# Pages Wood Greenspace Freshwater Ecosystem Restoration Plan

## Land of the Fanns Landscape Scheme

Land of the Fanns in collaboration with Thames 21

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# ACRONYMS

| Acronym | Explanation |
|---|---|
| CMF | Capital Modernisation Fund |
| EU | European Union |
| FPP | Fixed Point Photography |
| GiGL | Greenspace Information for Greater London |
| GIS | Geographical Information System |
| GLA | Greater London Authority |
| GPS | Global Position System |
| LoTF | Land of The Fanns |
| STW | Sewage Treatment Works |
| UK | United Kingdom |
| WFD | Water Framework Directive |

# 1 INTRODUCTION

Across the globe mismanagement and incorrect use of resources, including freshwater ecosystems has resulted in significant destruction and loss of natural ecosystems (Lambert, 2003). Freshwater ecosystems are sensitive ecosystems that are subject to stress from anthropogenic activities (Janssen et al, 2005). According to Russo et al. (2012), more than 50% of the world's freshwater ecosystems have been damaged or destroyed. In recent times freshwater ecosystems have received greater recognition as fundamental components of catchment systems due to the ecological goods and services they provide (Woodward and Wui, 2001). Traditional economics supports the notion of the general concept of the less there is of something the more valuable it becomes (Mitsch and Gosselink, 2000), this can be said of freshwater ecosystems.

Freshwater ecosystems provide a wealth of ecosystem benefits and services to both society and the natural environment and are governed by many policies and guidelines locally, regionally and globally. Within the United Kingdom (UK) freshwater ecosystems are governed by the EU Water Framework Directive 2000/60/EC (WFD). An objective of the WFD is to establish an integrated approach for the protection, management and sustainable use of water resources. One of the WFD aims is to prevent further deterioration and protect and enhance the ecological status of aquatic ecosystems and associated wetlands. Freshwater ecosystem restoration is a holistic system based approach to improve the functioning and integrity of the system, thereby improving its ability to produce direct and indirect ecosystem services. The Ingrebourne River runs through the Pages Wood[1] (**Figure 1.1**) which, falls within Havering Council is located to the North of Upminster, Greater London and forms part of the greater Thames River Basin. Pages Wood, formerly Pages Farm, lies within in the Thames Chase Community Forest boundary. The Forestry Commission acquired the site in 2002 on a 300-year lease from the London Borough of Havering with financial assistance from the Cleanaway Havering Riverside Trust and the Capital Modernisation Fund (CMF). Ecological surveys were carried out in 1999 and 2000. The River Ingrebourne was considered to merit designation against Greater London Authority (GLA) Criteria as a Site of Borough Importance. The grassland habitats on Mount Pleasant merited designation as a Site of Local Importance and as such were considered not appropriate for woodland planting. In the past public access has been limited to two peripheral public footpaths and a permissive path along the field boundaries and along the River Ingrebourne. The Forestry Commission now receives over 130,000 visits per year to this community woodland.

Thames21 has been entrusted by Land of the Fanns (LoTF) Partnership[2] to develop a freshwater restoration/enhancement strategy for Pages Wood. The LoTF Partnership Scheme is an ambitious 5-year programme currently comprised of 26 individual projects. The Scheme is aimed at engaging local communities of Havering, Barking & Dagenham, Thurrock, Brentwood and south-west Essex with the natural, geological, archaeological and built heritage of their local area. This report aims to outline the proposed strategy to enhance the freshwater ecosystems within the study site.

[1] The study site.

[2] The Land of the Fanns Partnership is funded by the Heritage Lottery Fund (HLF) and comprises of the Thames Chase Trust, London Borough of Havering, London Borough of Barking & Dagenham, Brentwood Borough Council, Thurrock Council, Essex County Council, the Forestry Commission, Thames21 and the Thames Estuary Partnership.

