The Water Vole Mitigation Handbook

The Mammal Society Mitigation Guidance Series

Authors
Mike Dean
Rob Strachan
Derek Gow
Richard Andrews

Editors
Fiona Mathews
Paul Chanin

Endorsement

The UK Water Vole Steering Group is pleased to endorse *The Water Vole Mitigation Handbook* as the industry standard for all those undertaking surveys, assessing impacts and designing mitigation for water voles in the context of development or construction activities. The Group includes representatives of the following organisations: Environment Agency, Natural England, Natural Resources Wales, People's Trust for Endangered Species, Royal Society for the Protection of Birds, Scottish Environmental Protection Agency, Scottish Natural Heritage and The Wildlife Trusts.

This document is also endorsed by the Chartered Institute of Ecology and Environmental Management.

Citation

This document should be cited as Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). *The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series).* Eds Fiona Mathews and Paul Chanin. The Mammal Society, London.

Acknowledgements

The authors and The Mammal Society would also like to thank the following individuals, who provided comments on drafts of this document, or who attended a workshop in May 2013, which lead to its production:

Elaine Gill, Kat Walsh, Charlie Wilson and Tony Bird (Natural England); Joanne Holland, Chris Strachan and Julia Massey (Environment Agency); Rob Raynor (Scottish Natural Heritage); Jean Matthews (Natural Resources Wales); Jane Sears (Royal Society for the Protection of Birds); Darren Tansley and Helen Perkins (The Wildlife Trusts); Adam Grogan (Royal Society for the Prevention of Cruelty to Animals); Helen Booth, Cliff Carson, Charlie Dwight, Merryl Gelling, Pippa Hamshaw, Vicki Johnson, Steve Judge, Chris Manning, Hazel Ryan, Peter Smith, David Smith and Diana Ward.

The assistance provided by Jacobs UK and the Environment Agency in providing meeting rooms and other resources is also gratefully acknowledged.

Particular thanks are due to Roisin Campbell-Palmer for assisting with the production of the guidance relating to health screening protocols.

Contact details:
Mike Dean. MD Ecology Limited www.mdecology.co.uk

Derek Gow. Derek Gow Consultancy www.watervoles.com

Richard Andrews. Ricardo Richard.Andrews@ricardo.com

Fiona Mathews and Paul Chanin. The Mammal Society www.mammal.org.uk

Dedication

This publication is dedicated to Rob Strachan. His enormous contribution in highlighting the catastrophic decline of water voles, championing the conservation and legal protection of the species, and increasing our understanding of its ecology cannot be underestimated.

Rob, in collaboration with Don Jefferies and The Vincent Wildlife Trust, undertook the first national water vole survey (1989–1990) which identified the scale of the decline affecting the species. He oversaw numerous research projects on water voles during his time with Oxford University's Wildlife Conservation Research Unit, and wrote the first edition of the *Water Vole Conservation Handbook*, (which was published in 1998), as well as subsequent revisions with co-authors Tom Moorhouse and Merryl Gelling. He wrote a monograph of the species 'The Water Vole' (published in 1997), which he illustrated himself, as well as a number of other publications, including *The Mink and the Water Vole: Analyses for Conservation* in 1999 (with David Macdonald). Rob also worked for the Environment Agency and subsequently for EA Wales (now part of Natural Resources Wales), providing practical advice on conservation issues for both organisations.

But Rob was much more than the sum of these many parts. He shared his knowledge and experience freely. His enthusiasm for water vole conservation, and wildlife in general, was infectious, leaving a lasting impact on those who heard him speak at conferences, or who attended one of his many training courses or lectures on water voles and other riparian mammals.
Rob made time for anyone interested in water voles, irrespective of their level of experience or seniority. He acted as a focal point for the numerous organisations and individuals interested in water voles, linking the various strands of emerging knowledge. This meant that a phone call to Rob always ended up being a learning experience, and often produced new opportunities to get involved with water vole conservation.

The guidance set out in this document has been developed with input from many practitioners with experience of survey, conservation and mitigation techniques for water voles. There are still gaps in our knowledge of the species, not least in relation to the effectiveness of mitigation techniques. But without Rob's contribution we would not have managed to produce half of what is presented here. Rob died in May 2014. We are incredibly fortunate to have had his input to the first drafts of this document, as well as the legacy of his extensive publications on water voles, to guide us. We hope that he would have approved of the finished product.

Contents

Text Boxes

Executive Summary

The water vole (*Arvicola amphibius*) is one of Britain's fastest declining wild mammals. It is listed as a species of principal importance for the conservation of biodiversity in England, Scotland and Wales, and is protected under wildlife conservation legislation in the UK. Water voles are therefore a material consideration when planning applications are determined.

This publication aims to promote best practice amongst ecological consultants in undertaking surveys, and in designing and implementing mitigation measures for water voles. It is also intended to guide and inform decision makers to ensure that the survey information provided, and mitigation measures proposed, are appropriate. A flowchart is provided in Appendix 7 to assist those reviewing planning applications. The guidance set out in this document should be considered to be 'interim' guidance. It will be revised as required to take account of relevant new evidence.

The guidance in this document relates to development projects and other construction activities, including those requiring other environmental permits, such as flood defence consent. It is not intended to be used in relation to routine management or maintenance of watercourses for flood risk management purposes, in order to preserve public health and safety, or for conservation management. These activities may be subject to different licensing requirements and relevant advice is provided in the *Water Vole Conservation Handbook* (Strachan *et al.*, 2011).

There has been a recent review of the interpretation of the legislation relating to water voles by the relevant Statutory Nature Conservation Organisations (SNCOs). This has included clarification of what constitutes an offence, and what defences could apply. Information on the legal protection afforded to water voles and relevant aspects of planning policy are included within this document. The guidance set out in this document therefore supersedes the *Water Vole Conservation Handbook* in all aspects relating to development (i.e. those relating to legislation, survey and impact assessment and mitigation in the context of development). A summary of the key recommendations, and any significant differences from previously published guidance, are provided below:

1) **Licensing in relation to the 'displacement' of water voles**
   In England and Wales, activities aimed at displacing water voles in the context of a development project have previously been routinely undertaken without a licence, with reliance on the 'incidental result' defence. It is now considered that such activities are not covered by the 'incidental result' defence, and therefore require a licence. In England, certain displacement operations can be carried out under a Class Licence by a registered person; other displacement operations require a site-specific licence. In Wales, site-specific licences are required for *all* displacement operations. In both England Wales, the projects must deliver a net benefit for water voles because the licence will be issued for the purpose of conservation. Scottish Natural Heritage considers displacement a licensable activity and issues licences under the Wildlife and Countryside Act (as amended by the Wildlife and Natural Environment (Scotland) Act 2011) 'for any other social, economic or environmental purpose', provided certain conditions are met. Note that these conditions do not include providing a net benefit to water voles, in contrast to the requirements in England and Wales. See Sections 2.1 and 2.2 for further details.

2) **Recommended approach to relocating water voles – when to use trapping and when to use displacement**
   There is a lack of evidence on which to judge the efficacy of displacement (see Box 3), and further research is urgently needed. In the interim, displacement may be considered a potentially useful technique, particularly for small-scale works, where trapping would be

disproportionately expensive and could impact on animals outside the working area due to individuals moving into vacant territories. See Section 4.6 for full details.

In summary displacement is recommended under the following circumstances:

i) Where there is a working area with a maximum length of 50m (for watercourses this equates to 50m on each bank), although a shorter maximum length will be appropriate in situations where water voles are at high density; *and*

ii) Works are conducted between15th February and 15th April inclusive (although some seasonal variation is accepted depending on weather and geographical location – see 4.6.23 and Appendix 1 for further details); *and*

iii) Where there is sufficient available alternative habitat for water voles to move into.

In England, such displacement can be conducted under a Class Licence by a registered person; the displacement of water voles in other circumstances would always require a site-specific licence. In Scotland and Wales, a site-specific licence would be required.

3) Appropriate timing for trapping and relocation operations

Ideally, water voles should be trapped during early spring (between 1st March and 15th April inclusive). In southern England during mild weather, trapping can begin as early as mid-February. Water voles can also be trapped during autumn (between 15th September and 30th November inclusive), but this should only be considered as a last resort since water voles trapped during the autumn period may require over-wintering in captivity to improve survival rates. It is not recommended to trap water voles during the height of the breeding season, as this can have a significant effect on their breeding success and therefore the status of the population. It is also not recommended to trap water voles during the winter months when they are no longer breeding, as their behaviour makes them difficult to catch. Trapping should be timed to avoid periods of heavy rain or snow, fluctuating water levels, and periods when the overnight temperatures fall below freezing (0^{o}C). Some seasonal variation in appropriate dates for trapping is acceptable in certain parts of the UK. See 4.6.4 and Appendix 2 for further details.

4) Water vole surveys to support planning applications, or other construction activities

This document provides suggested protocols for field surveys to support planning applications or other construction activities. These differ in some important aspects from the methodologies used in the national water vole surveys undertaken by the Vincent Wildlife Trust (Strachan and Jefferies, 1993; Jefferies, 2003). In many cases, the baseline information used to inform an assessment of the effects of a development on water voles should be based on a combination of desk study, habitat assessment and field sign survey. See Section 3 and Box 1 for further details.

In most cases, water vole field sign surveys should include searches for field signs undertaken over at least two separate visits conducted sufficiently far apart to account for variations in habitat suitability across the season. One survey should be undertaken in the first half of the season (between mid-April/early May and the end of June) and one in the second half of the season (between July and September); the survey visits should be undertaken at least two months apart. See 3.3.11 for further details. Circumstances in which only a single visit is likely to be necessary are set out in Box 2.

