River Thame Conservation Trust

Flood Risk Appraisal – Cuttle Brook habitat improvements

Project	Thame Chalk Streams Strategy
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Working for a river catchment with healthy fresh waters and wildlife, valued and enjoyed by local people

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1 Introduction

The objective of the project is to improve habitat for fish, invertebrates, and other wildlife over approximately 3km of the Cuttle Brook[1] (Figure 1) as it flows from Greysmead Lodge, through the Cuttle Brook Nature Reserve (NR) and Rycote Meadow.

The FRAP (Re: EPR/WB3752GM) was submitted in February 2024. Following a conversation with Natalie Ford of the EA's Flood Risk Management team on 1 May 2024, the EA requested some further detail on flooding mechanisms in the proposed project area. It was confirmed that no modelling of detailed studies would be required but a short Flood Risk Appraisal report would assist in decision making on the FRAP.

This Flood Risk Appraisal complements the Project Overview and details document submitted as part of the FRAP application and the Cuttle Brook method statement submitted subsequent to the FRAP review.

[1] https://environment.data.gov.uk/catchment-planning/WaterBody/GB106039023840

Figure 1: Location of map (with scale) showing overall location of the Project Area in Thame

2 Proposed work

The locations of the proposed tasks are presented in Figure 1 and example photos are provided in Annex A. The following provides a summary of the proposed work by task:

1) Tasks 1b, 2a, 2b, 4, 6 & 7 of the proposed works in the NR will involve building natural habitat structures using natural material sourced from the NR. Natural Habitat structures will meet the design criteria set out in FRAP exemption 15 and will only affect low flows. They reduce the low flow area and increase adjacent velocities during low to medium flows, which will expose gravels and provide more diverse habitat, while enhancing the deposition zone around the structure. The work will be supervised by RTCT and completed by the Cuttle Brook Conservation Volunteers (CBCV);
   - Tasks 3b, 5 & 8 of the proposed works in the NR will involve building revetment structures using natural material sourced for the NR to manage the scour around modified sections of the watercourse. Revetments will meet the revetment design criteria set out in FRAP exemption 13. The work will be supervised by RTCT and completed by the CBCV;
2) Tasks 1a, 3a, & 7 of the proposed works in the NR will include deposition of gravels in the riverbed. Areas for deposition have been identified by a longitudinal level survey of the centre line of the Cuttle Brook through the NR, during which a number of locations of excessive bed scour were identified. These scoured areas induce excessive sedimentation due to the increased flow area and slower velocities. The work will be supervised by RTCT;
   - Task 9 comprises vegetation clearance to improve the conveyance of flow (including extreme flows in the channel). This work does not require a FRAP but is included here for information purposes. The work will be supervised by RTCT and completed by the CBCV;
   - Task 10 will comprise the removal of the malfunctioning weir, this will be completed using an excavator and will be contracted to a supplier with expertise and experience in river restoration techniques. The channel will be naturalized by the removal of the weir, and the channel width will be reestablished with revetment using locally sourced natural material on the left bank. The work will be supervised by RTCT and revetment work will be completed by the CBCV;.
3) Task 11 will comprise the installation of notched fish baffles[2] downstream of the existing weir, and at a safe distance (10 m downstream) from the weir, thereby raising the low flow water level upstream of the baffles (with notch designed to allow Q95 flow) and drowning out the existing weir, so that fish passage is no longer obstructed. Riparian landowner and access has been established and RTCT have confirmed the approach with Exolum. The work will be completed by RTCT.

Table 1 presents a summary of each activity in the FRAP, including some adjustments to dimensions (e.g. natural habitat structures now <30% of channel width) and one activity (Task 5b – leaky dam) removed based on the discussion with the EA Flood Management Team on 1 May 2024, due to the lack of quantitative analysis of the impact.