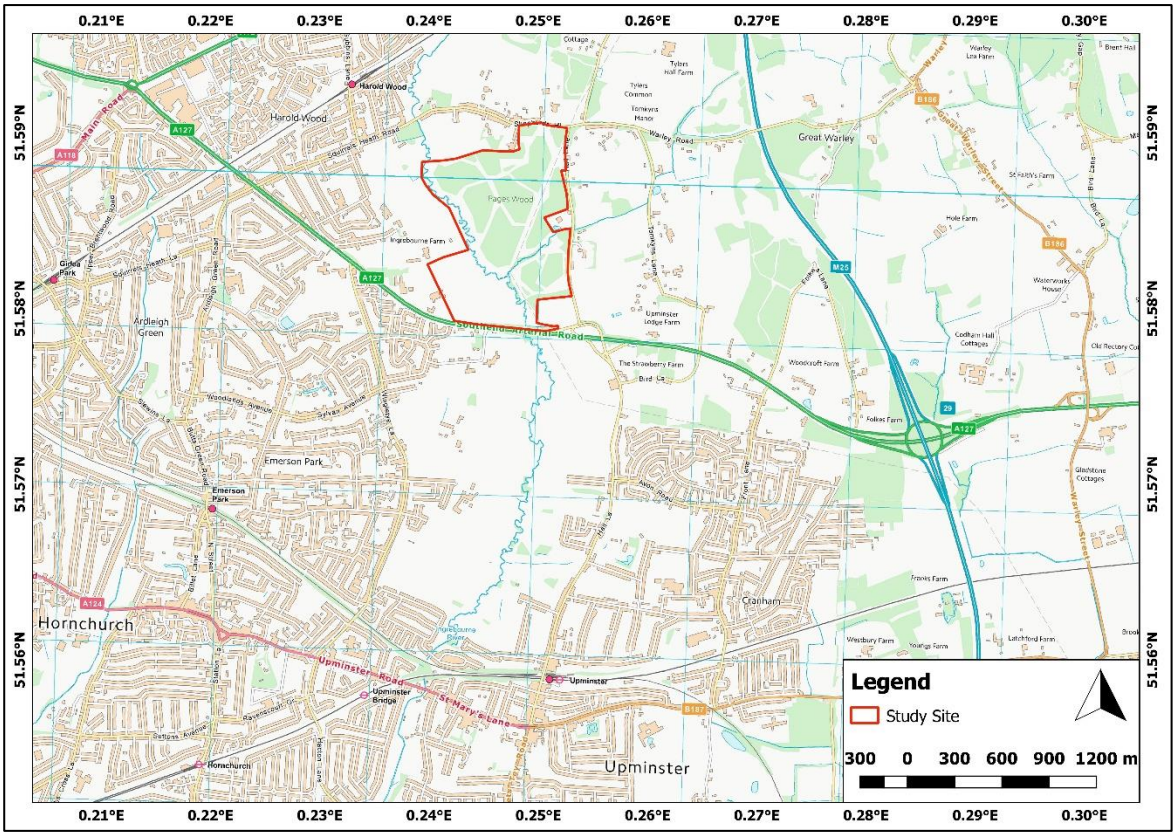


**Figure 1.1 Location of study site in the broader landscape**

# 2 STUDY SITE

The following section provides a regional context overview of the study site.

## *2.1 Thames River Basin*

The River Ingrebourne forms part of the Roding, Beam and Ingrebourne (RBI) catchment area which, falls within the Greater Thames River Basin. The Roding, Beam and Ingrebourne Rivers are subject to a relatively high degree of environmental stress. The Ingrebourne consists of two distinct river environments separated by the discharge from the Brentwood Sewage Treatment Works (STW). Water quality is generally moderate and impacts are split between agricultural and urban diffuse pollution. Downstream of the STW, the water quality is generally poor and diversity of fish species are limited. According to the 2015, Thames River Basin Management Plan the River Ingrebourne have been classified as moderate for ecological status or potential of surface water.

## *2.2 Urban Green Spaces*

Urban green spaces have in recent times become pertinent topics of discussion with regards to urban development and sustainability. According to Natural England (2009), green infrastructure are connected multi-functional green spaces which support natural and ecological processes integral to the sustainability of the surrounding communities. Wetlands fall under the natural and semi-natural urban green spaces with rivers, including their banks, being classified as green corridors. Central to the green space concept is to incorporate a number of functions into each green space (Natural England, 2009) such as:

- Habitat management;
- Access to nature/interpretation; and
- Flood attenuation and water resource management.

According to the Greenspace Information for Greater London (GiGL) portal, the study site falls within an area of Ingrebourne Valley site of Metropolitan Importance for Nature Conservation. Metropolitan Importance areas are the highest priority for protection compared to sites of borough or local importance. Metropolitan sites are either a good example of natural London habitat, sites which contain rare or endangered species or green space within heavily developed areas of London.

# 3 METHODOLOGY

The following methodology was adopted to inform the development of the freshwater ecosystem restoration/enhancement strategy.

## *3.1 Desktop Survey*

At the outset, a desktop analysis of the study site was undertaken to identify the freshwater ecosystems onsite and the geographical topology of them. The geographical study was undertaken using a Geographical Information System (GIS). The historical aerial imagery was also interrogated to determine what the benchmark/reference state form a geomorphological perspective of the freshwater ecosystems was prior to transformation and local urban development. The desktop analysis further served to inform the overall wetland restoration planning process, with the objectives being to:

- Identify potential restoration intervention locations for implementation;
- Preliminarily evaluate the study site based on:
    - Topography (Lidar);
    - Area;
    - Level of transformation;
    - Visible problem/impact areas;
    - The potential risk to urban infrastructure.
- Prioritise areas/features within the study site that warrant restoration.

## *3.2 Site Visit*

Numerous site visits were conducted to verify the extent of freshwater ecosystems within the study site and assess the current level of ecological integrity and ecosystem services provided by the river and wetland habitats. Observation points (points of interest/waypoints) were recorded using a Global Positioning System (GPS)[3]. The subsequent information was used to inform the production of a GIS spatial coverage of observation points. Observation points included but were not limited to:

- Non-native invasive plant infestations;
- Possible restoration intervention locations;
- Possible surface water management interventions;
- Impact/problem points;
- Different vegetation communities; and
- Areas of untransformed habitat.