1. Introduction

1.1.1. This publication is intended to assist those involved in actions that affect water voles (*Arvicola amphibious*) in the following circumstances:

- Ecological consultants undertaking surveys, and designing and implementing mitigation measures for development or construction projects;
- Decision makers reviewing planning applications to ensure that any potentially significant impacts have been appropriately mitigated, and that the development accords with the relevant legislation. A flowchart has been provided in Appendix 7;
- Those responsible for issuing other environmental permits (such as flood defence consent), which will also need to address potential impacts on protected species.

1.1.2. The guidance is not intended to be used in relation to routine management or maintenance of watercourses for flood risk management, or in order to preserve public health and safety, or for conservation management. Relevant advice for these circumstances, which may fall under different licensing requirements, can be found in the *Water Vole Conservation Handbook* (Strachan *et al.*, 2011).

1.1.3. The guidance set out in this document includes information on the legal protection currently afforded to water voles and relevant aspects of planning policy (The Mammal Society will provide updates to this document as appropriate on its website www.mammal.org.uk). The interpretation of the legislation relating to water voles has recently been reviewed by the relevant Statutory Nature Conservation Organisations (SNCOs), in terms of what constitutes an offence and which defences might apply.

1.1.4. The guidance set out in this document therefore supersedes the *Water Vole Conservation Handbook* in all aspects relating to development (i.e. those relating to legislation, survey and impact assessment and mitigation in the context of development).

1.1.5. This publication does not provide a detailed description of the ecology of the water vole, its UK distribution, historical decline, current status, or advice on conservation measures that are not development-related. These topics are discussed in detail in the *Water Vole Conservation Handbook* (Strachan *et al.*, 2011).

2. Legislation and Policy

2.1. Legal protection and licensing – England and Wales[1]

2.1.1. In England and Wales water voles are listed on Schedule 5 of the Wildlife and Countryside Act 1981, receiving full protection since 2008. The Wildlife and Countryside Act 1981, together with amending legislation, lists the following offences:

- Intentionally killing, taking or injuring a water vole (Section 9(1));
- Possessing or controlling any live or dead water vole, or any part or derivative (Section 9(2));
- Intentionally or recklessly damaging or destroying a water vole's place of shelter or protection (Section 9(4)(a));
- Intentionally or recklessly disturbing a water vole whilst it is occupying a structure or place which it uses for shelter or protection (Section 9(4)(b));
- Intentionally or recklessly obstructing access to a water vole's place of shelter or protection (Section 9(4)(c));
- Selling, offering for sale, or possessing or transporting for the purposes of sale, any live or dead water vole, or any part or derivative, or advertising any of these for buying or selling (Section 9(5)).

2.1.2. It is generally agreed that a place of shelter or protection used by water voles includes a network of active burrows and/or any nests that have been constructed within the burrow system or above ground amongst dense vegetation.

2.1.3. The trapping and displacement of water voles needs to be carried out under a licence issued by the relevant SNCO (Natural England or Natural Resources Wales). In England and Wales there is no provision for licensing development or other construction activities under the Wildlife and Countryside Act. Such works should therefore be carried out under a conservation licence, which requires the applicant to demonstrate a conservation benefit for water voles. The conservation benefit can be achieved by delivering a net gain in the amount of habitat available to the water vole population, or by improving the quality of the habitat. It may also be possible to deliver a conservation benefit by significantly improving the linkages between water vole colonies.

2.1.4. Operations aimed at displacing water voles from a development footprint (in England and Wales) have previously been routinely undertaken without a licence, with developers relying on the 'incidental result' defence. **Natural England and Natural Resources Wales have reviewed their position on this and now take the view that displacement activities are not covered by the 'incidental result' defence, and therefore should be licensed.**

2.1.5. **In England** displacement operations can be carried out under a Class Licence by a registered person (as of January 2016), provided that they conform to the licence conditions which include:

- Only to be used for displacement over a continuous length of bank not exceeding 50m (for watercourses this equates to 50m on each bank);
- Only to be used during the period 15th February to 15th April inclusive (with some exceptions, as set out in Appendix 1);
- The project must have planning consent (for schemes requiring such consent);

[1] The legislative position in Scotland is described separately (see Section 2.2) as it differs significantly from that in England and Wales.

- An annual report of actions must be provided to Natural England.

2.1.6. Displacement operations which do not conform to the conditions set out in the Class Licence may still be permissible in certain circumstances, such as where weather conditions do not allow for displacement during the period specified above. Displacement in such circumstances will need to be carried out under a site-specific licence.

2.1.7. **In Wales**, site-specific licences will be required for all displacement operations.

2.1.8. **In both England and Wales** a licence to displace water voles, whether site-specific or a Class Licence, will be issued for the purpose of conservation and the project will therefore need to deliver a conservation benefit for water voles (see 2.1.3).

2.2. Legal protection and licensing – Scotland

2.2.1. In Scotland water voles are listed on Schedule 5 of the Wildlife and Countryside Act 1981, but currently only in respect of Section 9(4). The following are therefore offences in Scotland:

- Intentionally or recklessly damaging or destroying a water vole's place of shelter or protection;
- Intentionally or recklessly disturbing a water vole whilst it is occupying a structure or place which it uses for shelter or protection;
- Intentionally or recklessly obstructing access to a water vole's place of shelter or protection.

Full protection for water voles in Scotland is due to be implemented and this is therefore likely to change (The Mammal Society will provide updates to this document as appropriate on its website www.mammal.org.uk).

2.2.2. Scottish Natural Heritage (SNH) requires the displacement of water voles in Scotland to be carried out under licence. This is unlikely to change as a result of the proposed amendment to the protection afforded to water voles in Scotland. Trapping of water voles does not currently require a licence; this will change once water voles receive full protection.

2.2.3. The Wildlife and Natural Environment (Scotland) Act 2011 has added a licensing purpose to the Wildlife and Countryside Act 'for any other social, economic or environmental purpose', which allows SNH to licence development or construction activities, subject to the following conditions:

i) That undertaking the conduct authorised by the licence will give rise to, or contribute towards the achievement of, a significant social, economic or environmental benefit; *and*

ii) That there is no other satisfactory solution.

2.2.4. In assessing licence applications, SNH will give consideration to the effect of the proposals on the conservation status of the species. Further details and advice for applicants is provided at http://www.snh.gov.uk/protecting-scotlands-nature/species-licensing/mammal-licensing/shrew-vole/.

2.3. Biodiversity duty – England, Wales and Scotland

2.3.1. The Natural Environment and Rural Communities (NERC) Act 2006 required the Secretary of State to publish lists of habitats and species of principal importance for the conservation of biodiversity in England and Wales, under Sections 41 and 42 of the Act, respectively. These lists are used to guide decision makers (such as planning authorities) in implementing their duty to have regard to the conservation of biodiversity when carrying out their normal functions (under Section 40 of the NERC Act). Water voles are listed as species of principal importance for the conservation of biodiversity in England and Wales, under Sections 41 and 42 of the NERC Act 2006, respectively.

2.3.2. Similar to Section 40 of the NERC Act, Section 1 of the Nature Conservation (Scotland) Act 2004 states that all public bodies and office holders have a duty to further the conservation of biodiversity in exercising its/their functions. Water voles are listed as a species of principal importance for the conservation of biodiversity in Scotland under Section 2 of the Act.

2.4. Planning policy – England, Wales and Scotland

2.4.1. In England, the National Planning Policy Framework (NPPF) 2012 includes policies relating to conserving and enhancing the natural environment. This requires local planning authorities to aim to conserve and enhance biodiversity by refusing planning permission for developments that would cause significant harm, unless it can be avoided, adequately mitigated or, as a last resort, compensated for. Water voles are therefore a material consideration in determining a planning application. The Government Circular on Biodiversity and Geodiversity (06/2005) sets out that it is essential that the presence or otherwise of protected species, and the extent to which they may be affected by a proposed development, is established before planning permission is granted. The NPPF also states that the planning system should deliver net gains for biodiversity where possible, and requires local planning authorities to encourage opportunities to incorporate biodiversity in and around developments.

2.4.2. In Wales, Planning Policy Wales (Edition 5, November 2012) sets out planning policies and is supported by a series of Technical Advice Notes (TANs) including TAN5 'Nature Conservation and Planning'. The presence of water voles is a material consideration in determining a planning application under these documents, as water voles are both a protected species (see Section 2.1 above) and a species of principal importance for the conservation of biodiversity in Wales (see Section 2.3). In addition, TAN5 includes the key principle that developments should deliver a net gain for biodiversity.

2.4.3. In Scotland, Scottish Planning Policy (June 2014) sets out key principles of planning policy, including the conservation and enhancement of protected sites and species, and the need to seek biodiversity benefits from new developments where possible. It states that the 'presence (or potential presence) of a legally protected species is an important consideration in decisions on planning applications. If there is evidence to suggest that a protected species is present on site or may be affected by a proposed development, steps must be taken to establish their presence.'

2.4.4. Local planning policies will also need to be considered in determining planning applications for development. This will normally require proposed developments to avoid or mitigate possible impacts on water voles.

2.5. Biodiversity Action Plans (BAPs) and the Post-2010 Biodiversity Framework – UK

2.5.1. The UK Biodiversity Action Plan was published in 1994, and included water voles as a 'Priority Species'. The UK BAP has now been succeeded by the UK Post-2010 Biodiversity Framework (July 2012) and biodiversity conservation work is now generally focussed on the individual countries and their species of principal importance for the conservation of biodiversity (see Section 2.3). Water voles are therefore considered a national priority for conservation in England, Scotland and Wales. They are also identified as regional or local priorities for conservation in BAPs produced at relevant geographical levels.

2.5.2. Water voles are also included as priority species for conservation in BAPs produced by water companies and government departments, such as Highways England.

3. Survey

3.1. Survey design

3.1.1. Water vole surveys need to be designed to determine whether water voles are present and could be affected by a proposed development. This requires a field survey (see Section 3.3), although a desk study will often also be useful in providing historical and contextual information (see Section 3.2). The absence of water voles can only be assumed on the basis of lack of evidence from field survey(s) undertaken at the appropriate time of year and not through a desk study alone. For small sites, where a field survey undertaken at an appropriate time of year confirms the likely absence of water voles, a detailed desk study may not be required.

