6.0 – Environmental Impacts / Mitigation

The aims of the project are to increase the overall biodiversity and sustainable conservation management of the site, and the wider Wensum cSAC. In this case the cSAC designation is confined to the river channel and does not extent to any land pockets. There is no County Wildlife Site designation and the land on the RHB has been entered into the Broads Environmentally Sensitive Area (ESA) scheme, administered by the Department for Environment Food & Rural Affairs.

A high level target of the Conservation Strategy for the River Wensum (EA /EN 2000) is to ‘encourage self-sustaining populations of native fish species’
Issue 13 of the strategy identifies a ‘Lack of Habitat Diversity’ as a factor influencing sustainable fish populations. The subsequent recommended action arising from issue 13 is to ‘Implement rehabilitation measures in suitable stretches of river’

The project also has direct links in with seven ‘Nature Conservation Objectives’ of the Strategy:

- 1- (Physical Structure)
- 5 - (Fast Flowing Water)
- 6 - (Riparian and In-River Features)
- 7 - (Siltation)
- 9 - (Fisheries)
- 10 - (Invertebrates)
- 12 - (Mammals)

Therefore it would seem that the aims of the project closely match those of the Conservation Strategy . That said, it is of vital importance that each component of the design and restoration work proposals are considered individually to assess any impacts on SAC Features, and Biodiversity Action Plan (BAP) Species. This is essential if the overall integrity of the site is to be protected and conserved.

The SAC features are:

- Desmoulins Snail (*Vertigo moulinsiana*)
- Water Crowfoot (*Ranunculion fluitantis*)
- Bullhead (*Cottus gobio*)
- Brook Lamprey (*Lampetra planeri*)
- White Clawed Crayfish (*Austropotamobius pallipes*)

Further to this there are several species specific targets included in the 'Conservation Objectives for the European interest features of the SSSI'(En 2000) that the project contributes. At the end of each target the component of the project contributing to this will be in brackets.

Bullhead

Attribute -Habitat Structure

Measure – Extent of gravel / pebble dominated structure
Target – maintain & where necessary restore. **(riffles)**

Measure- Extent of slack-water refuges
Target- Maintain & where necessary restore **(Off-river refuges)**

Measure – River form
Target – maintain & where necessary restore the characteristic physical form of the river channel **(Restoration of riffle – pool sequence)**

Brook Lamprey

Attribute – Habitat Structure

Measure – Area of spawning habitat
Target – Maintain & where necessary restore **(Riffles)**

Measure - Area of nursery habitat
Target – Maintain and where necessary restore **(Off river-refuges)**

Measure – Area of emergent riparian vegetation
Target – Maintain a high extent throughout the river system **(Fencing of one bank)**

Measure - River Form
Target – Maintain and where necessary restore the physical form of the river channel **(Restoration of riffle-pool sequence)**

White-clawed crayfish

Attribute – Habitat Structure

Measure – Extent of cobbles / boulders
Target – Maintain to an extent characteristic of the river type. **(riffles)**

Measure – Density of bankside refuges
Target – Submerged tree root systems and/or crevices in banksides should be available at intervals **(Faggot narrowing)**

Measure – Extent of submerged and marginal vegetation
Target – Maintain patchy cover where characteristic of the river type **(fencing of one bank)**

Measure – Extent of overhanging riparian vegetation
Target – Should be present intermittently along the bank throughout the year **(Fencing of one bank)**

Measure – River form
Target – Maintain and where necessary restore the physical form of the river channel.
(Restoration of riffle-pool sequence)

BAP Species are:

- Water Vole (*Arvicola terrestris*)
- Otter (*Lutra lutra*)

The Wensum is not just a tick list of SAC Features and BAPs and this design reflects this fact, by way of its holistic approach to river management . This project's design aims are to improve and restore the overall ecological quality of the Wensum, at Costessey. It will hopefully provide numerous 'knock-on' positive effects to a range of species not necessarily within the remit of the high level Habitats Directive.

This section will consider two main areas of potential impacts on SAC and BAP features and species.

1) Impacts of the individual components of the project
2) Impacts of the works required during completion of the project

6.1 - Potential Impacts on SAC Features

1) – Desmoulins Snail.