[2] Fish Baffles | 8500034 (hahnplastics.com)

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Table 1 *Description of specifics of proposed tasks*

Task	Grid Reference	Description
1a	SP 7000705469	Up to 12 tonnes of gravel deposited over 20m to regulate the gradient of the bed level with additional benefits of enhancing natural habitat and conditions for spawning fish. The topographic survey completed by RTCT and CBCV indicates a required ~0.2m increase in bed level to remove the sediment sink that currently exists.
1b	SP 7001705476	Natural Habitat structure on right bank from locally sourced natural materials up to 20m long, and no more than 30% of width on the meander to protect the bank of the Cuttle Brook and to improve the velocity/diversity of flows to mobilise the buildup of sediment.
2a	SP 7004505477	Natural Habitat Structure on left bank from locally sourced natural materials up to 15m long, and no more than 30% of width on the meander to protect the bank of the Cuttle Brook and to improve the velocity/diversity of flows to mobilise the buildup of sediment.
2b	SP 7006005475	Natural Habitat Structure on right bank from locally sourced natural materials up to 15m long, and no more than 30% of width on the meander to protect the bank of the Cuttle Brook and to improve the velocity/diversity of flows to mobilise the buildup of sediment.
3a	SP 7008405464	Up to 18 tonnes of gravel deposited over 15m to regulate the gradient of the bed level with additional benefits of enhancing natural habitat and conditions for spawning fish. The topographic survey completed by RTCT and CBCV indicates a required ~0.4m increase in bed level to remove the sediment sink that currently exists.
3b	SP 7008705462	Remove existing instream vegetation and construct a revetment on right bank from locally sourced natural materials protecting a section of the bank no more than 10m long, and no more than 30% of width on the meander to protect the bank of the Cuttle Brook mobilise the buildup of sediment. Construction will comply with exemption 13. The top of the revetment will be set no higher than the top of the bank.
4	SP 7012805476	Natural Habitat Structure on right bank from locally sourced natural materials up to 20m long, and no more than 30% of width on the meander to protect the bank of the Cuttle Brook and to improve the velocity/diversity of flows to mobilise the buildup of sediment.
5	SP 7016905628	Revetment on right bank from locally sourced natural materials protecting a section of the bank no more than 10m long. The revetment will be constructed to comply with requirements set out in exemption 13. The revetment will not extend more than 30% of the width of the channel, and no higher than the top of the bank.
6	SP 7019705642	Natural Habitat Structure on right bank from locally sourced natural materials up to 8m long, and no more than 30% of width on the meander to protect the bank of the Cuttle Brook and to improve the velocity/diversity of flows to mobilise the buildup of sediment.
7	SP 7023205700	Natural Habitat Structure on right bank from locally sourced natural materials up to 12m long, and no more than 30% of width on the meander to protect the bank of the Cuttle Brook and to improve the velocity/diversity of flows to mobilise the buildup of sediment.

8	SP7023205720	Revetment on right bank from locally sourced natural materials protecting a section of the bank no more than 10m long. Constructed to no more than 30% of the existing (artificially widened) width. Construction will comply with exemption 13 and the revetment will be set no higher than the top of the bank.
9	SP 7023605752	Vegetation Clearance where channel is very narrow and over vegetated.
10	SP 6996806212	Weir Removal of an obsolete concrete structure using a long-armed excavator, plus revetment on left bank from locally sourced natural materials protecting a section of the bank no more than 10m long, which was caused by scour associated to the dysfunctional weir. REVETMENT will be constructed on the left bank and will comply with the requirements set out in exemption 13. The revetment will not extend more than 30% of the width of the channel, and will be set no higher than the top of the bank. Both riparian owners have been engaged and approve of the project.
11	SP 7097504633	Fish baffles will be installed across the channel at a safe distance downstream of the Exolum pipeline weir, in an orientation to minimise scour (v shape, pointing upstream), with a 0.2 m wide notch to allow the calculated Q95 flow. This design will raise the upstream water level to drown out the weir during low flows and allow fish passage.