3.1.2. Where water voles are present, additional information may be required to assess the significance of the effects on the water vole population, and to design appropriate mitigation. For example, data on the relative size and extent of the population affected and the distribution and status of water voles in the surrounding area are likely to be needed. In most cases this will require data to be collected through both field survey and desk study.

3.1.3. In some parts of the UK, where county-wide water vole surveys have been undertaken, a desk study may provide high quality information on the presence of water voles in the wider area surrounding a site. In other parts of the UK such data may not have been collected. In these areas, a desk-based habitat assessment of the wider area combined with spot checks for evidence of water voles may be a more appropriate means of gathering information on the likely presence of water voles in the wider area.

3.1.4. Examples of appropriate survey designs for different project types and different scales of impact are provided in Box 1.

Box 1: Survey design

The appropriate approach to collecting baseline data will vary in different circumstances and surveys need to be designed accordingly. The approaches recommended below are illustrative only and are not intended to form a specific requirement in each case. The distances quoted in terms of scale of impact and survey area/distance are also illustrative and are based on average home range sizes and dispersal distances.

Type of works	Example project	To confirm presence or likely absence of water voles	Additional information (if water voles present)
Very small-scale works affecting up to 15m of watercourse	Construction of an outfall, bridge repair works, or installation of pipes up to 15m long within narrow field drains (where these do not form part of a larger development)	Field survey – footprint of the works, including temporary work areas, plus 100m upstream and downstream. A comprehensive desk study exercise will not necessarily be required.	Micro-mapping of the habitat and burrow locations to allow design to minimise impacts (where relevant). Further data may be needed to ensure that there is sufficient alternative habitat available to displace water voles into (see 4.6.23). This may be obtained through a desk study or a habitat assessment combined with 'spot checks' for water voles over a wider area (1–2km upstream and downstream of the works).
Works *temporarily* affecting up to 50m of watercourse	Pipeline crossing a watercourse	Field survey – footprint of the works, including temporary work areas, plus 200m upstream and downstream of the works. A comprehensive desk study exercise will not necessarily be required.	
Works *temporarily* affecting more than 50m of watercourse	Watercourse re-profiling or repair/re-instatement of bank stabilisation structures	Field survey – footprint of the works, including temporary work areas, plus at least 200m upstream and downstream of the works. For works affecting more than 500m of watercourse the study area should increase to 500m upstream and downstream of the works. A comprehensive desk study exercise will not necessarily be required, but would be advisable for works affecting ≥ 250m of watercourse.	Desk study – site and up to 2–5km around it (or a habitat assessment combined with 'spot checks' for water voles) to inform the approach to mitigation and the assessment of fragmentation effects. The study area should be proportionate to the length of habitat affected.
Works with *permanent* impacts affecting 15–50m of watercourse	Bankside revetment works	Field survey – footprint of the works, including temporary work areas, plus 100–200m upstream and downstream of the works (proportionate to the length of watercourse affected). Desk study – site and up to 2km around it (or a habitat assessment combined with 'spot checks' for water voles).	Sufficient information is likely to have been provided by the 'presence/likely absence' surveys.
Works with *permanent* impacts affecting more than 50m of watercourse	Bankside revetment works	Field survey – footprint of the works, including temporary work areas, plus 200–500m upstream and downstream of the works (proportionate to the likely fragmentation effects). Desk study – site and up to 2–5km around it, or a habitat assessment combined with 'spot checks' for water voles.	The study area for the desk study (or habitat assessment combined with 'spot checks' for water voles) may need to be increased to inform the approach to mitigation.
Works requiring *permanent* culverting of watercourses	Highway schemes or some residential/mixed-use developments		
Very large-scale works	Coastal re-alignment projects (where there are reasonable grounds to expect the presence of water voles)	Field survey – footprint of the works, including temporary work areas, plus approximately 1km around it. Desk study – site and up to 10km around it (or a habitat assessment combined with 'spot checks' for water voles).	

3.2. Desk study

3.2.1. Desk studies should include a search for existing records of water voles from the local Biodiversity Records Centre and/or other relevant organisations or informed individuals, such as the Environment Agency, local Wildlife Trust, local Mammal Group, landowner, or Local Authority ecologist. Reports from previous water vole surveys, undertaken either for development reasons or for strategic conservation purposes, may also be available from the local area.

3.2.2. Desk study information can be highly variable in terms of quality, and should therefore not be relied upon alone (i.e. without a field survey). In some parts of the UK, a desk study can provide reliable recent records of water voles (such as where a county-wide water vole survey has been undertaken), but in other areas the data may be much less reliable, due to the age of the record or the lack of corroboration.

3.2.3. A good desk study will also include a review of Ordnance Survey maps and aerial photographs of a site and the surrounding area to identify potentially suitable habitat and possible habitat links (although this cannot be used to conclude an absence of suitable habitat without a field visit).

3.2.4. The appropriate study area for the collection of desk study information will need to be determined on a case-by-case basis, dependent on the scale and nature of the impacts associated with the development, including any ancillary activities, such as watercourse engineering downstream of the site or sewer/drainage connections. Examples are provided in Box 1.

3.2.5. Desk studies can also provide useful contextual information that allows an assessment of the importance of a specific water vole colony or population, which is likely to be affected by a proposed development. This is needed to inform an ecological impact assessment (CIEEM, 2016) – it will be primarily based on the proportion of the county or district's water vole population that could be affected, but also include consideration of the strategic importance of the colony in maintaining the wider population. Such assessments therefore require county level data on water vole distribution, as well as records of water voles within a given radius of the site.

3.3. Field survey

3.3.1. Field surveys for water voles in the context of a development have two key elements:

- An assessment of the (relative) suitability of the habitat for water voles;
- A search for field signs indicating presence, or possible presence, of water voles.

Habitat assessment

3.3.2. An **initial habitat assessment** will normally be undertaken to determine the need for more detailed water vole surveys (often as part of a 'Preliminary Ecological Appraisal' (CIEEM, 2013a) or 'Extended Phase 1 Habitat Survey' (JNCC, 2010). Such an assessment needs to be undertaken by a suitably experienced surveyor walking the banks of the watercourse or waterbody to determine whether or not the feature supports the habitat preferences of water voles, specifically those listed below.

i. Dry areas above water level for nesting, either in burrows or above-ground woven nests. Need to consider:
   - Burrow entrances do not need to be above water level;
   - Bank profile – steep banks are preferred as water voles can excavate burrow systems that are more adaptable to changing water levels (note that water voles can use banks with very shallow profiles where water levels are stable);
   - Bank substrate – whether water voles can burrow into the banks (note that burrows can be formed behind stonework with suitably-sized gaps, behind sheet piling, where water voles can access the banks behind by either corrosion or by climbing the sheet piling or adjacent vegetation, and that water voles can also create burrows some distance back from the water's edge, where the substrate at the toe[2] of the bank is unsuitable (see Photograph 1));
   - Daily fluctuations in water level (such as on estuaries or the tidal reaches of rivers);
   - The availability of suitable above-ground nest sites, where there are no banks, or banks with a shallow profile, such as in extensive reed/sedge bed habitats or in tussocks within ponds.

ii. Herbaceous vegetation to provide food and cover. Water voles will generally favour areas with herbaceous vegetation on the banks and (ideally) in the channel. However, it should be noted that:
   - The level of cover provided by vegetation will vary depending on the season and how recently management work has been undertaken;
   - The level of cover required by water voles will vary, with water voles in urban or suburban areas, or intensively sheep-grazed uplands, surviving in habitat with very little cover;
   - Water voles will eat a wide variety of plant species (as well as amphibians, invertebrates and fish) and can survive in areas where there is a low diversity of species and a lack of lush emergent vegetation;
   - Water voles are very capable climbers and will forage up into a hedgerow understorey for fruits and shoots where a watercourse is present at its base; they can also exist at low densities in the banks of watercourses shaded by woodland.

iii. Water, as a means of escape from predators
   - Note that water voles will sometimes use very shallow watercourses that contain a few centimetres of water, and terrestrial populations have been recorded which are unconnected to wetland habitat.

In general, water voles require all three of these habitat 'preferences' in close proximity to each other, although there are circumstances where water voles survive in less favourable habitat (examples are provided in the list above). There are also clear exceptions in relation to terrestrial populations (see 3.3.27 and 3.3.28).

3.3.3. Where habitat capable of supporting water voles is present, it should be mapped and described (see Section 3.4). Whilst water voles need the features listed above to be in relatively close proximity to each other, they can move over short distances of up to several hundred metres.

[2] The toe of the bank is defined here as the area of the bank at, and immediately above, water level.

3.3.4. It is rarely possible to rule out the presence of water voles based on an initial habitat assessment alone. Water voles can be found in areas that may be assessed as being very poor habitat (see Photographs 2a and 2b, taken at the same site at different times of year). If the habitat is in any way suitable, even suboptimal, it should be searched for field signs as described below. Habitat Suitability Indices have been developed for water voles but are not, as yet, appropriate for use in determining the absence of water voles in the context of a development proposal.