## *3.3 Restoration Planning*

The restoration of freshwater ecosystems is considered to be a complex undertaking and the planning process involves multiple disciplines. The following steps were undertaken:

- Desktop analysis – GIS-based data collection;
- Infield site visit – involves the assessment of the current state of the habitat within the study site and identification of restoration intervention types and locations;
- Reporting – documenting the findings of the data collected and restoration strategy;
- Environmental Authorisation; gain environmental authorization from the relevant competent authority;

[3] Garmin eTrex Legend HCx

- Implementation – implement the restoration plan in accordance with stipulated conditions from the authorities; and
- Monitoring and Evaluation- undertake monitoring activities such as fixed point photography, water quality monitoring, and habitat assessments.

# 4 CHARACTERISTICS OF THE FRESHWATER ECOSYSTEMS

The study site is comprised of a number of different habitats such as grassland, woodland riverine and wetland habitats. The catchment of the River Ingrebourne has been heavily transformed particularly through urban development and agriculture. Based on the review of historical and current imagery and the site visits the Ingrebourne River within the study area is still in a natural condition. The channel boasts a number of instream characteristics such as meanders, deep pools, steep banks, riffles and sandbanks/shelves. Down the length of the channel, there are a number of the tree blocks that have trapped large amounts of solid waste.

Adjacent to the river channel, floodplain wetland habitat is present. Floodplains are considered to be important landscape features for attenuating floods due to their topographic setting, geomorphological features (oxbow lakes and depressions) and the nature of the vegetation. Floodplain wetlands generally receive their water inputs from the overtopping of the stream banks. The over-topped stream flows lose confinement and therefore flow velocities decrease as they spread out over the floodplain. The floodplain has been slightly transformed through the construction of cycle/path. The path since its construction has required constant maintenance due to damage caused by surface and fluvial flooding.

# 5 WETLAND RESTORATION PLAN

## *5.1 Freshwater Ecosystem Impacts*

The biophysical drivers of the identified freshwater ecosystems have been significantly impacted upon by historical activities and will continue to degrade in the absence of the proposed restoration, including but not limited to:

- Surface water flooding;
- Fluvial flooding;
- Vegetation encroachment (dense stands of vegetation that reduce sunlight penetration to the river and understorey;
- Limited public access to the river; and
- Alteration to water flows in the catchments, especially from the Brentwood STW.

## *5.2 Aims and Objectives of the Restoration Plan*

With the implementation of freshwater ecosystem restoration, it is important to set aims and objectives for the planned restoration.

**Aim:**

The aim of the freshwater restoration strategy is to enhance the functioning and integrity of the freshwater ecosystems whilst improving the public amenity of the site.

**Objective:**

The primary objective of the restoration[4] strategy is to secure and improve the overall integrity of the freshwater systems, particularly focusing on improving the levels of biodiversity and limiting the surface flooding

[4] The restoration timeframes would be subject to a lag period, but ecosystem response would be expected within three to five years of the implementation of the restoration activities.

## *5.3 Restoration Strategy*

Based on the site visits, numerous restoration strategies for the site were discussed by the team members involved in the site visits. There was a unanimous agreement that the fluvial geomorphological characteristics of the Ingrebourne River are in a good natural condition. It was therefore decided that no restorations works should be aimed at the channel itself. The focus of the restoration changed to incorporating more ecologically enhancing features within the floodplain and surface water management of the cycle/footpath network in close proximity to the floodplain, public amenity and selective vegetation clearing in the tributary feeding into the River Ingrebourne (**Figure 5.1**).

