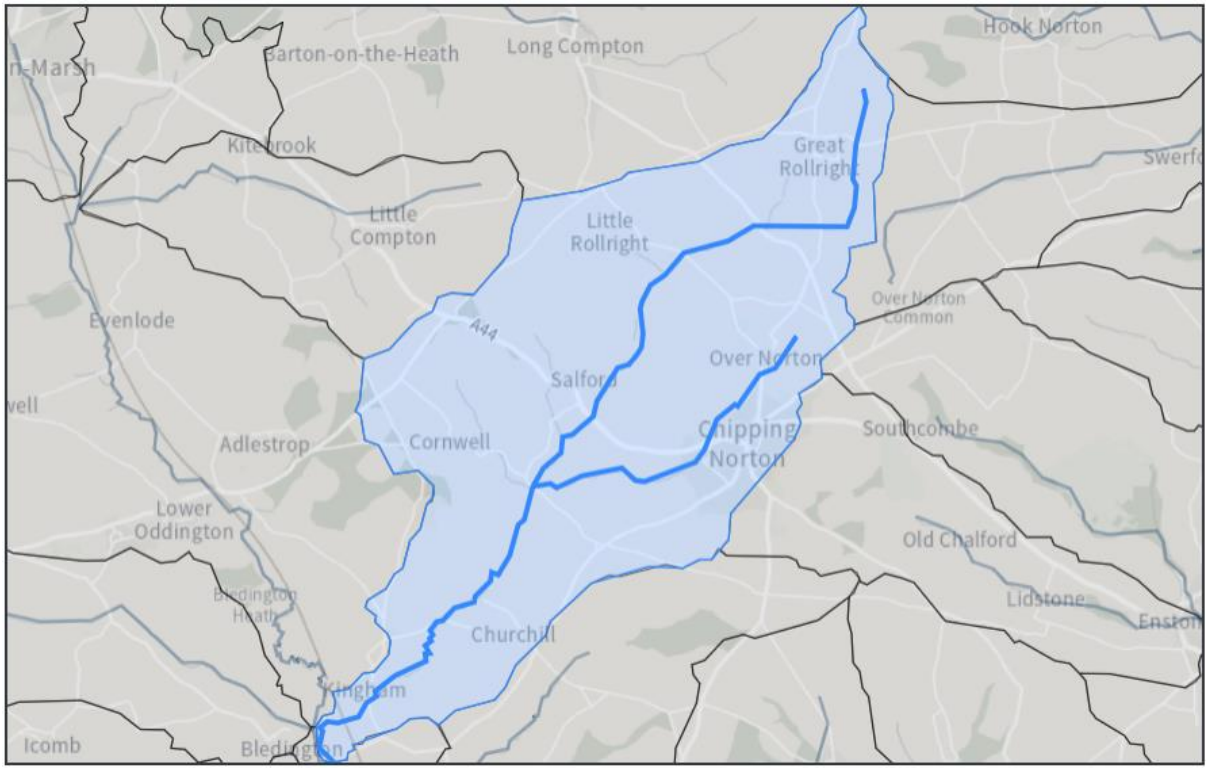

Figure 13 - Cornwell Brook and Tributaries (Source to Evenlode) water body.

Bliss Mill

When the flow returns to the stream via the outlet structure, the volume will have been reduced through infiltration and evapotranspiration; however, there is enough water to provide for both uses, unless there is a drought. The stream is joined by numerous drains and smaller tributaries between the inlet and Bliss Mill, and it will have a number of large woody debris dams installed along the reach to retain water and encourage consistent flow to downstream areas.

The watercourse supplies Bliss Mill with water that is now used for aesthetic purposes around the Mill (see photograph 16). Having spoken with the Property Manager, they are happy for flow to be reduced while the pond and wetlands are inundated, so long as they are able to offset the leakage through their sluices with the baseline flow. A loss of head level on site would be unsightly and could possibly risk bank stability on site, depending on the unknown condition of the mill pond pilings.

To ensure that we do not reduce their flow beyond this level, Pool Meadow will be inundated throughout the course of a winter when flow rates are at their highest and there is more than enough surplus to balance the needs of all users. It is not foreseen that any contingencies will be required beyond maintenance needs, but if there is ever a problem, it will be possible to temporarily block the Pool Meadow inlet structure to top-up Bliss Mill as required. This is undesirable but the wetland will be resilient to this due to the outlet structure maintaining the level.

It is worth remembering that Pool Meadow was probably (see Archaeology section) used as a retention pond for Bliss Mill historically, so the system is likely to be resilient to the filling of the pool.