Photographs showing apparently suboptimal habitats used by water voles

	**Photograph 1:** An upland watercourse in Northumberland supporting a water vole population. The water voles have excavated burrows in the earth banks and cross the stones at the bank edge to reach the water. © Derek Gow
	**Photograph 2a:** A branch of the River Churn in Cirencester, within an artificial block stone-lined channel. Photograph taken in late April, before in-channel vegetation has developed; there are few field signs of water voles visible at this time of year and the site appears to be 'poor' habitat for water voles. © Mike Dean

	**Photograph 2b:** The same site in July, when in-channel vegetation has developed; at this time of year there will be field signs of water voles present, and animals are often seen on rafts of vegetation. © Mike Dean

3.3.5. During a survey, the relative suitability of the habitat for water voles should be assessed based on the factors listed below. The habitat within the study area should be subdivided into sections where relative habitat suitability varies. Factors to consider are:

- Bank profile;
- Bank substrate, specifically its suitability for burrowing;
- Water depth;
- Likely frequency and height of water level changes, relative to bank height;
- Amount of shading from trees/shrubs;
- Bankside herbaceous vegetation type (tall tussocky grass, tall grasses/weeds, closely mown grass, etc.);
- Bankside herbaceous vegetation density;
- In-channel herbaceous vegetation type;
- In-channel herbaceous vegetation width (from toe of bank – the point at which the bank meets water level);
- In-channel herbaceous vegetation density;
- Percentage of the channel with in-channel herbaceous vegetation;
- Evidence of current or recent management, and the likely effects of management;
- Any other relevant factors.

3.3.6. This survey will inform the assessment of effects (where some areas of suitable habitat are affected, but others are retained), scheme design (e.g. locating watercourse crossings), and the appropriate approach to mitigation.

3.3.7. The survey should be undertaken during the breeding season, normally in parallel with a search for field signs (see below), and be updated during any subsequent field surveys.

Searching for field signs

3.3.8. Field signs of water voles are described in the *Water Vole Conservation Handbook* (Strachan *et al.*, 2011). The presence of water vole droppings is the only field sign that can be used reliably on its own. Experience is required to distinguish between feeding remains, burrows

and footprints of water voles and other species. However, a combination of these other signs in close proximity to each other is highly suggestive of water vole presence.

3.3.9. Any field signs identified should be mapped and described; the level of detail to which field signs should be mapped will depend on the scale and nature of the proposals (see Section 3.4). The presence of scats and footprints of key predators such as mink (but also cats and foxes) should also be recorded.

3.3.10. The best period to determine water vole presence is during the breeding season when latrines are regularly visited and marked (see 3.3.23 to 3.3.26). **Given that the suitability of habitat for water voles can change markedly over the course of the breeding season, affecting the distribution and apparent population size, two survey visits should be undertaken in most cases: one in the first half of the season (mid-April[3] to the end of June) and one in the second half of the season (July to September inclusive). These visits should be undertaken at least two months apart.** In some cases it may be possible to justify an assessment based on a single visit if a precautionary approach is followed (see Box 2 for further details).

3.3.11. Searches for water vole field signs need to be undertaken by a suitably experienced surveyor accessing the areas where field signs are likely to be present. This will vary between sites and habitat types, but for most lowland sites will comprise the strip of marginal vegetation at the toe of the watercourse's bank – extending at least 1m out into the water and at least 1m up the bank. In most cases, the most effective way of accessing this area will be by walking along the toe of the banks (on both sides) or by wading in the channel; in some cases a boat may be required. Islands or tussocks or marginal vegetation away from the bank, where present, will also need to be accessed to confirm the absence of water voles. In upland habitats with pebbled shorelines, water voles may occupy burrow systems in friable banks many metres back from the water (see Photograph 1). In Scotland they have been recorded occupying entirely terrestrial environments with no focal aquatic habitat and areas of extensive wet sedge/grassland.

3.3.12. Many watercourses or waterbodies will be challenging to survey. For this reason it is vital that the surveyors are experienced in determining the most appropriate approach to a survey, and in assessing which parts of a 'site' need to be accessed. All field staff should be aware that water voles can carry leptospirosis, and be familiar with its symptoms, pathways for transmission to humans, and the control measures required to prevent infection.

3.3.13. Watercourses with deep water or steep banks may be better surveyed by wading through the channel, or using a boat. In some cases artificial latrine sites can be used to aid the survey, formed from pieces of 'Cellotex' or other equivalent cavity wall insulation material which is buoyant, but which unlike polystyrene, does not break up into small balls (see Photograph -3). The rafts should be approximately 60cm × 30cm, positioned within vegetation at the toe of the bank at a density of one per 10m **and tethered in place**. Binoculars can assist the clear identification of water vole field signs in such cases. The platforms should be removed following the completion of the survey.

[3] This represents an average for the UK; for example, surveys may commence earlier in south-east England (mid-March), but should start later in Scotland (mid-May).

Box 2: Field sign surveys – one site visit or two?

The water vole is a mobile species that responds to habitat changes over the course of the breeding season: a single visit can therefore be insufficient to confirm likely absence in many cases. In addition, where water voles are present, survey data based on two visits will allow a more robust assessment of the impacts of the project, particularly where water voles use different parts of a site during different parts of the breeding season. This can also be important in determining the most appropriate approach to mitigation. These guidelines therefore recommend that two field survey visits are routinely undertaken. However, it is recognised that the second visit may not be required in some cases, and it may therefore be possible to make a case for an assessment based on one visit. Examples of scenarios where a single visit (before submitting a planning application) may be sufficient are as follows:

i) *Water vole presence is confirmed during the first survey visit*

A second visit may not be needed where the assessment of effects on water voles can be made on a precautionary basis (i.e. water voles are present throughout the site at the maximum density that the habitat could support), **and** the approach to mitigating incidental mortality (displacement, relocation by trapping, off-site translocation, etc.) can be determined from the first visit alone.

The assessment of the quality of the habitat, and therefore the likely maximum density of water voles, will need to consider changes to the habitat in different parts of the breeding season as a result of natural processes (e.g. changes to water level) and management activities. This can be a difficult assessment to make for many sites.

ii) *Water vole presence is not confirmed during the first survey visit*

A second visit may not be needed where the habitat is of very low suitability for water voles and there is a very low likelihood that water voles are present in the surrounding area – up to 2km from the area of the proposed works, or less where significant barriers to water vole dispersal are present.

The assessment of the suitability of the habitat will need to consider changes to the habitat in different parts of the breeding season as a result of natural processes and management activities. This can be a difficult assessment to make for many sites. It will be difficult to make a robust case for not undertaking a second survey where access to surrounding areas is limited or impossible.

A second visit may also not be needed where the assessment of effects on water voles can be made on a precautionary basis (as per point i above).

In all cases, a second visit would be advisable prior to commencing works.

Photograph 3: An artificial latrine site formed from a floating raft.
© Derek Gow

3.3.14. Surveyors should undertake and follow a site-specific risk assessment. This should include appropriate biosecurity measures, such as disinfecting boots and equipment following a survey, to minimise the risk of disease or non-native invasive species being transferred between sites.

3.3.15. In many cases a metre-by-metre search of the suitable habitat will be required to determine the absence of water voles. However, for relatively homogenous sites **where the presence of water voles has been determined**, estimates of latrine density can be made from recording field signs every 5m. This approach can be safer and it reduces the damage to bankside vegetation.

3.3.16. The numbers of latrines recorded by the survey will give an indication of **relative** population size, and can be helpful in identifying the most valuable parts of a site for water voles. The survey area can be subdivided into areas supporting water voles at 'high', 'medium' or 'low' density, which could be interpreted as follows:

Relative population density	**Approximate number of latrines per 100m of bankside habitat**	
	First half of survey season (mid-April to end of June)	**Second half of survey season (July to September)**
High	10 or more	20 or more
Medium	3–9	6–19
Low	≤ 2 (or none, but with other confirmatory field signs)	≤ 5 (or none, but with other confirmatory field signs)

3.3.17. It is not possible to make robust estimates of absolute numbers of animals from latrine counts. However, latrines provide relative indices of activity suitable for the purposes of assessing impacts or designing mitigation.

3.3.18. ‘Spot-check’ surveys for field signs of water voles may be used to collect data on distribution in the wider area surrounding a site (see Box 1). Such surveys may be helpful in situations where there are few desk study records or desk study data are considered unreliable. However, they will generally be limited by access availability and time, and the level of effort employed will need to be specified in each case.

3.3.19. Detailed examination of burrows, using a fibrescope for example, is not normally required and, in any case, does not yield reliable assessments of occupation/vacancy of a burrow by water voles. In addition, the use of a fibrescope may require a licence from the relevant SNCO because of the potential disturbance it could cause to water voles.

Study area

3.3.20. As for desk studies, the study area for field surveys will depend on: (i) the purpose of the survey (see 3.1.2 and 3.1.3); and (ii) the scale and nature of impacts associated with the development, including any ancillary activities. Examples are provided in Box 1.

3.3.21. In some cases, the survey will need to extend beyond the boundaries of the development site to account for all of the development activities. The study area should also extend beyond the development site where necessary to enable an accurate assessment of the impact of a specific project on linked colonies in the wider environment, and to allow appropriate avoidance and mitigation measures to be designed. This can be achieved either by surveying a sufficiently large study area from the outset, or by taking a phased approach, with the initial study area being widened if necessary, dependent on survey results.

3.3.22. Water voles can exist as a dispersed meta-population, with individual sites at the periphery showing water voles present in some years and absent in others as sites are colonised, abandoned and recolonised, depending on chance extinction events and local population fluctuations. If no evidence can be found at a site that supports good habitat, but water voles are known to be present in the surrounding area, it may be appropriate to anticipate the possibility of the site being colonised by water voles at a future date prior to construction.

Timing

3.3.23. The optimum period for undertaking water vole surveys is during the water vole’s breeding season, when field signs are more evident; for most of the UK this is considered to be mid-April to the end of September. However, there is some seasonal variation, based on latitude and altitude:

- In south-east England the season is longer – March to October (or even longer during periods of good, stable weather);
- In lowland Scotland or upland England and Wales, it will be appropriate to survey over a shorter period – mid-May to mid-September.
- In upland Scotland, the optimum months for water vole surveys are June, July and August.

3.3.24. It is possible to undertake habitat assessments outside of these periods, although consideration will need to be given to how the habitat might change during the course of the year. Field sign surveys outside of the periods described above should be avoided; the presence of water voles can be identified out of season, but absence of water voles cannot be confirmed, and the extent and relative size of a water vole population cannot be estimated robustly.