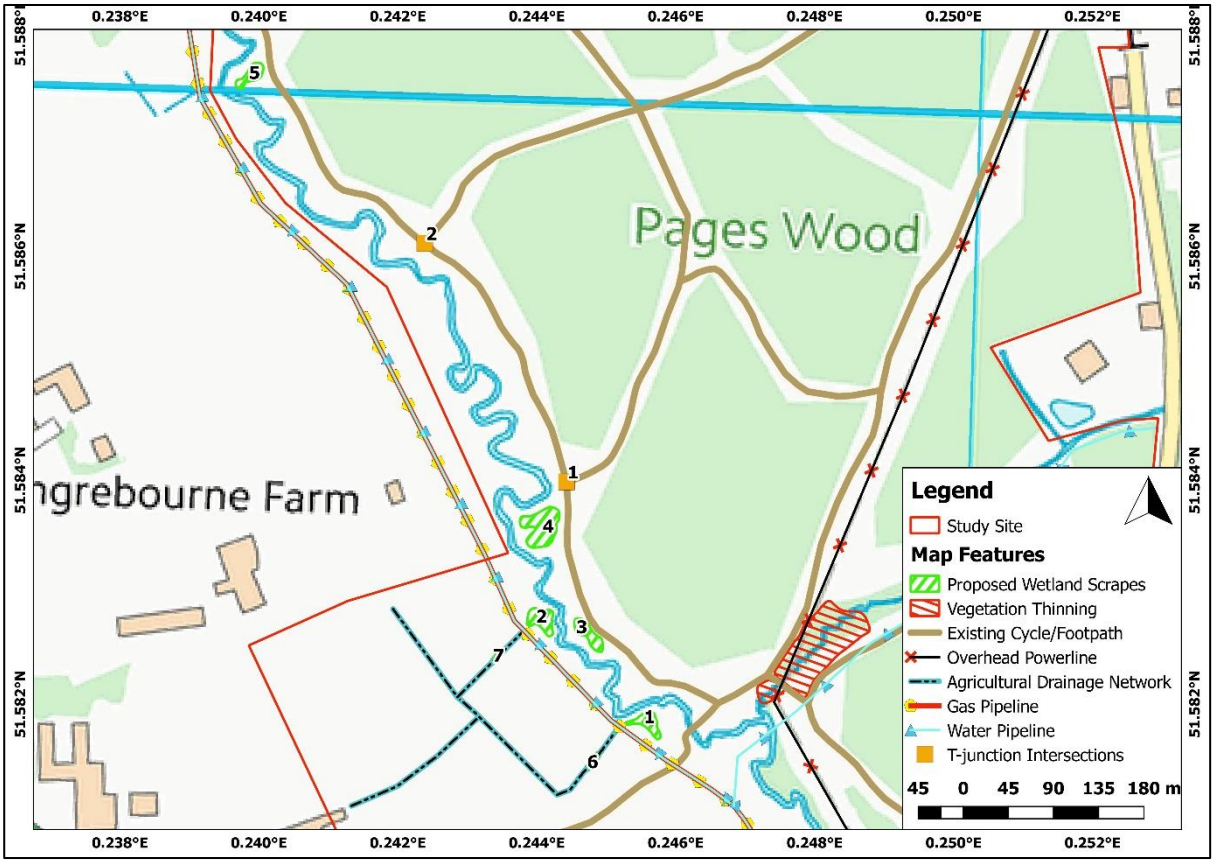


**Figure 5.1 Overview of the restoration plan for Pages Wood green space.**

## 5.4 Interventions

The following section provides an overview of the proposed interventions that are required to meet the objectives of the restoration.

### *5.4.1 Wetland Scrapes*

A scrape is a shallow depression with gently sloped edges in a wetland that is periodically inundated during the wet season. The natural migration/movement of the river within the floodplain would naturally form scrapes within the floodplain (River Restoration Centre, 2013). Scrapes are fed by the river overtopping the channel banks, natural springs and depending on their location within the floodplain surface flows originating from the adjacent hillslopes. Scrapes that are predominantly fed by springs or surface flows from the adjacent hillside offer off-river habitat for water tolerant plant and animal species such as birds, frogs and newts

(River Restoration Centre, 2013). Site characteristics[5] are key factors in determining the location and whether the scrape will successfully receive and retain water (RSPB, 2010). From a biodiversity perspective, the fringe/margins of the scrape are the most important features. It is paramount that a large proportion of the entire scrape area is dominated by shallow, mudflat habitat. The deepest part of the scrape should be in the centre/middle.

It is proposed that five wetland scrapes be excavated into the Ingrebourne River floodplain and two into the hillside to the west of the floodplain (**Figure 5.2**). Wetland Scrapes 1 and 2 will be located directly below the discharge points of two surface drains. Wetland Scrape 4 will predominantly receive surface inputs from T-junction 1. An approximately 2m wide channel will be excavated from the culvert outlets to divert flows to the Scrape 4. Due to the water quality concerns[6] of the River Ingrebourne, isolating the scrapes from the river will ensure that the water quality within the scrapes will be significantly better than if the scrapes were hydrologically linked to the river. These significantly less polluted water inputs should provide suitable habitat for species such a Great Crested Newts and other amphibian species and waterfowl. Wetland Scrapes 3 and 5 will be ephemeral ponds that will only be inundated when the river overtops its banks. When the Ingrebourne River does overtop its banks these flows will inundate Wetland scrapes 1 to 5, but based on the notion of 'dilution is the cure for pollution' significant long-term effects to the plant and animal species utilising the scrapes are not anticipated.

[5] Soil type, topography, water sources and quality, existing land drainage networks etc.
[6] Water pollution/contamination caused by the Brentwood STW upstream of Pages Wood.