Potential Impacts of scheme:

- Removal of habitat during construction of 2-Stage Channel
- Accidental damage by machinery operators during construction

Distribution data for this species still remains patchy in the Wensum Valley. It is known that the snail generally favours Glyceria fringes greater than 5m wide. There is the possibility it may be present at proposed riffle sites, however most, if not all of the fringes are less than 5m wide. The major potential impact of the works would be from the creation of 2-stage channels running parallel to riffles The excavations will be taken from the 'wet end' which is less favourable to the snail which prefers drier habitat closer to the bank. The creation of a shallow berm will in the long term increase the overall width of Glyceria habitat available to the snail. Currently Glyceria is present on the site in isolated patches and not a continuous strip. The 2-stage channel is a condition placed on the project by EA Development Control to compensate for any loss of channel capacity via the introduction of gravel riffles. The 2-Stage Channel would be excavated to cause minimum disruption to the remaining proportion of the fringe. The extent of each feature will be staked out to guide machinery operators. All machinery operators will be fully briefed before commencement of works to avoid potential environmental damage.

2) – Water Crowfoot

Potential Impacts of scheme:

- Smothering due to emplacement of gravel riffles

A prime consideration of many river rehabilitation projects is to change 'Channel Dimensions' to restore previous habitats. The majority have been carried out to redress deficiencies in some reaches due to elevated siltation, lack of discharge, or inadequate velocities associated with past channel modification, such as over-deepening and over-widening. The guiding principles of many rehabilitation projects have been to increase velocity that has invariably led, at least in the short term, to the re-appearance of Ranunculus. The exact reasons for this are uncertain, but some very significant improvements were achieved on Hampshire chalk rivers in the mid 1990s when Ranunculus was declining elsewhere. (Rannunculus and Chalk Rivers –EA 2000)

Cattle have been implicated in some studies as a major contributory cause to changing natural channel dimensions and fencing has been employed locally with good effect to help in-stream vegetation recovery and bring about channel narrowing.

Crowfoot has been identified on site, albeit in one or two isolated locations. It is hoped that by creating habitat conditions suitable for Crowfoot that it will spread form its current limited distribution when roots are pulled up and re-settle during winter flood events. Wherever possible if *Ranunculus fluitantis* is found to exist on proposed riffle locations, they will be shifted to avoid burial. This option would of course be subject to impacts on other SAC features. This may option may not be practicable, however the long term aim of the project is to provide a large increase in habitat suitable for colonisation by crowfoot. Studies have shown some success with the re-planting of crowfoot in areas suitable for re-colonisation. Visual observations at Bintry on the Wensum indicate an increased distribution of crowfoot on and

downstream of created riffle sites.

Fencing the entire double bank of the project is not advocated in the interest of developing a patchwork of different habitats so that diversity is maintained to sustain a rich marginal invertebrate population.

2) - Bullhead

Potential scheme impacts:

- Temporary disturbance during works

*****Need distribution data from EA*****

The project will benefit this species by restoring pool-riffle sequences, which are the favoured habitat. The re-introduction of gravel and stones will provide spawning substrate and daytime refuges. The improvement to the health of the river system will boost invertebrate biomass, therefore increasing food supply to the fish. The project should have a positive long term status of the species. It will assist in establishing favourable conservation status for the species as required under the Species and Habitats Directive.

Bullhead are likely to be in the reach where the restoration work will be undertaken. It is therefore possible that the population will suffer temporary disturbance during the works. Their spawning season is March to April. There are no plans for in-channel works for this site at this time. Being highly mobile, it is unlikely that restoration works will directly affect these species. Re-colonisation of the new habitat is likely to be rapid. Long term benefits to the population will greatly outweigh any short term disturbance.

3) – Brook Lamprey

Potential Scheme Impacts

- Temporary disturbance during works
- Removal of juvenile and adult habitat

***** Distribution Data Need from EA*****

As with Bullhead the restoration of a pool-riffle sequence, is the favoured spawning habitat for lampreys. Spawning typically occurs when water temperatures reach a constant 10-11^{0}C, around April time. Again there are no planned in-channel works during this period. After hatching young larvae (ammocoetes) leave the spawning nest and distribute themselves by drifting downstream and burrowing in suitable areas of silty and sandy material. Recent surveys by the local EA Fisheries Team into ammoceate and adult habitat selection found vegetated point bars containing Glyceria to be important habitat (pers comm. A. Hindes, EA Fisheries). Straight sections with Glyceria ‘hover’ were found to be poor habitat for Lamprey. The 2-stage channel excavations are planned to take place in straight areas of ‘hover’ and no works are planned on vegetated point bars. Glyceria beds only occur at the site of riffle 2’s Two-Stage Channel. During the works both Project Manager and machine operators will keep an eye out for any lampreys should they emerge from the excavated material, and place them back into the river down-stream. This mitigation technique was recently utilised by the EA on channel works at Great Ryburgh on the River Wensum.