3.3.25. The likely absence of water voles from a site should not be concluded unless two survey visits have been completed at appropriate times of year (as above) except in circumstances as outlined in Box 2. **It is not possible to confirm (likely) absence of water voles based on absence of field signs outside of the periods described in 3.3.23.**

3.3.26. Field sign surveys should be timed to avoid periods of high rainfall and/or high water levels, as these can wash away field signs. Surveys should also be timed to avoid being undertaken immediately following habitat management activities, as water vole field signs are likely to be less visible until the vegetation has become re-established.

Terrestrial water voles

3.3.27. The terrestrial habit of water voles is well documented across parts of mainland Europe, but it has also been recorded at a number of sites in Britain, including the small islands in the Sound of Jura, western Scotland around Ullapool, parts of urban Glasgow (see Photograph 4), in Newcastle-upon-Tyne, and on Reeds Island in the Humber Estuary. Typically, these animals live in friable soils amongst grass tussocks and tall ruderal plants (coarse grassland) that provide food and cover. They can inhabit environments where this cover is very patchy. It is not yet known how far they will migrate through unsuitable environments to access unrelated mates or identify suitable unoccupied territories.

3.3.28. Burrows in terrestrial habitats may be detected by the molehill-like spoil heaps, with a plug containing woven vegetation and droppings in the centre of the burrow (see Photograph 5). Although obvious spoil heaps are not always present, the ground can feel spongy as a result of the extensive burrow systems. Runs between grass tussocks may be marked with large latrines that help confirm the species, and latrines may also be found below items such as boards or metal sheets. It is possible that water voles exhibiting terrestrial behaviour are overlooked at other sites.

Photograph 4: Terrestrial habitat used by water voles in Scotland.

© Derek Gow

Photograph 5: Burrow entrance used by terrestrial water vole, plugged with droppings and woven grass.

© Derek Gow

3.4. Presentation of survey results

3.4.1. Water vole survey results can be presented in a stand-alone report or incorporated into a wider ecological impact assessment report for the proposed development.

3.4.2. The following information should be provided:

- Sources of desk study information;
- Study area for desk study;
- Study area for field survey (with reference to a suitably annotated map);
- Dates of field surveys and desk study;
- Name and experience of field surveyor;
- General description of prevailing weather conditions and/or water levels at the time of the field survey;
- Approach undertaken for the field survey, and an explanation of why this was considered to be appropriate (e.g. walking along top of bank, wading in channel, use of a boat, etc.);
- Any limitations to collecting survey information;
- Description of survey results, identifying information derived from desk study, habitat assessment and field sign search (with reference to a suitably annotated map);
- The study area should be subdivided into sections based on the suitability of the habitat and the approximate relative density of the population (see 3.3.16) – both should be clearly stated. The level of detail needed in presenting the results will, to some extent, be dependent on the nature of the development and likely scale of effects.

4. Impact Assessment and Mitigation

4.1. Potential impacts of development on water voles

4.1.1. The following should be assessed:

- **Habitat loss and deterioration**
  The quantity and quality of habitat lost (or altered) as a result of a development must be clearly stated, along with the timescale for which the loss will be experienced (e.g. until restoration for temporary losses). The implications for the local water vole population must be assessed. It should be made clear whether burrows will be lost or otherwise affected. Habitat quality should be assessed on the basis of the relative density of water vole latrines (see 3.3.16), as well as suitability factors described in 3.3.2 and 3.3.5.

- **Fragmentation**
  Dependent on the location, extent and timescales of any habitat loss, there may be a fragmentation effect that also needs to be assessed.

  Certain development types, such as highway schemes or large-scale housing developments, may result in the construction of culverts which can have a barrier effect and cause permanent fragmentation. The implications of such fragmentation, in addition to habitat losses, must be assessed.

- **Incidental mortality during site clearance or construction**
  Operations affecting habitat suitable for water voles have the potential to kill (or injure) water voles. The likelihood of this occurring should be determined based on presence of identifiable burrows, and/or a combination of the relative density of water vole latrines (see 3.3.16) and the suitability factors described in 3.3.2 and 3.3.5.

4.1.2. In addition, the effects of the following impacts may need to be assessed, depending on the nature of the development:

- **Damage to burrows**
  In most cases, damage to water vole burrows will have been considered under 'habitat loss and deterioration', above. However, in some cases, such as for operations adjacent to wetland habitat that involve significant vibration, it may be appropriate to assess the likelihood of damage to burrows, and therefore also incidental mortality.

- **Introduction of domestic predators**
  Residential developments may result in an increase in the numbers of cats present within a given area; the effect of this on the local water vole population will need to be assessed.

- **Management**
  Changed management (e.g. increased frequency of mowing of banks or dredging of watercourses) can significantly degrade the habitat for water voles. Opportunities to deliver a beneficial effect through appropriate management should be sought.

- **Pollution**
  Although water voles are known to survive in watercourses with very poor water quality, the pollution of wetland habitat could have a significant effect through degradation of the habitat; it will be necessary for this potential impact to be mitigated through good drainage design and construction working practices, and is therefore not discussed in detail in this document.

- **Water level**
  Altered water levels may result from new water level control structures or from changes to the surrounding hydrology (e.g. drainage). This could lead to flooding of burrows or to the drying-out of a standing waterbody.

4.1.3. Noise and visual disturbance are, in most cases, unlikely to have a significant effect on water voles. However, it should be noted that the disturbance of water voles occupying a place of shelter or protection is an offence under the Wildlife and Countryside Act 1981 (as amended); operations with the potential to disturb a water vole to the point where it abandons its burrow, should therefore be considered as part of any impact assessment.

4.1.4. The impacts of developments on terrestrial populations of water voles are not well understood. In situations where terrestrial populations may be affected the principles set out in this guidance document relating to impact assessment and mitigation should be followed, although site-specific advice should also be sought from the relevant SNCO.

4.2. Why mitigate?

4.2.1. Mitigation measures are those taken to avoid or reduce an impact. There are two main reasons why it might be necessary to employ mitigation measures:

- To ensure compliance with the legislative protection afforded to water voles and the requirements of licensing, where these apply; and
- To avoid, reduce (or offset) impacts that would otherwise give rise to a significant effect, and therefore be contrary to:
  i) Planning policy and/or
  ii) The 'Biodiversity Duty' of the NERC Act/Nature Conservation (Scotland) Act.

  The latter will be relevant to many 'permitted developments' which are not covered by planning policy.

4.2.2. In many cases, the mitigation measures required will be aimed at ensuring legislative compliance *and* at avoiding, reducing or offsetting effects that would otherwise be significant.

4.2.3. The Chartered Institute of Ecology and Environmental Management (CIEEM) have published guidelines on ecological impact assessment, which define a 'significant effect' as one which supports or undermines nature conservation objectives; in the case of a species population, changes to its conservation status would be considered to be a significant effect (CIEEM, 2016).

4.3. Avoiding/minimising effects – considerations at the design stage

4.3.1. The options to avoid impacts on water voles should be considered at the design stage. For example:

- Retaining watercourses/wetland habitats in their current locations as part of a development;
- Protecting a buffer zone around a watercourse/wetland habitat to ensure that burrows are not affected (the size of the buffer zone will be dependent on the nature of the works and the likely extent of burrows, but is likely to be in the region of 3–5m from toe[4] of bank);
- Incorporating suitable habitat for water voles (new or existing) into Sustainable Drainage Schemes;
- Avoiding the need to culvert watercourses;
- Use of existing bridge structures to avoid the need to construct new bridges;
- Locating a pipeline watercourse crossing or new bridge to avoid the water vole population;
- Installing pipelines or services using 'no-dig' or 'trenchless' methods, such as directional drilling;
- Use of clear-span bridges that retain river banks underneath.

4.3.2. Where impacts cannot be avoided entirely, the options to minimise the impacts should be considered. For example, where a development cannot be relocated to avoid a water vole population, consideration should be given to avoiding the regions of highest density. It should be noted that habitat linkages may be required to ensure that sufficient habitat is available to support a viable population.

4.3.3. Appropriate timing of development activities can also aid in minimising the effects. For example, works affecting areas used by water voles only at certain times of year, or during certain conditions, can be timed to avoid those periods. For example, some watercourses/waterbodies may always dry out in late summer, with the water voles moving into other habitat when this occurs. Conversely, the habitat at the periphery of a water vole population may not be occupied by water voles in spring, when populations are at their lowest.

4.3.4. Standard good working practices to avoid damage to the banks of watercourses or wetland habitat during construction, or pollution events, should always be employed. These should be set out in a Construction Environment Management Plan (CEMP), or similar document.

4.4. Mitigating habitat loss

4.4.1. Habitat loss will need to be mitigated or offset by the creation of new habitat, or the improvement of existing habitat for water voles. The area and quality of habitat created should be at least equivalent to that lost and ideally greater (a net gain in terms of habitat available to the water vole population is likely to be a requirement where works are carried out under licence). In most cases, the losses and gains will be measured in terms of the length of bankside habitat, although the quality of the habitat being lost/gained should also be accounted for. Relatively long lengths of bankside habitat can be provided in small areas, by creating a network of channels, or ponds with islands.

[4] The toe of the bank is defined here as the area of the bank at, and immediately above, water level.

4.4.2. Where the new habitat is to act as a receptor site for relocated water voles, it will need to be sufficiently large to support the maximum number of animals that could be captured (see 4.6.8) and allow for their expansion within the timeframes of the project.

4.4.3. Temporary losses of habitat should also be mitigated, where the loss could have a significant effect on the ability of the population to breed successfully. This will need to be assessed on a case-by-case basis, but will be particularly appropriate for works taking place over a period of more than 1 month and over lengths of greater than 100m of watercourse.