Photograph 16 - Bliss Mill

Public Engagement

There is a great deal of public support for this project to go ahead, with the project team being approached regularly on site and by email with people offering help and encouragement for the scheme. Since erecting signage on site (see photographs 17 and 18), we have been inundated with positive support from the public.

The ongoing themes are that people are very enthusiastic about improving the natural environment, and the amenity benefit from the site. Many people have told us that they will greatly appreciate the improved footpath surface and access for all.

The only concern raised has been from dog walkers who want to know if dogs will still be allowed on site. They have all been responded to individually and informed that dogs will continue to be welcome on site, but it is of increased importance that people pick up after them to avoid polluting the water. Dogs should also stay out of the pond because they stir up a lot of sediment that blankets macrophyte species that produce oxygen.

A public outreach event was hosted with Beaumont Rivers and the Cotswolds AONB team on the 5th April 2023, which was well attended and a huge success.

A further public outreach day will be held shortly before construction commences to inform people of what we are doing and why. This will be complemented by information posters erected around the town. This will avoid/minimise any concerns from the public when they see works involving herbicide or machinery taking place on site.

Photograph 17 - Signage on upstream entrance gate

Photograph 18 - Signage on downstream entrance gate

Educational Outcomes

This project is highly innovative and an excellent example of nature restoration projects. Because we are working with many different topics across geography, biology, ecology, chemistry, physics, engineering, history, archaeology, sociology and health and social care, there are huge opportunities for educational outcomes across the curriculum. The site is also freely accessible to schools and provides an excellent educational resource, both now and post-restoration. Every school (both state, and private) within a 10-mile radius has been offered the opportunity to come to site and learn from subject matter experts free-of-charge, but none have taken us up on the offer yet. The offers have been left open, and the schools will be contacted again as the project gets underway.

Beaumont Rivers is also giving university students the opportunity to study any aspects of the project they are interested in. Aberystwyth, Oxford Brookes and Oxford Universities have been directly contacted, but students from any university are welcome. University students usually require data from both the baseline and completed project to make a conclusive study, so now the baseline data have been captured effectively, future study opportunities will develop as the restoration takes effect.

Ahead of the public outreach event hosted by Beaumont Rivers and the Cotswolds AONB team on 5th April 2023, every school within a 10-mile radius was emailed again to inform them that we were hosting the day aimed at schoolchildren with a request that they share the information with parents. The event was also publicised on social media (including by Chipping Norton Town Council) and posters around Chipping Norton and surrounding area. Delegates were given talks on a variety of environmental topics, including water quality, pollution, ecology, climate change, and environmental restoration. 50 Cadbury Crème Eggs were provided, so that delegates could learn how different species (water voles, foxes, etc.) like to eat. The event was well attended by a majority of adults.

On completion of the scheme, we will reach out to the local schools again and offer the chance of field trips for classes to learn about the geography, history and ecology of the site, and we'll set up some fun educational activities for the kids (and teachers!) to enjoy.

Public Safety Risk Assessment

To ensure that we are building a safe asset for the community, a public safety risk assessment has been carried out. Designs were then either changed to remove the hazard, or mitigations were added to lower the risk and/or consequence of occurrence. Following construction, there will be a site inspection of the built environment to ensure all risks are accounted for and mitigated appropriately.

In addition to the risks that have been designed out, the risk assessment identified a number of control measures that have been added to the design:

- Rescue aids (life ring and throw rope) will be installed in easily accessible areas (beneath interpretation boards).
- Interpretation boards will include What3Words coordinates to help guide emergency services to the right location.
- Safety signage will be installed to warn site users of risks, including the need to keep dogs on leads and clean up after them.
- Edge protection with child-safe infill mesh will be installed where the footpath is directly next to/over water, steep banks, and heights (including inlet/outlet structures and at downstream extent of pool).
- Vehicular access to site will be maintained and improved for emergency response.

Chipping Norton Town Council has a formal procedure for the review of incidents and near-misses and will be responsible for implementing further risk management if the need arises.