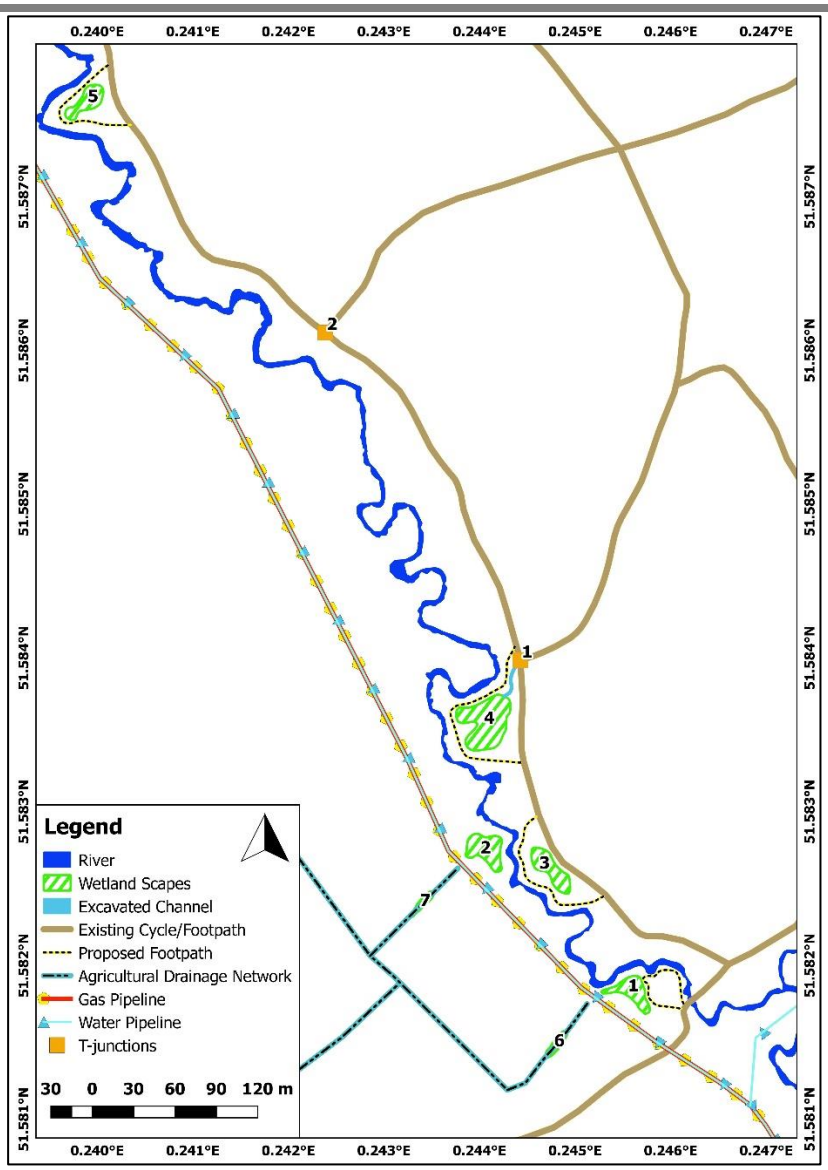


**Figure 5.2 Location of the proposed wetland scrapes and footpaths**

Wetland Scrapes 6 and 7 are located along the length of the surface drains (**Figure 5.2**) leading to Wetland Scrapes 1 and 2. Scrapes 6 and 7 have been specified to polish flows in the channel before they discharge into Scrapes 1 and 2. A simple compacted earthen plug with a base flow pipe will be constructed across the existing drain to obstruct flows (**Figure 5.3**). The structure will serve to back flood to drain to the invert level of the pipe that will allow flows back into the drain, to continue down the hillside. It is proposed that scrapes 6 and 7 are densely planted with sedge (*Carex sp.*) plants. The high level of surface roughness and the obstruction will promote sedimentation will ultimately improve the quality of water flowing into wetland scrapes 1 and 2.


**Figure 5.3 A scrape created on an old ditch line with a water control pipe** (RSPB, 2010).

The central depth of the scrapes will be approximately 0.5m below the current natural floodplain surface level. From the central points, the bed of the scrapes will be gently graded to the outer fringe to promote optimal mudflat habitat. The seven scrapes will cover a combined area of approximately 0.18 ha. In places water tolerant wetland plant species should be planted, however, it is key that sections of the fringe remain devoid of vegetation to promote habitat variability and access to the water's edge for resident waders. On the eastern floodplain of the Ingrebourne River, it is proposed that a footpath is cleared to enhance access to the river and a view of Scrape 1 for the green space uses. The second path near Scrape 2 should be clear and will provide users with a view of the Ingrebourne River and the scrape.

### *5.4.2 Surface Water Management*

Due to the steep hillsides adjacent to the floodplain on the eastern side of the Ingrebourne River appropriate surface water management is required to manage the high volume of surface runoff. Currently, the cycle/footpath that runs parallel to the river is constantly been eroded/scoured of its material. This is due to fluvial and surface water flooding. There are limited opportunities to decrease the fluvial flooding risk, however, there are a number of cost-effective opportunities that exist to improve the surface flooding along this path. Opportunities exist at two of the T-junction intersections where surface flows from the adjacent hillsides meet the floodplain.

The current surface water management strategy (**Figure 5.4**) for the two T-junction intersections involves surface drains that run parallel to the roads transporting collected surface flows to the T-junctions. At the T-junctions, two culverts allow collected flows under the path. These flows then flow into the Ingrebourne River as overland flow. The entry points into the river are currently showing signs of minor soil/bank erosion. The problem with this drainage system is that the culverts have insufficient capacity to cope with the volume of surface runoff collected in the drains and the inlets and outlets of the culverts have also been

blocked by excess sediment and debris. Water therefore backs-up behind the culverts. When a sufficient amount of water has backed-up behind the culvert all excess water that continues to come down the drains starts to flow down the path. Surface flows down the path gather velocity due to the limited surface roughness of the artificial surface and begin to erode the path.