4) – White Clawed Crayfish

Potential Scheme Impacts:

- Temporary disturbance during works

Environment Agency records show that native crayfish have not been recorded at this Site. Although records are patchy it should be assumed likely that native crayfish are present, albeit perhaps in limited numbers. Thankfully Signal Crayfish have not been recorded on the site either. With this in mind it could be concluded, that, at present, habitat availability is the limiting factor influencing native crayfish distribution. At present the habitat suitable for crayfish at Costessey is extremely limited. The creation of chalk stream riffles will create one of the major habitat types preferred by crayfish. Submerged tree roots, which occur on the top section of the LHB, form important ' woody debris' habitat. The creation of the 'Faggot Berm' on the LHB will increase the available habitat for crayfish, especially juveniles.

To minimise impacts of the works on Crayfish it is proposed that a hand search / netting survey is carried out immediately prior to the start of the works in August-October. This will have to be conducted by a licensed surveyor under Section 5 of the Wildlife &Countryside Act (1981) . Co-incidentally this is the peak time of activity for crayfish, and hence the best time to ascertain their presence or absence. Should any crayfish be caught they will be re-located upstream away from the works. Upstream of the site is faster flowing gravel bed habitat below the Costessey Mill. If large numbers of crayfish are found by hand searching, traps may have to be deployed as a more efficient method of capture and re-location. Survey and trapping methodology from the recent publication 'Guidance on Works Affecting White-clawed Crayfish' (EN 2000) will be followed. As water voles are present on site it is recommended that 'Vole-friendly' traps are used. These are not traps but artificial refuges, comprising clusters of tubes.

The following 'best practice' will be adopted during the works to protect white-clawed crayfish.

- Disturbance to river banks kept to a minimum.
- Works on the channel and banks will be done in short sections.
- Works are to be conducted where current crayfish habitat is unsuitable
- Any crayfish accidentally removed during works to be re-located upstream to areas of equal habitat quality.
- Larger flints to be placed on riffles to act as refuges from high flows.

6.2. Potential Impacts on BAP Species

1) Water Vole & Otter

The Project commissioned Norfolk Wildlife Trust (NWT) to conduct a vole and otter survey in December 2003.

The summary of the survey results, assessment and recommendations is below. A full copy is provided in Appendix 4.

Survey results

Water vole

A water vole colony occupies parts of both banks within the section identified for in-channel and bank modifications. Burrows and latrines, which indicate usage by water voles as core areas for breeding, were located.

Otter

No active otter holts or resting sites were located during the survey

There is a potential holt/resting site along the right-hand bank and areas along and adjacent to the left-hand bank could also support holts/resting sites

Impact Assessment & Recommendations

The primary point of conflict relates to potential damage to, or obstruction of, water vole burrows which are protected under the Wildlife & Countryside Act

It is recommended that potential impacts on water voles be minimised by adopting three approaches:

- Adherence to recommended limits to timing of works
- Implementation of operational best practice procedures for contractors throughout the works
- Implementation of specific mitigation measures in relation to riffle installation and bank re-profiling where there is a potential impact on water vole burrows

Water vole

Impact Mitigation Recommendation 1

Removal and damage to vegetation along the riverbanks during riffle installation works and any bank re-profiling should be minimised in order to ensure that water vole food sources and concealment is maintained into the winter period

Impact Mitigation Recommendation 3

- During the riffle installation process, implement an operational 3m exclusion zone for machinery, in parallel with the right-hand bank
- Mark the boundary of the exclusion zone clearly using coloured tape

- In addition to the implementation of buffer zones along the bank to prevent accidental damage or obstruction to burrows during riffle installation and bank re-profiling, general operational best practice procedural guidelines should also be adopted

Impact Mitigation Recommendation 4

- During any materials reclamation operations along the right-hand bank, implement an operational 3m exclusion zone for machinery, in parallel with the riverbank
- Mark the boundary of the exclusion zone clearly using coloured tape

Impact Mitigation Recommendation 5

- Ensure that the potential impact on water vole burrows resulting from an increase in channel water levels following riffle installation is minimised
- Water levels should rise gradually, over a minimum period of 4-5 days

- In relation to Riffles 1 & 3, the impact on water vole burrows of bank re-profiling requires mitigation

There are two options:

1. Undertake bank re-profiling to create two-stage channel and implement measures to mitigate impact on water vole burrows that will be damaged or destroyed.
2. Drop two-stage channel approach to compensation of in-channel capacity lost.
   The compensation for loss of in-channel capacity foregone can be achieved by widening and deepening two existing ditches along the right-hand bank, upstream and downstream of Riffle 3 respectively (where water vole burrows are not present).