Pool Meadow Restoration Project Public Safety Risk Assessment

Hazard / Risk	Information	Who is at risk	Precautions and Control Measures	Residual Risk
Falling into deep water – pond and upstream impoundment structure	Drowning Hypothermia Cold water shock Visibility of hazard is reduced after dark Wheelchair users particularly vulnerable to unguarded edges	Site users, pets	Rescue aids (life ring and throw rope) will be installed in an easily accessible areas (beneath interpretation boards). Edge protection with child-safety infill mesh will be installed where footpath is directly next to/over water (including inlet/outlet structures and at downstream extent of pool). Signage will be installed to warn site users of the risk of deep water. Shallow depth and incline will ensure that most users can stand without being out of their depth for self-rescue.	Medium
Freezing water	Slips, trips and falls Falls through ice into deep water Victims could be trapped beneath the ice	Site users, pets	Rescue aids (life ring and throw rope) will be installed in an easily accessible area (beneath interpretation board). Edge protection with child-safety infill mesh will be installed where footpath is directly next to/over water (including inlet/outlet structures and at downstream extent of pool). Signage will be installed to warn site users of the risk of deep water. Shallow depth and incline will ensure that most users can stand without being out of their depth for self-rescue.	Medium
Differential pressures	Differential pressures at hydraulic control structures can cause people, animals, or debris to become lodged against control structures	nil	Low flow rate spread over a large cross-sectional area will minimise differential pressures to safe levels.	Low
Submerged hazards	Submerged objects can remain unseen beneath the water/vegetation/sediment, leading to potential injury and subsequent disease	Site users, pets	Signage will discourage people from entering the water and any existing underwater hazards will be removed during construction (none currently identified). Site users are unlikely to throw in large debris (usually shopping trolleys or waste) due to distance from nearest supermarket and residential areas.	Low
Falls from height	Footpath along existing embankment passes a number of steep falls. Increasing the accessibility of the site will result in greater traffic, and therefore increased likelihood of risk manifesting.	Site users	Edge protection with child-safety infill mesh will be installed long the footpath where it crosses boardwalks, control structures, steep inclines and falls to water.	Low
Bites, scratches and stings	Nettles, insects, Lyme disease, allergic reactions and anaphylaxis	Site users	Bites, scratches and stings are an inherent risk of the environment that cannot be removed.	Low

Sickness and disease	Disease in the immediate environment may be caused by: Tetanus, Leptospirosis, Lyme disease, Blue-green algae, Dog mess, Faecal matter (coliform), Agricultural runoff	Site users, pets	Signage and vegetation will discourage people from entering the water and dog owners will be asked to keep their dogs on leads and pick up after them. Water body pollution from upstream will be low following the blockage of the sewage outfall.	Low
Trip hazards /soft and uneven ground	Slips, trips and falls can be caused by: Uneven ground (bund), Old and partially buried structures, Dense vegetation, Ice	Site users	A safe, stable and even footpath with edge protection where appropriate will be provided for site users.	Low
Tree safety	Falling trees/debris	Site users	Chipping Norton Town Council are undertaking a tree safety review on site separate to this project.	Low
Poor emergency service access	Difficulty in obtaining emergency help where required	Site users	Vehicular access to site will be improved as part of the project and What3Words coordinates will be included on interpretation boards to help guide emergency services to the right location.	Low
Dogs	Dog mess and contaminated waste	Ecology, the environment, site users	Dog owners will be requested to keep their dog on a lead and reminded to clear up after them. Information will be included on the safety signage to highlight the reasons that this is important.	Medium
Lack of maintenance	Loss of impoundment	Ecology, the environment	Hard engineered structures are designed to be low maintenance, and large woody debris dams will need monitoring and maintaining and eventually replacing as the river system adapts to their presence and the wood breaks down. Vegetation will need regular maintenance to ensure horsetail does not return to its previous dominance within the meadow.	Medium
Blockage	Impoundment beyond the design brief could lead to asset failure	Flood risk, the environment	A 2-stage weir is being installed at the outlet structure to ensure resistance and resilience to blockage. Due to the low flow speed and profile, large debris is unlikely to block the outfall without human intervention. If blocked, the control structure will be slow to increase depth due to flow rates and ponded area.	Medium

Table 2 - Pool Meadow Restoration Project Public Safety Risk Assessment

Maintenance

Most of the day-to-day maintenance of the area will be undertaken by volunteers from Chipping Norton's Green Gym, which is a local, independent group that undertakes environmental work in much of the public open space within the town to a very high standard.

The hard engineered structures, such as the footpath, impoundment structures, inlet and outlet have been designed to be low maintenance, and should require very little work. These need to be kept clear and free of vegetation, and the surface of the footpath will need to be maintained to avoid erosion and localised damage.

The leaky dams will need monitoring and eventually replacing after several years as the river system adapts to their presence and the wood breaks down.

It is advised that the condition of assets is monitored by a professional asset inspector on an annual basis, or more regularly if the condition drops below good status, subject to the decision of the asset inspector. This is to include all impounding structures in contact with water.