4.4.4. The design of new habitat for water voles will need to take account of the factors discussed in 3.3.2 above. In most cases this will mean:

- Ensuring that the watercourse/wetland area contains water throughout the year. Watercourses should ideally be designed with a slow, stable flow rate;
- Creating banks using a substrate which is suitable for burrowing and not liable to collapse;
- Providing a suitable bank profile, which allows water voles to access the water easily and create a network of burrows above high water level – this will require steep banks (such as a gradient approaching 1 in 1, where bank stability allows) which extend above flood levels (1 in 100 year flood).[5] At least one bank of a watercourse should be designed with a steep bank; the opposite bank can be designed with a shallower profile, which will encourage the development of marginal vegetation;
- Establishing suitable bankside and marginal vegetation using a range of native herbaceous species to provide both food and cover throughout the year. There is a range of methods possible for the establishment of vegetation, which have varying establishment times (see below);
- The establishment of herbaceous vegetation on the face of the bank and up to 2m back from the bank top, and the establishment of marginal or in-channel vegetation (ideally, covering at least 20% of the surface area of the wetted channel, or as wide a marginal fringe as possible for standing waterbodies).

4.4.5. Bankside vegetation can be established through seeding using a seed mix appropriate for the production of a tussocky, species-rich sward. Alternatively, turves can be translocated to reduce the establishment time. Where turves are to be translocated, it can be advantageous to lay some of the turves so that they overlap and create hummocks and refuge sites that water voles can exploit.

4.4.6. Marginal vegetation can be established by plug planting at suitable intervals, or through the translocation of existing suitable vegetation on site. This can help to reduce the establishment time. A planting shelf immediately below normal water levels can help to ensure a fringe of marginal vegetation. Pre-planted coir fibre rolls can also be used to reduce the establishment time, and to provide support at the toe of the bank, although they are often less effective at establishing vegetation than the translocation of existing material. It will be necessary to ensure that any vegetation to be translocated is taken from areas where water voles are absent, and that are devoid of non-native and/or invasive plants.

4.4.7. Photographs 6a and 6b show a receptor site at different stages of development, following the planting and translocation of marginal vegetation, translocation of turves and the seeding of part of the banks. Photographs 7a and 7b also show a receptor site at different stages of development. In this case the initially excavated site (Photograph 7a) had

[5] Steep banks are important for water voles particularly for flowing watercourses (to allow an inter-connected burrow system to be constructed with entrances close to water level, which can adapt to changing water levels) and where the adjacent land is used for grazing livestock (as it reduces the trampling of the banks).

insufficient cover and a very hard bank substrate; topsoil recovery and translocation of existing vegetation from elsewhere on site was required (Photograph 7b).

4.4.8. There may be other opportunities available on site to establish a receptor site. For example, dry areas of wetland vegetation adjacent to a watercourse can be re-wetted by cutting narrow channels through it if groundwater levels are sufficiently high, allowing the existing vegetation to be retained intact.

4.4.9. It will be important to consider the location of any new habitat to ensure that it can be easily found and colonised by water voles, and to avoid any possible fragmentation effects of the development.

4.4.10. The timing of seeding, planting and vegetation translocation need be carefully considered to maximise the likelihood that the new vegetation becomes established. Where the new habitat is to act as a receptor site for translocated water voles, the vegetation will also need to have become sufficiently well established to receive water voles. This is likely to require an entire growing season. It may be possible to create sufficiently well-established habitat over a shorter period of time, although this will require considerable expertise and the translocation of vegetation with its own rootstock, rather than seeding or plug planting, or the use of pre-planted coir fibre rolls or pallets.

4.4.11. New habitat provided for water voles will need to be managed to ensure that it remains suitable, in the long term. A management plan should be provided as part of any planning application, or be required by planning condition. Details of appropriate management for water voles are provided in the *Water Vole Conservation Handbook* (Strachan *et al.*, 2011).

4.4.12. It may be appropriate to provide suitable protection for new planting, particularly to prevent grazing or poaching by livestock or grazing by wildfowl. Appropriate fencing will be required in either case. Measures to control invasive species including non-native species such as Himalayan balsam (*Impatiens glandulifera*) and native species such as *Typha latifolia* (known as bulrush or reedmace) may also be required, where these could degrade the value of new habitat for water voles. This may need to be achieved through pulling or digging out invasive species, although care will be required to ensure that this does not damage water vole burrows.

Photograph 6a:
Receptor site *not* sufficiently established to receive water voles.

Bankside vegetation has not become established; there is insufficient cover for water voles.

In-channel/marginal vegetation is too sparse – the translocated plants provide some food and cover, but it is insufficient and any released animals would be exposed to too great a risk of predation.

© Mike Dean

Photograph 6b:
Receptor site is ready to receive water voles.

Bankside vegetation has become well established; a good sward of grass provides sufficient cover.

A continuous fringe of in-channel/marginal vegetation has become established providing plenty of food and cover for water voles.

A soft-release pen is shown in the photograph (see Appendix 4 for further details).

Islands have been created (left bank) as a refuge from cat predation.

© Mike Dean

4.5. Mitigating fragmentation

4.5.1. Where watercourses are to be in-filled or culverted, new links between isolated areas of suitable habitat should be created.

4.5.2. Water voles are known to use culverts under roads of certain types and sizes, but it is not known which culvert design and size works best, nor which will not be used at all by water voles. The following types/lengths of culverts are known to be effective in allowing the movement of water voles, based on the authors' personal observations:

i. Over-sized box culverts up to 30–35m in length, with ≥ 1m of headroom above normal water levels;
   - Water voles have been shown to colonise a new section of watercourse 'isolated' from the existing water vole population by two culverts of this type and size;
   - Ledges immediately above water level on either side of the channel within the culvert are likely to be used by water voles, particularly where these are formed from earth/silt. However, it is unclear whether these are necessary to allow water voles to use the structure;

ii. Circular culverts of 1200mm diameter, up to 10m in length, with ≥ 300mm of headroom above normal water levels;

4.5.3. It is not known whether or not water voles will use dry pipes positioned away from the watercourse (such as provided for otters or badgers in association with a new road).

4.6. Avoiding incidental mortality during site clearance/construction

4.6.1. The main techniques that have been used to avoid the incidental mortality of water voles during site clearance or construction are: (i) displacement; and (ii) relocation by trapping. There are advantages and disadvantages to both techniques, and constraints on when each can be used, as described below. There is uncertainty over the effectiveness of 'displacement' in different circumstances. Both techniques need to be undertaken under licence. In England and Wales the licence will be issued for the purpose of conservation: the project will therefore need to deliver a benefit for water voles (see 2.1.3).

4.6.2. In all cases, the mitigation operation will need to consider the potential impacts on other protected species. For example, vegetation strimming as part of a displacement exercise should only be undertaken following confirmation that nesting birds are absent from the area of the works.

Relocation by trapping

4.6.3. **Relocation by trapping** is the capture of water voles from a development site and their release into a suitable receptor site away from the works. Trapping of water voles can only be undertaken by a suitably licensed and experienced person. **Further details of the appropriate protocol for trapping water voles are provided in Appendix 2**.

4.6.4. Where water voles are to be relocated by trapping, the following guidance applies:

- **Receptor site/holding facility**
  Ideally, a suitably large and well-developed receptor site must be available at the time of the trapping, so that captured animals can be released immediately (see below). If this is not available, a suitably equipped holding facility, preferably on-site, will need to be available (see Appendices 3 and 4).

- **Scale of impact**
  Water voles should not be relocated by trapping from small areas of affected habitat (up to 50m length of watercourse), where there is suitable adjacent habitat, without the use of exclusion fencing. Trapping in such circumstances is otherwise likely to cause a 'sink' effect, leading to more animals being captured than is necessary. The installation of exclusion fencing can cause damage to a significant proportion of the affected area in such circumstances. Therefore, consideration should be given to using the displacement technique (see 4.6.17 to 4.6.26) instead.

- **Licence**
  The relocation of water voles by trapping can only be undertaken under a site-specific licence issued by the relevant SNCO (see Section 2).

- **Time of year**
  Relocation of water voles by trapping should ideally be undertaken between 1st March and 15th April inclusive in most parts of the UK (it may be appropriate to commence trapping around mid-February in south-east England, or mid-March in Scotland).

  In lowland habitats in England and Wales, water voles can be trapped in autumn (15th September to 30th November inclusive) as a last resort. However, given their high levels of winter mortality, and the fact that they store food for autumn in burrow systems, it is not recommended to release animals at this time of year. Autumn trapping is therefore significantly less preferable to relocating water voles during spring, as it is likely to require the animals to be over-wintered in captivity, and should only be undertaken as a last resort. Licence applications for projects where it is proposed to trap water voles in autumn rather than spring will need to be supported by an appropriate justification for this approach.

  The timing of autumn trapping operations in Scotland, or in upland habitats in England and Wales, will need to be determined on known information about the breeding season in that specific location.

  No trapping should take place during the peak part of the breeding season (16th April to 14th September) except in very exceptional circumstances, as there is a very high likelihood that females with dependent young will be captured, leading to the death of juvenile animals; it is not possible to determine accurately whether females have dependent young based on visible signs of lactation.

  Also, trapping of water voles during the breeding season can have a significant impact on the reproductive success of the colony, and can therefore lead to the loss of colonies in certain circumstances.

  No trapping should take place during the winter months when water voles are less active and trapping is unlikely to be effective (1st December to the end of February in most parts of the UK).

The timing of the spring window for trapping can give rise to practical difficulties, where the vegetation within the receptor site has not established sufficiently well for water voles to be released into it. In such circumstances consideration should be given to delaying the relocation operation (where possible). Where this is not possible, the following protocols are suggested:

i. Trap the animals before 15th April and take them into captivity until the vegetation has matured sufficiently to allow them to be released; OR

ii. Trap the animals before 15th April and hold them in 'complete cages' within the release site as an 'on-site holding facility' (see Appendix 4). The cages must be positioned in an entirely secure location where they cannot be removed or interfered with by predators or people.

Unless the receptor site supported well-established habitats in September of the previous year it is unlikely to be suitable by March/April.