- This option also has the advantage that no mitigating measures are required

Preferred option is 2.

- Drop proposal to construct two-stage channel along right-hand bank at Riffles 1 & 3 as this will remove water vole habitat and incur mitigating measures
- Create compensatory valley-floor flood capacity by widening and deepening two existing ditches along the right-hand bank, upstream and downstream of Riffle 3 respectively (where water vole burrows are not present)

- In relation to Riffle 2, bank re-profiling does not impact on water vole burrows so mitigation is not required

Impact Mitigation Recommendation 6

- Drop proposal to widen the ditch mouth along the left-hand bank immediately upstream of Riffle 2

Preferred option

- Opt instead to reconnect and open out to the main river channel, two ditches along the right-hand bank located upstream and downstream of Riffle 3

Otter

The proposed works do not impact upon any otter holt or resting sites as none are known to be in current use. The timing of the works does not have any implications in terms of otters

A licence issued by DEFRA is <u>not</u> required <u>provided</u> there are no active holt or resting sites in current use prior to commencement of the works

Impact Mitigation Recommendation 7

- Re-check the large bramble patch along the right-hand bank, which constitutes a *potential* otter holt/resting site, for signs of current usage one month prior to the commencement of works

Impact Mitigation Recommendation 8

- During the installation of Riffle 2, implement an operational 10m exclusion zone for machinery around the large bramble patch along the right-hand bank, which constitutes a *potential* otter holt/resting site
- Mark the boundary of the exclusion zone clearly using coloured tape

Important Note:

NWT's preferred option at riffles 1 and 3 is to drop the creation of a two-stage channel, preferring the creation of more floodplain storage.

However concerns from the Environment Agency over reductions in channel capacity, requires the creation of 2-stage channels as a pre-requisite condition to be incorporated into the design prior to submitting application for Land Drainage Consent.

This has been incorporated into the Norfolk Wildlife Trust report which recommended the following mitigation measures at Riffles 1&3. This proposal is fully supported by the project.

Impacts in relation to bank re-profiling in association with riffle installation
Re-profiling is proposed along the right-hand bank in order to create a two-stage channel. The aim is that a two-stage channel will provide volume compensation for loss of channel capacity due to riffle installation.

- Direct damage to or destruction of burrows and disturbance to voles within them will ensue within Riffle sections 1 and 3 where water vole burrows are present along the right-hand bank (three and two burrows respectively)

- **In relation to Riffles 1 & 3, the impact on water vole burrows of bank re-profiling requires mitigation**

- No water vole burrows were located along the right-hand bank corresponding to Riffle 2, so no impacts are envisaged in relation to the construction of a two-stage channel

- **In relation to Riffle 2, bank re-profiling does not impact on water vole burrows so mitigation is not required**

Options for mitigation of impacts at Riffle 1 & 3
Once colonised by marginal aquatic vegetation, berms (shelves) created by the construction of a two-stage channel potentially yield benefits for water voles by providing additional habitat. However, the right-hand bank corresponding to Riffles 1 and 3 is a steep earth bank providing opportunities for burrowing – this steep bank profile would be lost and water vole breeding/burrow habitat removed from the riverbank.

There are two options:

1. Undertake bank re-profiling to create two-stage channel and implement measures to mitigate impact on water vole burrows that will be damaged or destroyed.
2. Drop two-stage channel approach to compensation of in-channel capacity lost. Create compensatory river valley floor flood capacity by expanding the width and Depth of two existing ditches along the right-hand bank adjacent to Riffle 3.

Option 1 –
Implement measures to mitigate the impact of bank re-profiling at Riffles 1 & 3

Displacement & exclusion technique
This involves the complete removal of bankside vegetation and emergent marginal vegetation growing in the river channel. Removal of vegetation renders the habitat unsuitable, encouraging water voles to vacate burrows, dispersing to surrounding locations.

- The method requires the availability of suitable adjacent habitat for displaced water voles to move into

Timing
Late August/September is an optimal period for undertaking the displacement technique and the technique will also still be feasible during early October.

- **The technique should not be attempted during the period November-February**

Displacement & exclusion technique procedure

Stage 1. The locations of burrows should be marked with flagged canes before work begins.