In addition to the measures being proposed in the FRAP, 2 scrapes will be created in the floodplain within the NR (Figure 2). These scrapes do not require FRAP exemptions (according to Paul St Pierre of the EA) as spoil will be deposited outside of the floodplain. The scrapes will provide approximately 1000m^3 of additional floodplain storage.

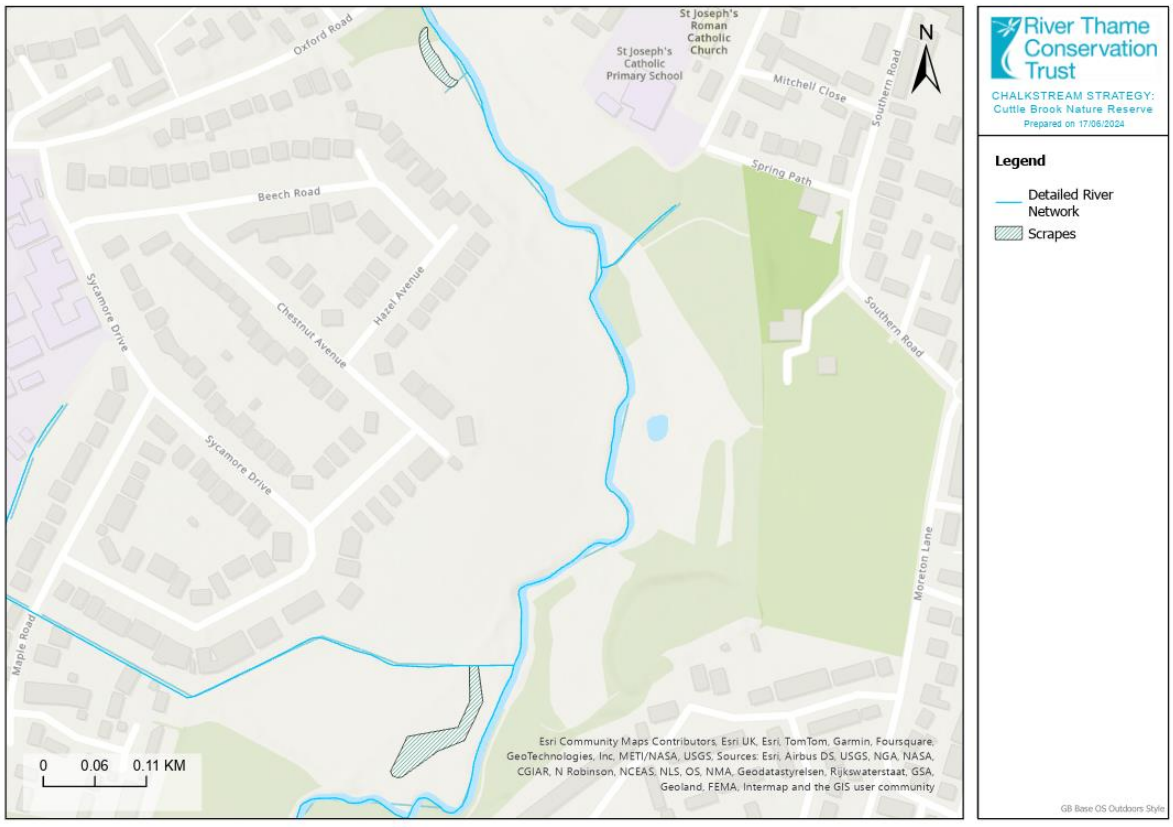

Figure 2 Proposed location of Scrapes

3 Flood Risk Appraisal

3.1 Sources of flood risk

Table 2 : Sources of Flood Risk

Flood source	Potential Risk				Reasoning
	High	Medium	Low	None	
Fluvial			X		The principle mechanism for fluvial flooding in this area is the water level in the River Thame rather than the Cuttlebrook (see section 3.2). Nevertheless, Natural Habitat structures are designed and located in line with design criteria in FRAP exemption 15. The structures will affect low flow velocities only. Gravel deposition will only be where excessive bed scour has occurred (according to centre line level survey). Deposited volumes will be restricted to re-establish the natural gradient in the channel bed. The proposed work will have negligible impact on fluvial flooding.
Canals				X	None present
Groundwater				X	No groundwater flooding is known on site. According to the BGS (1:625,000) mapping, geology at site is part of the Kimmeridge Clay formation, overlain by a discrete area of sandy soils (according to Cranfield's Soilscape data).
Reservoirs and waterbodies				X	None present.
Sewer				X	None present
Pluvial runoff				X	Anecdotally, pluvial flooding has occurred in the estate to the west of the NR, this is thought to be due to runoff from the developed area upgradient of the estate (see section 3.3). The surface water runoff maps show that rainfall runoff for the Cuttlebrook itself is constrained at the old rail bridge entrance to the NR. The proposed work will have no impact on pluvial runoff, the proposed scrapes (section 3.4) will have a beneficial impact on pluvial runoff
Effect of ponds and				X	There will be no reduction in storage in the floodplain, in fact the 2 proposed scrapes

wetland creation on wider catchment					(section 3.4) will provide increased floodplain storage. Spoil deposited outside of the floodplain will be deposited so to not to change infiltration rates or overland flow paths

Potential sources of flood risk relevant to the site were assessed (Table 2). Only identified risks are expanded upon in subsequent sections.

Applying the Sequential test: *due to the nature of the development, the objective of which is to provide improved habitat, remove a specific weir and to provide fish easement at a the Greysmead pipeline weir, the works include in channel / within flood zone 3 work, and therefore the sequential test indicates that the exception test should be applied.*