Chipping Norton Town Council are currently undertaking an independent review of tree safety and maintenance on the site and will ultimately remain responsible for its care and maintenance, as well as health and safety on site.

Maintaining the Wildflower Meadow

To ensure that the vegetation is managed in the best way to improve the local ecology and meet project targets, the following mowing schedule has been created. The application of this will depend on how existing species and the new wildflower sward react to the works, and as the wildflower meadow matures, maintenance may need to be pushed forwards or back to meet the needs of the environment. Likewise, local weather may lead to some annual movement in phenology. This will require some knowledge from the Town Council and the contractor; presently the Green Gym, who are more than capable.

When mowing the site, cut material should always be removed. This gradually lowers the fertility of the soil which encourages biodiversity. Highly fertile soil only grows a limited species mix, such as nettles and brambles, whereas unfertile soil supports a proliferation of different species. Cut vegetation also has an extremely high biochemical oxygen demand, and should on no circumstances ever be disposed of into, or near, the pond or watercourse.

Although the horsetail population will be greatly reduced by works to remove it during the initial construction phase, it will likely need strict management in the years ahead to keep on top of the population. It is advised that a zero-tolerance approach is taken to horsetail within the curtilage of Pool Meadow, in the expectation that some of it will nonetheless survive.

Mowing Schedule

March: Mowing at the end of March will remove the spore-bearing stems of horsetail, plus any other growth, which will make space for the seedlings. Always remove the cuttings from site.

June: In the first year, it is recommended to make a second cut approximately 2 months after the seedlings first appear to encourage strong root growth and remove any new horsetail that has appeared. This cut should be at the beginning of June. From the second year, this cut should not be needed, but may be advised, depending on how well the wildflower meadow is establishing. This will need a decision from the Town Council and the Green Gym. Always remove the cuttings from site.

August: Give the new wildflowers time to seed, and then cut in early August, including the removal of any horsetail that has appeared. Leave the cut material to dry and seed for 1-7 days before removing from site.

November: This should be the final cut of the year, removing any regrowth from the summer cut. This cut and removal is particularly important for lowering soil fertility and encouraging biodiversity.

Depending of the efficacy of the initial horsetail removal, there may need to be some "horsetail bashing" between cuts. This is best done at a high level, ideally above the wildflowers using a scythe, brush cutter, or even by hand (depending on amount), but this will need to be interpreted by growth on site.

	Pool Meadow Wildflower Meadow Mowing Schedule								
	March	April	May	June	July	August	September	October	November
First Year	END		NO MOW MAY	BEGINNING		EARLY			ANYTIME
Second Year	END		NO MOW MAY	MAYBE		EARLY			ANYTIME
Third Year Onwards	END		NO MOW MAY			EARLY			ANYTIME

Table 3 - Pool Meadow Wildflower Meadow Mowing Schedule

Roadmap to Construction

The feasibility study has identified the permits required for the construction of the scheme and obtained pre-application advice from each permitting organisation. Two further works have been identified as potentially required, which we are currently working with the permitting authorities to clarify.

These are:

- Detailed design of the scheme, which can be delivered by Beaumont Rivers.
- Development of the Preliminary Ecological Appraisal into an Ecological Impact Assessment, including a post-intervention habitat creation scheme, which can be delivered by Frank Lucas.

Following a site meeting on November 7th 2023, we are currently awaiting clarification on the cost and requirements of planning permission. It is certain that West Oxfordshire District Council will require detailed designs and they are currently investigating the requirement for the Preliminary Ecological Appraisal to be developed into an Ecological Impact Assessment, which we are hoping to avoid. We are also awaiting clarity on the costs of the planning permission application, as below.

Historic England are largely supportive of the scheme and have also requested detailed designs.

The Environment Agency are still to get back to us in writing, but have agreed that detailed designs are required. As with planning permission, they may also require the Ecological Impact Assessment.

Schedule of Design Deliverables

As part of the detailed designs, we need to trace the sewage outfall to identify whether we need to connect it to the mains network at the upstream end, or block it off. The cost of drain tracing with a local supplier is £264 (inc. VAT).

The detailed design needs to include:

- In-channel fixed crest impoundment structure.
- Fixed crest inlet structure.
- Blocking of the sewage outfall.
- Outlet/impoundment structure.
- Footpath surface/sub-surface design.
- 2no. boardwalks over the inlet/outlet structures.