Remove all current signs (droppings, latrines, *etc*.) of water vole activity.

Stage 1 must be undertaken by a competent surveyor/ecologist.

Stage 2. Remove all vegetation within the entire displacement zone encompassing the length of bank supporting the burrows plus 10m in all directions both linearly and laterally away from the riverbank.

- Emergent marginal aquatic vegetation, within the channel, should also be removed to water level if present

All contractors used in the displacement procedure to be fully briefed.

A hand-held brushcutter should be used taking care not to damage banks or damage/block water vole burrows.

Stage 3. Rake the vegetation and remove off-site.

Rake to achieve bare earth or as near as possible. This is important as water voles may remain if vegetation is left *in situ*, as this material can still provide food and concealment from predators.

Stages 2 & 3 to be supervised by a competent surveyor/ecologist.

Stage 4. Leave displacement zone undisturbed to allow any water voles present to vacate.

Stage 5. After four days, erect water vole-proof fencing around displacement zone to form an exclosure (which prevents any water voles subsequently trapped from returning to their burrows once they have been released outside the exclosure).

Stage 5 to be supervised by a competent surveyor/ecologist.

Stage 6. Re-survey the exclusion zone for fresh signs of water vole activity four days after the vegetation has been completely removed.

Set baited live-capture traps in suitable locations (adjacent to newly located water vole field-signs or where signs were located prior to strimming, with a minimum of one trap per 5m along bank) within the exclosure, to capture any animals remaining. Traps to be checked at least three times per day.

Stage 6 must be undertaken by a competent surveyor/ecologist.

Any animals displaced by the works will be able to locate suitable adjacent habitat along the left-hand bank. During late August/September the water vole population will be both at its highest level and most mobile, with juveniles dispersing from the colony.

Trapping & translocation procedure

If fresh signs of water vole activity are located after four days, this indicates that the burrows may not have been completely vacated and this will be confirmed should any water voles subsequently be trapped.

- However, it is expected that the displacement technique procedure should displace any water voles present and that trapping will be negative (see Bennett *et al*. 2001).

- The success of translocating water voles is as yet unproven (Bennett *et al*. 2001)

In keeping with the sustainability ethos of the project. the recommendation of NWT to create more compensatory flood storage / habitat has been retained in the design with the creation of the Off-river refuges. These features will remain, as well as the 2-stage channels. The refuges are to be profiled to a ‘vole friendly’ design. (see Technical specification 4.0). There are no mitigation measures required for this option.

6.3 - General Impacts

Timing of Works

The project works are to be conducted in the period August/September/October. This takes into account more generalised considerations on the effects on bird breeding, and salmonid and coarse fish spawning seasons. The timing also links in with mitigation measures proposed for white-clawed crayfish and water voles. This time period is also optimal due to the fact that the banks will be at their driest and plant machinery will not get stuck and cause damage to grassland habitat.

Plant Access

Plant will arrive from the farm track leading from Costessey Mill. Specific considerations to SAC features are mentioned earlier in this report. Before work commences all personnel involved with the project will be fully briefed and maps will be provided showing access routes that will also be marked to ensure no unnecessary damage occurs on site . Machinery will track along the river bank away from marshy areas and features such as vole burrows. Recent works that REEF project managed on the Stiffkey adopted this best practice.

There maybe additional temporary impacts from tracking machinery to and from work areas. As the RHB marshes do not support grassland of high conservation value, this is unlikely to be a significant concern. There may be also be a further temporary impact arising from the disposal of slubbings from the off-river refuges. This material will be spread within reach of the excavator. The marsh is semi-improved, and does not support species rich grassland. Spreading of slubbings is an established practice that has occurred for many cycles of both Environment Agency and Internal Drainage Board maintenance cycles.

6.4 – Impact Conclusions

Analysis of available ecological and fisheries data suggest that the stretch of river that forms the scheme to be in poor ecological condition. Data from the River Rehabilitation Feasibility Study conducted by the Environment Agency in 1998 suggests the river fishery is in a state of decline. Survey work forming Phase 2 of the Feasibility study identified poor habitat quality as a principle cause of this decline.

The long term impacts of the scheme will be positive for ecological and fisheries considerations. The impacts on protected species are also concluded to be positive in the long term.

There may be temporary negative impacts on populations of water voles in areas where contractors will be working. The project fully supports the recommendations of Norfolk Wildlife Trust to mitigate any such impacts.

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