Applying the Exception test: *(1) This Flood Risk Appraisal and the FRAP presents that the works will not increase flood risk to any third parties and it will provide wider sustainability benefits to the river. (2) This Flood Risk Appraisal demonstrates that the works will be safe for their lifetime, without increasing flood risk elsewhere, and will reduce flood risk overall.*

3.2 Fluvial Flood Risk

In the Cuttle Brook NR the principle fluvial flooding mechanism is from the River Thame. Extreme high-water levels (e.g. 1% AEP fluvial flooding) in the Cuttle Brook throughout the NR are strongly influenced by the water level in the River Thame. Figure 3 shows the EA flood zones in this area.

A comparison between Figure 3 and Figure 4 (EA surface water flooding map) shows that there is a strong correlation between surface water flooding mechanisms and fluvial mechanisms in the Cuttle Brook catchment upstream of the NR. On-site visual observations during flood plus flow direction data from the EA surface water flooding mapping implies that there is little flow direction and therefore little energy in the flooding mechanism within the NR (Figure 4). This strongly implies that the River Thame is causing flooding in the NR and that the fluvial flooding mechanism from the Cuttle Brook is only evident upstream of the phoenix trail old rail bridge (Figure 4).

The proposed works in the NR (Tasks 1-9) will not increase flow within the Cuttle Brook channel but will increase the localised velocity during low to medium flows. All habitat and woody structures in the NR will be built to the design criteria described under flood risk exemptions and the medium to high flows will see no discernible change in flows, while improving sediment deposition. Any change to conveyance during low to medium flows due to change in the channel profile (gravel deposition and natural habitat structures) will be offset by improved conveyance from vegetation clearance. In addition, the planned scrapes in the NR will provide in the order of an additional 1000m^3 of floodplain storage.

Task 10, the removal of the malfunctioning weir will not change flows in the channel, but will reduce sedimentation, scour and allow fish passage. The removal of the weir will return the channel to an unmodified state and improve conveyance. While the revetment will reduce the artificially widened (approximately 6m wide) channel directly downstream of the weir, it will reestablish the natural bank line and help reduce scour which will benefit the sediment transport to the Thame downstream.