Beaumont Rivers have contacted engineering design specialists to seek costings and the results were very high. As a more cost-effective method, Beaumont Rivers has recruited a freelance chartered engineer who can provide the same service for much less investment.

Costings

Costings and suppliers for these works and the permits are shown below in table 4.

Beaumont Rivers and Chipping Norton Town Council were successful in sourcing a £13,000 grant from the Evenlode Catchment Partnership, which was administered by the Trust for Oxfordshire's Environment. This is for the permits, the Historic Environment Desk Based Assessment and the Preliminary Ecological Appraisal. So far, £4,812.50 of that money has been spent acquiring the two reports.

Costs for Planning Permission and Environment Agency Licences are calculated by the District Council and Environment Agency at the time of application, but we procured best estimates in pre-application advice. It is hoped that the final costs for these will be significantly lower. The original Planning Permission quote was for £5,850; however, we received a second quote of £2,028, which we believe should then be halved to £1,014 as the application is being undertaken on behalf of the Town Council. West Oxfordshire District Council are currently working to clarify this, and we have requested clarity from the Environment Agency regarding their costs, as we may be eligible for a significant discount for environmentally beneficial works.

As we await clarity, the table below shows the worst-case scenario for upcoming costs.

Application	**Supplier**	**Cost (£)**
Land Drainage Consent	West Oxfordshire District Council	£50
Transfer License	Environment Agency	£1,828
Low Risk Impoundment License	Environment Agency	£1,441
Scheduled Monument Consent	Historic England	Free
Planning Permission	West Oxfordshire District Council	£1,014
Ecological Impact Assessment (requirement tbc)	Frank Lucas, Facilitating Nature	tbc
Detailed Design (inc. drain tracing)	Beaumont Rivers	£3,200
Consultant time - 14 days (£2381.24 Paid)	Beaumont Rivers	£7,000
Total Cost (including £4,812.50 previous expenditure)		**£21,726.74**
Outstanding Costs (once remainder of £13,000 grant deducted)		**£8,726.74**

Table 4 - Costs of Project Delivery

Funding Construction

Once we have the detailed designs, we will seek a minimum of 3 quotes from local contractors with a precise scope of works to ensure fairness in the tender process. Local contractors and consultants are being employed throughout the works for the benefit and engagement of the local community and economy.

Funding for the *construction* of the project will then be sought from a number of organisations, including:

- Chipping Norton Town Council
- Trust for Oxfordshire's Environment (TOE)
- Wild Oxfordshire
- Thames Water
- Heritage Lottery Fund
- Esmée Fairburn Foundation
- Local businesses willing to make a donation to improve their Environment, Social and Governance (ESG)/Corporate Social Responsibility (CSR) outcomes.

The Evenlode Catchment Partnership has set up a scheme to enable farmers and landowners to create wetland habitat on their land which this project would be eligible for (Wild Oxfordshire, 2022). Once we have the exact requirements for planning and permitting, we will submit this report with an expression of interest for funding.

There has been a high level of enthusiasm for this project across partnership organisations, so we are hopeful of obtaining the full amount of funding required.

Conclusion

This highly feasible project is an opportunity to undertake an effective environmental restoration project that will deliver first class results with partners across the Evenlode Catchment. The scheme promotes best practise and engages the whole community with the environment and history of the area, resulting in real-world benefits for all.

The project is highly beneficial to the local environment, benefitting ecology and biodiversity, geomorphology, downstream water quality, and flood and drought resilience. The restored habitat will be a new resource for endangered species to colonise, and although those currently missing will not appear overnight, restoring their habitat significantly improves the species' chances of survival.

The work will also have a significant impact on local people. Maximising use, engagement and accessibility of the historic site will enhance the area's natural appeal and provide important amenity for an inclusive range of people. The design of the site ensures that it will be a safe, resilient asset that can be used to educate students in a broad range of environmental and social subjects.

The restoration fits into a variety of strategies and legislation aimed at improving flood risk, resilience, biodiversity and protected landscapes. This includes, but is far from limited to: The Water Framework Directive, the Environment Act 2021, the Thames Water Draft Drought Plan 2022, the Flood and Water Management Act 2010, the 2020 Flood Risk and Coastal Erosion Strategy for England, and the Environment Agency's Flood and Coastal Erosion Risk Management Strategy Roadmap to 2026.

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Appendix

The Following reports are supplied with this document:

- Topographical survey (Oxford Geospatial, 2023)
- Preliminary Ecological Appraisal (Lucas, 2023)
- Historic Environment Desk-Based Assessment (GWHeritage and Robinson Wild Consulting, 2022)

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