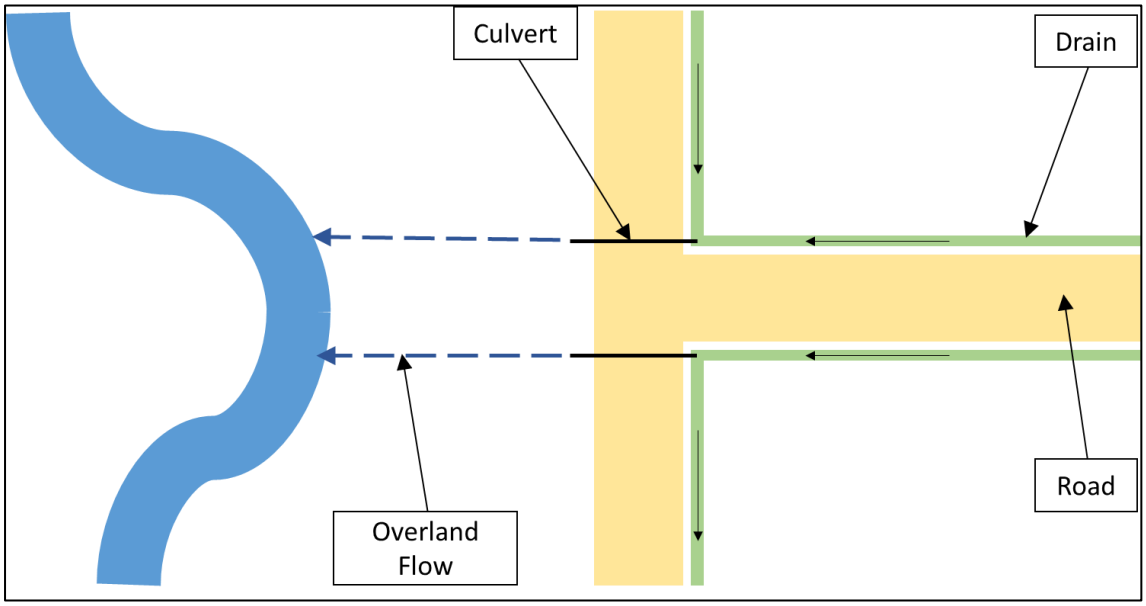


**Figure 5.4 Overview of the existing surface water management strategy**

It is proposed that for T-junction 1, two small attenuation ponds be excavated on either side of the incoming path (**Figure 5.5**). The attenuation ponds will store flows that back-up behind the culvert. The attenuation ponds will not exceed the depth of 50cm. It is envisaged that the attenuations ponds will fill up during all rainfall events depending on the placement (freeboard) of the culvert in relation to the bottom of the pond. If the current 20cm diameter culverts are positioned 10cm below the surface and if the ponds are 50cm deep at their deepest point they will fill to 20cm before flows will start flowing through the culvert. Wetland plants (*Carex sp.*) can be planted around the fringe of the attenuation ponds to prohibit people and animals (pets) from gaining access. The vegetation will have to be monitored to ensure that it does not encroach into the pond too much as this would lead to a reduction in pond capacity. The attenuation ponds will act as dry ponds and thus will only hold water during rainfall events (wet season). From an ecosystem functioning perspective, the dry ponds will be effective at trapping sediments. It is therefore important that routine maintenance of the ponds take place to ensure that trapped sediments do not obstruct the culvert inlets.

The culverts should be realigned to allow the ponds to fill slightly and to ensure the gradient is sufficient to allow flows through the culvert. Berms, approximately 0.3m in height have been specified to limit the chance of flows spilling onto the pathway surface (**Figure 5.5**). Material blocking the outlets of the culverts should be removed to ensure the flow is not impeded in any way. A channel will be excavated from the culvert outlets to the wetland scrape south of the T-junction within the floodplain. A wooden fence should be constructed to prohibit access to the area of overland flow and the river for health and safety reason. If need be a fence can also be constructed along the earthen berm to prevent people and animals from gaining access to the attenuation ponds from the paths.