Task 11 will not change flows in the Cuttle Brook. The construction (described in the Project Detail report included in the FRAP) will be completed by RTCT with hand tools only and will not change any conveyance of flows. The fish baffles will be submerged for 95% of the time (the notch width is designed to convey the Q95) they will not change the flow mechanisms in flows any higher than the Q95. Therefore, the fluvial flooding mechanism will not be affected. Out of bank flooding of the right bank will continue to occur for extreme events only (Figure 5).

The proposed works will not change fluvial flooding in this area.

Figure 3: EA flood zone map – Cuttle Brook Nature Reserve. Source: Gov.uk website, June 2024

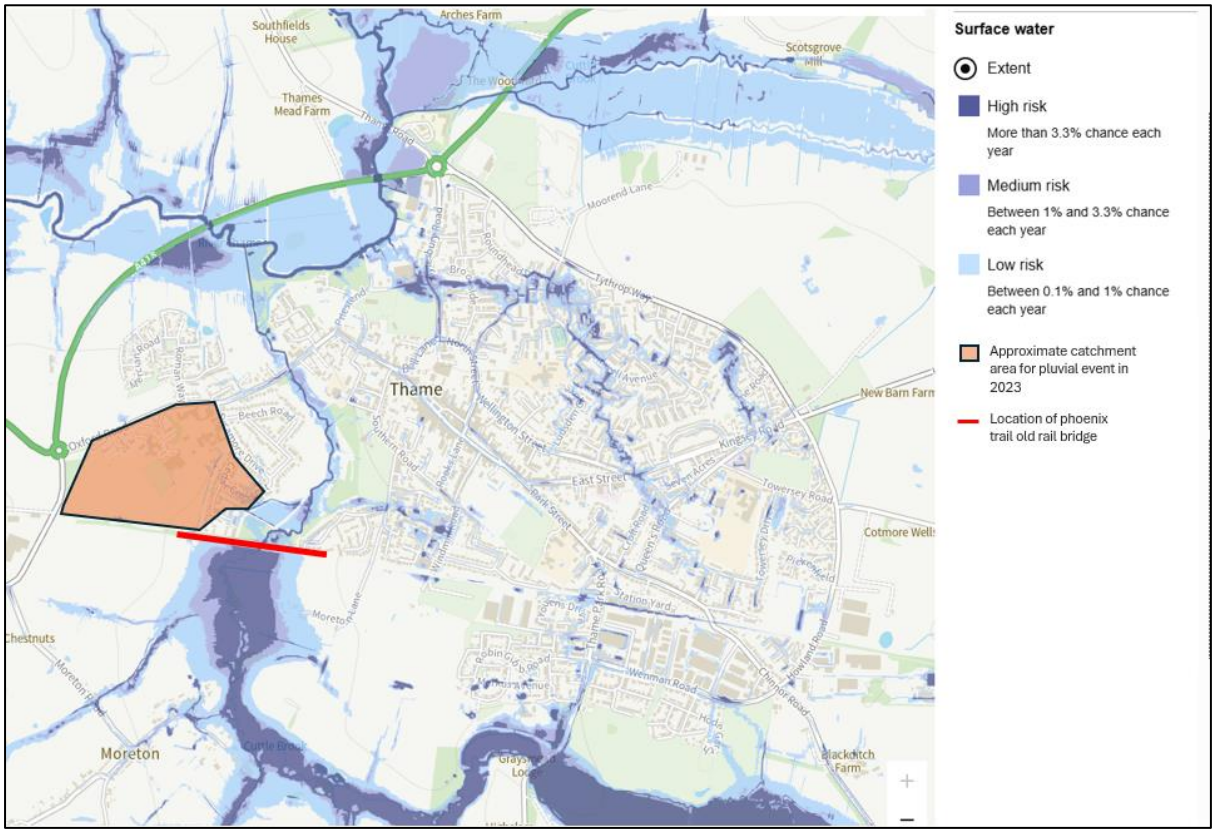

Figure 4: Surface water flooding map. Source: Gov.uk website, June 2024

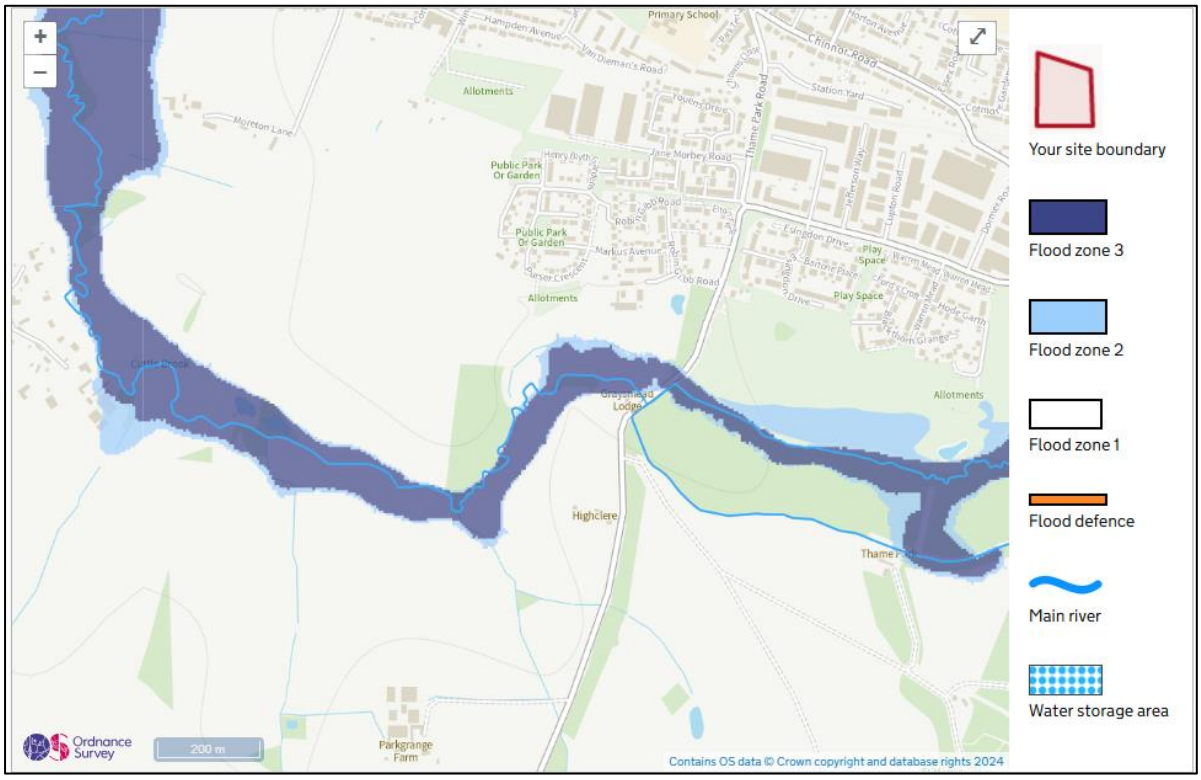

Figure 5: EA flood zone map – Cuttle Brook at Greysmead (Task 10).

3.3 Pluvial Flood Risk

Figure 4 shows that the rainfall runoff mechanisms in the catchment are curtailed by the fluvial flooding from the Thame in the NR (see section 3.2). Therefore, the pluvial flood risk from the Cuttle Brook catchment will not be affected by the proposed work.

Properties in the estate directly to the west of the NR (see orange polygon in Figure 4) were subject to pluvial flooding in 2023. The orange polygon presents an estimation of the catchment for this pluvial mechanism, which is heavily urbanised and thereby maximising the runoff potential in this area. The proposed works will have no influence on this pluvial flooding mechanism. The proposed southernmost scrape may offer some additional storage and conveyance to the Cuttle brook downstream of the pluvial flooding.