4.6.5. In certain development scenarios, it may be appropriate to use a combination of relocation by displacement and relocation by trapping. For example, in a phased development, water voles may be displaced from a small area, such as that needed for site access, in advance of the main works that will affect large areas of habitat used by water voles. However, it will be important to ensure that these operations do not conflict with each other, or subject water voles to increased risks overall.

Receptor sites

4.6.6. **Receptor sites** should, ideally, be located on-site. However, consideration of their location should take account of the long-term survival prospects of a given population. Translocation of water voles to off-site receptor sites can be appropriate where an on-site receptor site would result in a population being fragmented and unviable. Such off-site relocation should remain within the same river catchment wherever possible. Off-site translocations can be effective for sites with a guaranteed stability of use, where extensive habitats are available for population expansion, willing partner organisations exist and effective mink control can be secured in the long term.

4.6.7. A lead-in time for the creation of receptor sites is likely to be at least 9–15 months (dependent on the time of year when the works commence and methods used to establish the habitat (see Section 4.4 above)), but can take longer to establish in some cases. The vegetation within the receptor site must be established with friable soils to allow burrowing, and complete bankside cover and dense marginal vegetation before water voles can be released into it. Further details of habitat creation methods for water voles are provided in Section 4.4.

Photograph 7a: Proposed receptor site which was *not* well established and unlikely to become suitable to receive water voles without major habitat improvements.

Bankside vegetation has not become established and so there is insufficient cover for water voles. The banks are hard and therefore difficult for water voles to burrow into.

© Derek Gow

Photograph 7b: Topsoil has been added to the banks to improve the profile and provide a suitable substrate for water vole burrows. Bankside and marginal vegetation has been translocated with its soil and root systems.

A wide fringe of marginal vegetation has become established providing plenty of food and cover.

© Derek Gow

4.6.8. Receptor sites will need to be sufficiently large to support the maximum number of animals that could be captured and must cater for their future expansion (i.e. until fencing around the receptor site is removed). The receptor site should therefore provide at least the same quantity of habitat as the area from which water voles are to be trapped. Where there is a risk of ingress of water voles into the trapping area from retained adjacent habitat (i.e. where the entire population is not being affected), the receptor site should be between 50% and 100% larger than the area affected, dependent on the likely risk.

4.6.9. **A soft-release technique, as described in Appendix 4 should be used**. Ideally, water voles will be released into receptor sites immediately following capture, avoiding the need to take animals into captivity even for short periods.

4.6.10. Receptor sites will need to be managed to ensure that they continue to provide suitable habitat for water voles throughout the period of the relocation and in the longer term (for permanent receptor sites). This may need to include mink control measures in certain locations, at least until the colony within the receptor site has become established (on-site receptor sites) and in the long term (off-site receptor sites), where there is a constant threat to the population. Receptor sites should also be managed as suitable habitat for water voles in the long term (especially if they are off-setting loss of habitat as a result of a development).

4.6.11. Trapping can be considered to be complete once there has been a period of 5 days or more (when the temperature has not dropped below freezing (0^{o}C) overnight) with no further captures, and no field signs within the capture site. Once completed, a destructive search of the area should be undertaken (see Appendix 1; parts vi and vii of the displacement protocol).

Translocations/holding animals in captivity

4.6.12. In some cases it may be appropriate for water voles to be translocated to an off-site receptor area, or taken into captivity for breeding, and their offspring released at a re-introduction site. This approach is most likely to be justified where there is no possible option for an on-site receptor area, or where large-scale developments will remove significant areas of suitable habitat or isolate any remaining animals from the rest of the population, such as coastal realignment projects.

4.6.13. There are a number of requirements associated with this approach:

i. The impact of the removal of a water vole colony and associated habitat from a site on the wider population will need to be assessed (e.g. loss of a stepping stone could isolate other populations and make them less resilient). Ideally, water voles will be allowed to recolonise the site from adjacent areas post-construction;

ii. Ownership and/or permission for the use of the receptor site must be established prior to planning consent being granted;

iii. Where animals are to form part of a re-introduction programme, the location of the re-introduction site must be established and the funding for the project secured before the project commences; animals should not be taken into captivity to build up a stock for an undefined future re-introduction proposal; in Scotland the process must comply with the Scottish Code for Conservation Translocations (National Species Reintroduction Forum, 2014);

iv. Long-term management must be secured, and a management plan be provided (or required by planning condition);

v. Ideally, off-site receptor sites will be in areas where water voles are absent, but that are linked to existing water vole colonies. The reasons for the absence of water voles from the receptor site will need to be established and remedied if necessary. In practice, finding suitable sites that are not already occupied by water voles can be extremely difficult;

vi. The carrying capacity of the receptor site will need to be assessed, by considering the habitat quality in relation to the expected water vole population density that it can support, based on information from comparable sites and published sources;

vii. The creation of isolated populations should be avoided. However, where the receptor site is relatively isolated from other known water vole populations, a

minimum viable population size of water voles will need to be released, with an appropriate sex and age structure (at least 100 individuals at peak breeding season, or 30–50 individuals at the beginning of the breeding season, occupying approximately 1.5–2km length of good quality habitat); further releases of unrelated water vole populations into the surrounding landscapes over time may also be appropriate where no other populations survive;

viii. No movement of Scottish animals to England or vice versa for release should be attempted, without genotypic evidence that the animals being moved are of the same origin as those present, or formerly present, in the release location. Movement of intermediate populations with range overlap zones such as North Wales, Cumbria or Northumberland should be agreed in advance with the relevant SNCOs, and may also require genotyping;

ix. Mink control will be required, and this will need to extend beyond the site itself. It should therefore ideally be part of a wider initiative;

x. There must still be a net conservation benefit for water voles.

4.6.14. In some cases health screening of water voles (see Appendix 6) will also be required. For example where there will be mixing of animals from different populations at a release site, or where animals are kept in captivity in locations where zoonotic transfer between water voles and other species is likely (such as zoos or rehabilitation centres).

Fencing

4.6.15. On-site receptor sites, or receptor sites in areas where water voles are present, will generally require water vole resistant fencing to prevent colonisation in advance of the relocation, and to prevent relocated animals from returning to their site of capture (see Photograph 8). However, it should be noted that this fence design is not guaranteed to exclude water voles. It should not be relied upon to exclude water voles over long periods of time (more than 2 months) where water voles remain in adjacent areas; the fence could be made higher, buried deeper and a more robust material used in such cases. Stock-proof fencing may be required to prevent livestock or horses damaging the water vole resistant fencing. See Appendix 5 for further details of fencing design.

4.6.16. It is almost impossible to install fencing across a flowing watercourse which is both effective in excluding water voles and which does not impede flow within the channel. Ideally, therefore, water vole receptor sites should be designed as ditches or ponds, which do not carry flowing water. Where it is necessary to fence across a flowing watercourse, flood defence consent is likely to be required. A possible design of fence for a watercourse crossing is provided in Appendix 5.

Photograph 8: Water vole resistant fencing.

© Mike Dean

Relocation by displacement

4.6.17. Displacement is the deliberate removal of the vegetation around the water vole burrow system (by strimming or turf stripping) with the aim of making the habitat unsuitable and therefore causing the water voles to relocate to adjacent unaffected habitat (see Photographs 9a and 9b). It may also include water draw-down to degrade the habitat further. The deliberate displacement of water voles needs to be undertaken under licence issued by the relevant SNCO. **Further details of the displacement technique are provided in Appendix 1.**

4.6.18. Concerns over the reliability and misuse of the displacement technique have led to the need for better clarity as to when it is appropriate and when it is not, and a clear recognition of the uncertainty of effect. In the absence of robust evidence of the effectiveness of this technique (see Box 3), its use is recommended in circumstances where expert judgement suggests it is most likely to work, and where relocating animals by trapping is likely to be disproportionately expensive. The guidance on displacement of water voles will need to be reviewed in the light of future research.

4.6.19. Three factors are considered likely to reduce the risk to the water voles and ensure that displacement is only used in appropriate circumstances: (i) scale; (ii) time of year; and (iii) availability of sufficient alternative habitat.

4.6.20. The appropriate scale for displacement is ≤ 50m (a length of up to 50m on each side of the same stretch of watercourse; note that whilst this equates to 100m of habitat it is not appropriate to attempt displacement from multiple shorter lengths to total 100m). For standing waterbodies, the appropriate scale of displacement is 50m of bank. Where water voles are present at high densities (e.g. where there is at least one latrine per 5m of watercourse bank) it would be appropriate to restrict use of the displacement technique to lengths of up to 30m. At this scale of work, only one or two animals are likely to be directly affected (based on a home range size of between 50m and 150m per breeding female, with an adult male's range overlapping). It is not recommended to try to displace water voles from lengths of more than 50m, given the uncertainty over its effectiveness and the risk it poses: water voles should be relocated by trapping in such circumstances.

4.6.21. It is **not** appropriate to attempt to displace water voles over longer distances by carrying out sequential displacement along consecutive 50m stretches. Water voles should be relocated by trapping in such circumstances.

4.6.22. For watercourses, vegetation strimming will generally be required on both banks, even if only one bank is affected by the works (unless the watercourse is sufficiently wide that the two banks are likely to be used by different individuals).

4.6.23. The recommended time of year for attempting displacement is spring, when the animals are already predisposed to move as they begin to establish breeding territories; this is defined as between 15th February and 15th April for most of England and Wales and 15th March to 30th April in Scotland, although there are variations to this for upland sites, for northern counties of England and for the south-east of England (see Appendix 1 for further details). During the breeding season it is likely that females are more sedentary due to the presence of young. Water voles are also more sedentary during winter, and less responsive to habitat changes. The effectiveness of displacement in autumn is unknown, but is considered less likely to be effective than spring displacement given the higher densities of animals at this time of year, and that breeding can continue until late in the season. In addition, water voles store food below ground during autumn, and displacement at this time of year could put animals at greater risk of winter mortality.