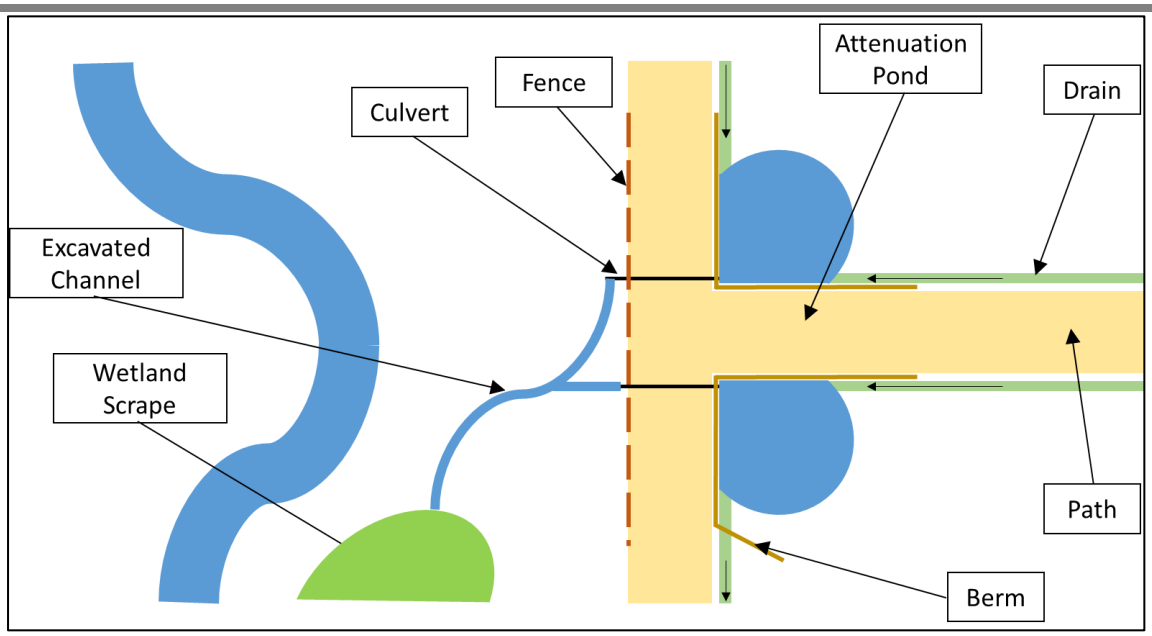


**Figure 5.5 Proposed surface water management strategy for T-Junction 1**

Similar to T-junction 1, T-junction 2 will follow a similar strategy but with only one attenuation pond to the south of the joining path (**Figure 5.6**). A second attenuation pond is not required as a formal drainage ditch exist that has sufficient capacity to cope with the surface flows. Flows from the southern culverted will be diverted into the drainage ditch which has a gentle gradient flowing into the Ingrebourne River. Wooden fencing has been specified for health and safety reasons.

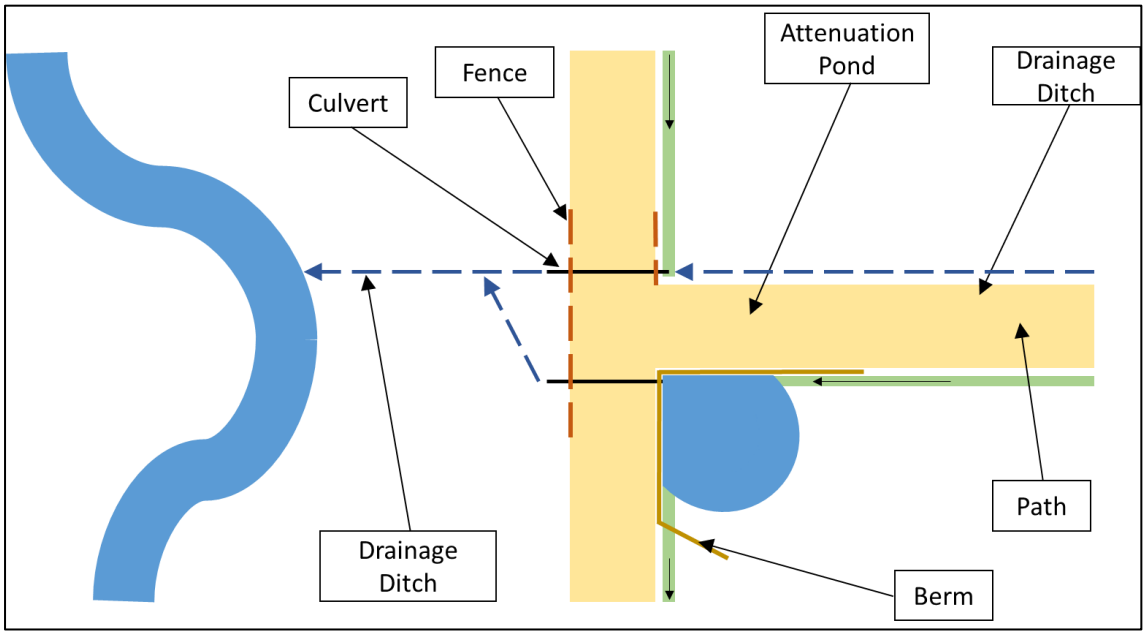


**Figure 5.6 Proposed surface water management strategy for T-Junction 2**

### *5.4.3 Vegetation Thinning*

The vegetation within the lower reaches of the tributary feeding into the Ingrebourne River is dense and impenetrable. It is thus proposed that selective vegetation clearing of two sections (**Figure 5.7**) on either side of the formal bridge crossing the tributary take place. The primary purpose of the thinning is to allow light to infiltrate through the upper vegetative canopy to the

understory to promote the growth of understory vegetation. This cleared habitat would be ideal habitat for Water Voles (*Arvicola amphibious*) to occupy. The second reason for clearing on either side of the bridge is to allow users to visually see the tributary as it is currently not visible. The outer fringes of the marked vegetation thinning areas are to be maintained to limit public access to these.