The proposed works will not change pluvial flooding in this area.

3.4 Flood plain storage

The creation of scrapes in the NR (Figure 2) is not within the scope of the FRAP, however, there will be some betterment provided by them due to an increase in floodplain storage.

3.5 Climate change considerations

The above analysis shows that the proposed works will not change the fluvial or pluvial flooding mechanisms in the vicinity of the NR. Therefore, any change to fluvial or pluvial flooding relating to climate change will also not be affected by the proposed work.

The habitat improvement from the project will provide more habitat for aquatic and amphibious fauna to take refuge and thereby help support aquatic species through the likely changes in the climate as the water environment warms and more extreme events occur.

4 Measures to mitigate flood risk

It is recognised that the activities will occur within the flood zone 3, and therefore key environmental management activities must occur to reduce the risk of fluvial flooding impacting the construction phase and any third parties. Therefore, the following measures will be put in place during fieldwork activities:

- Works planned to be undertaken outside of the typically wettest months of the year (fieldwork planned for July / August 2024).
- In the event the site becomes flooded, the site will be evacuated, and all equipment removed from the floodplain.
- Both the RTCT and the CBCV will be signed up to the Environment Agency's free Flood Line Warnings Direct service, providing advice and warnings on potential flooding issues in the immediate area
- Weather conditions and river levels will be monitored prior and during the works.
- Gravel delivery will only occur when ground is dry and there is no risk of high flows.
- In the event of sustained heavy rainfall, the works will be suspended until river levels are deemed safe by the project manager.
- No lone working unless agreed by project manager.
- All equipment and plant will be stored outside of flood zone 2 and 3
- Evacuation routes will be established, kept clear and communicated clearly to all workers on site.

A maintenance plan was submitted as part of the FRAP submission. It highlights the following:

The following measures will be recommended to the CBCV. This applies only to structures put in place for this project and does not apply to anything that may occur outside that remit.

Habitat	Measures	Frequency
In-stream	Check for loose woody material that could block the channel. Remove as necessary.	Quarterly
Bankside vegetation	Scrub management to allow light to access the channel.	A quarter of the total to be managed each year on a rotational basis, as required.

Annex A – photographs of RTCT examples

Figure 6 Photos A&B: Habitat structures constructed on the Chalgrove Brook, Chalgrove Highstreet - completed under FRAP

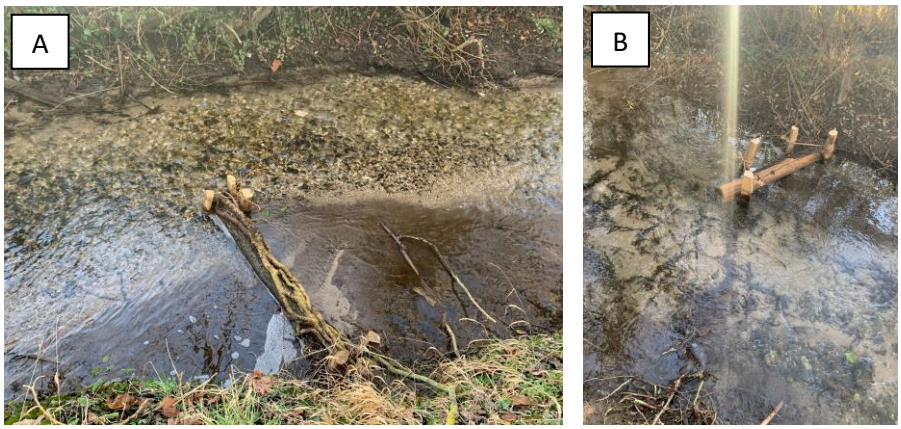

Figure 7 Photos A&B: Log features constructed on the Chalgrove Brook, Cutmill - completed under FRAP