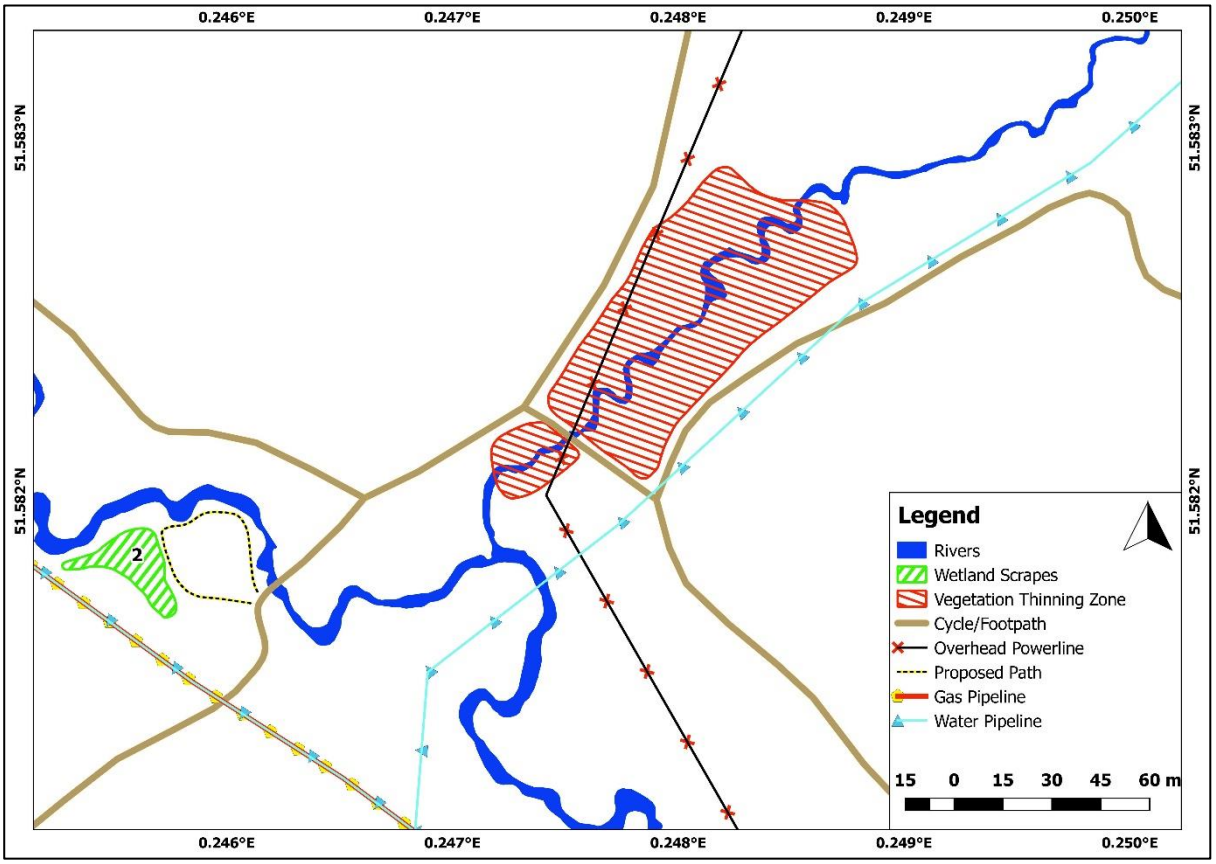


**Figure 5.7 Location of vegetation thinning zones along the tributary**

# 6 MONITORING AND EVALUATION

The following wetland restoration monitoring framework should be applied to assess the anticipated outputs and outcomes of the project. The monitoring framework includes the collection of baseline and post-implementation monitoring information to enable the evaluation of the restoration effectiveness. It should be noted that the following recommended monitoring is considered to be the minimum level of monitoring required to show restoration effectiveness, and additional monitoring may be required by the relevant authorities (e.g. water quality, water depth, vegetation composition).

## *6.1 Monitoring of Interventions*

The assessment of the integrity of the interventions should be undertaken to ensure the long-term stability of the interventions and the likelihood of achieving the stated objectives. This assessment would serve to identify weaknesses or strengths of the interventions within the freshwater ecosystems. The criteria for monitoring the structural integrity of the interventions are:

- Dimensions according to specifications;
- Authorised deviations from the plan;
- Excessive settling of the soil;
- Evidence of soil erosion;
- Establishment of vegetative cover;
- Evidence of downstream scouring;
- Evidence of outflanking; and
- Adequate compaction of soil.

## *6.2 Fixed Point Photography*

Pre- and post-implementation photographs must be recorded of the freshwater ecosystems as photos are a useful means of illustrating the visual changes of the landscape due to the implementation of the proposed restoration activities. These should be collected in the form of Fixed Point Photographs (FPP). FPP's should be taken from easily accessible elevated positions within the study site to allow repeated monitoring to be undertaken. It is crucial to identify FPP positions that can be easily relocated (e.g. trees, soil mounds, telephone/power line poles) and marked using a GPS for reference.

## *6.3 Restoration Effectiveness*

All of the above-mentioned monitoring should be used to inform the evaluation of the effectiveness of the restoration of the freshwater ecosystems. This would be undertaken once the required monitoring information has been collected.

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