Photograph 9a: Section of watercourse before vegetation strimming has taken place.

© Mike Dean

Photograph 9b: After strimming had been undertaken. Banks have been strimmed to bare earth; in-channel vegetation has been cut; all arisings have been removed.

© Mike Dean

4.6.24. The availability of sufficient alternative habitat for displacement will need to be determined by an experienced ecologist on a case-by-case basis. Given the lack of evidence of the effectiveness of displacement it is impossible to provide a definitive assessment of what constitutes sufficient habitat. However, as a general guide:

- There is likely to be *sufficient* alternative habitat where:
    - the affected water voles form part of a large population in the wider area, without barriers to movement between them or long lengths of unsuitable habitat; and
    - the affected section of watercourse represents less than 1% of the habitat available to the population in the wider area (without barriers to movement).

  For example, where 50m will be affected, there would be at least 5km of suitable, well-connected habitat available.
- There is likely to be *insufficient* alternative habitat where:
    - the affected water voles form part of a discrete colony that is not well-linked to other colonies; and
    - the affected section represents more than 10% of the available habitat (e.g. where 50m will be affected within a constrained length of up to 500m of suitable habitat).
- In circumstances which fall between those described above, an assessment will need to be made based on a range of factors, including:
    - Connectivity of habitat;
    - Quantity of habitat affected as a proportion of that available;
    - Quality of habitat affected in comparison with that available;
    - Size of the water vole population.

4.6.25. In situations where water vole displacement is to be attempted at two separate locations on the same watercourse in the same year, these locations should ideally be at least 500m apart. This is a requirement of the use of Natural England's Class Licence for displacement. There are likely to be some development scenarios which involve small-scale impacts (< 50m) at more than one location on the same watercourse, and within 500m of each other, such as where two or more outfalls need to be constructed to drain surface water run-off from a development site. Displacement of water voles may still be considered to be the most appropriate technique to relocate water voles, although detailed consideration will need to be given to the length of habitat affected, the proximity of affected lengths to each other, and the proportion of available habitat affected (see 4.6.24). A site-specific licence is likely to be required in all such cases (including in England).

4.6.26. As water voles show high burrow fidelity, there is always a chance that they will remain in their burrows despite reasonable effort to displace them through habitat removal. Therefore the displacement technique should always include a 'destructive search' (see Appendix 1) unless there are exceptional circumstances which prevent a destructive search being undertaken, or allow only certain elements of a destructive search. Any such circumstances should be made clear in the licence application (or reported to Natural England, with appropriate justification in the case of works carried out under a Class Licence).

4.6.27. It is unlikely to be appropriate to install fencing as part of a displacement operation except to prevent water voles returning to a site from which they have been displaced and where the habitat cannot be fully destroyed for a prolonged period of time (although this situation should be avoided if at all possible).

4.6.28. Given that water voles are a prey species for many predators, mitigation techniques which seek to exclude them from their burrow systems by preventing re-access by meshing banks or other blocking techniques are inappropriate.

Box 3: Is displacement an effective means of relocating water voles?

The few available published studies and anecdotal reports on water vole displacement do not allow a robust assessment of the effectiveness of the technique, due to a lack of consistent study design, insufficient sample sizes and difficulties in determining 'success'.

Displacement by strimming alone does not work in all cases (see Dean, 2003 and Markwell, 2008). It *may* be effective in certain circumstances and, if so, these are *likely* to relate to a range of factors, possibly including the length of watercourse affected, time of year, the availability of space for the animals to move into, habitat type, and how thoroughly strimming is carried out. Given the different scenarios in which it has been attempted, and the difficulty in demonstrating success (see below), there is no clear indication of exactly when, if ever, the approach is successful.

In some cases water draw-down has been used to attempt the displacement of water voles in combination with vegetation strimming. This technique has been used on a large scale, where it reduced the likelihood that animals remained in the area of the works, in comparison with vegetation strimming alone (see Markwell, 2008). Of 30 animals captured and marked prior to water draw-down and strimming in that study, 9 (30%) successfully relocated, 2 (7%) did not move and needed to be trapped out (1 of which returned to the affected area), 2 (7%) died prior to mitigation commencing, 1 (3%) was presumed predated, and the fate of the remaining 16 (53%) was unknown. It is therefore unclear what proportion of the animals had relocated and what proportion have been predated.

It is difficult to determine whether displacement has been successful or not. Water voles exhibit high burrow fidelity (Dean, 2003; Gow, *et al.*, 2012). This exposes them to a high predation risk if they remain following vegetation strimming and/or water draw-down. Determining whether the absence of water voles from the area of the works post-displacement is due to successful relocation or to predation is beyond the scope of most monitoring projects (as it would require a capture-mark-recapture study, or radio collaring of individuals). It has also been shown that water voles will continue to occupy burrows in a strimmed bank and leave no field signs of their presence (Dean, 2003), demonstrating that field sign surveys are not an effective means of confirming success.

Further research is needed to determine:

- Whether the technique is effective in relocating water voles;
- Which factors, if any, are linked with success (e.g. length of watercourse affected, or time of year);
- Whether water draw-down is a more effective means of relocating water voles.

4.7. Mitigating introduction of domestic predators

4.7.1. There are few options for mitigating the effect of increased cat predation on water vole populations as a result of housing developments. Restricted covenants which prevent new homeowners from owning cats have been proposed as a mitigation measure in some situations, although these are generally considered to be unenforceable and therefore not an appropriate mitigation measure. The following should be considered, but are unlikely to eliminate the impact completely:

i. Where new on-site habitat for water voles is created, this should be designed to reduce cat predation as far as possible by:
   - Constructing large islands within ponds (see Photograph 6b);
   - Providing wide fringes of dense marginal vegetation at the toe of the banks.

ii. New and existing habitat should be managed in a way which reduces cat predation as far as possible by:
   - Maintaining wide fringes of marginal vegetation at the toe of the banks;
   - Ensuring that bankside vegetation is cut infrequently (once every 2 years) and on a rotation which ensures that at least half of the habitat is retained intact each year (i.e. only cut 50% each year).

4.7.2. Brown rats (*Rattus norvegicus*) may also predate water voles or compete with them, and the 'urbanisation' of a watercourse may result in increased numbers of brown rats. Water voles are known to co-exist with rats, which makes it difficult to determine the likely significance of this impact or to mitigate for it. However, consideration will also need to be given to the potential for rat control measures associated with a new development to result in non-target poisoning.

4.8. Sensitive management

4.8.1. Details of the appropriate timing, methods and intensity of management of wetland habitat for water voles are provided in the *Water Vole Conservation Handbook*.

4.9. Writing mitigation strategies

4.9.1. Mitigation strategies for water voles will detail the measures required to avoid or reduce any impacts that would otherwise give rise to a significant effect; and ensure compliance with legislation (and accounting for the interpretation of the legislation).

4.9.2. Mitigation strategies should include:

i. Details of the amount and quality of habitat being lost and gained, along with:
   - A plan showing the location of habitat creation relative to other retained wetland habitat and the habitat being lost;
   - A programme for habitat creation;
   - Methods for establishment of vegetation (seeding, plug planting, turf translocation, etc.);
   - Lists and percentages of species to be planted or seeded;
   - Details of bank profiles;
   - Proposed water levels relative to planting/seeding and measures to maintain/control these;
   - Details of long-term management, including a management plan.

ii. Details of methods to be used to relocate water voles (displacement or relocation by trapping) along with:
    - A justification for the chosen method, following the criteria set out in Section 4.6;
    - Names and experience of personnel to undertake any relocation operation;
    - Equipment to be used;
    - Whether the works will need to be undertaken under licence;
    - A detailed programme of works, including a phasing plan (where appropriate).

iii. Details of measures to protect water vole habitat from accidental damage during construction, including pollution, will need to be:
    - Included on constraints plans and Construction Environment Management Plans, to ensure that contractors are aware of the constraints;
    - Communicated to all contractors, through site inductions or task-specific briefings.

iv. Details of other measures required to avoid adverse effects, such as culvert design to minimise fragmentation, measures to reduce cat predation, etc.

v. Details of any monitoring to be undertaken pre-, during and post-construction (see Section 6).

5. Biodiversity Gain

5.1.1. Developments requiring planning consent are encouraged to deliver a biodiversity gain where possible,[6] although there is no requirement for this to be delivered in relation to any particular species.

5.1.2. Biodiversity gain for water voles can be delivered through the creation of new areas of suitable habitat, which should be managed sensitively for water voles (as set out in the *Water Vole Conservation Handbook* (Strachan *et al.*, 2011)). This can form part of the site's drainage proposals, where this approach can be agreed in advance with the organisation taking responsibility for the management of those features. It is also likely to be possible to deliver biodiversity gain by implementing sensitive management of existing wetland habitat for water voles, where current management is unfavourable or by improving the linkages between water vole colonies.

5.1.3. Where a development proposal would *not* have an adverse impact on water voles, it would be possible for a demonstrable biodiversity gain to be delivered in relation to water voles. However, a benefit for water voles is only likely to result where they are known to be present on site or in adjacent areas to which the site is connected by suitable habitat.

5.1.4. It should be noted that certain mitigation activities relating to water voles (specifically those required in relation to 'mitigating incidental mortality during site clearance/construction' (see Section 4.6)) will need to be undertaken under a conservation licence in England and Wales, and this requires the applicant to demonstrate a conservation benefit for water voles (see 2.1.3). In such circumstances the project will need to deliver a biodiversity gain for water voles in order to be granted a licence. Therefore projects in England and Wales which require a licence in relation to water voles will, by default, be delivering a benefit for this species.

[6] Paragraph 109 of the National Planning Policy Framework in England; Paragraph 2.1 of Technical Advice Note 5: Nature Conservation and Planning in Wales; and Paragraph 194 of Scottish Planning Policy.

6. Monitoring

6.1.1. In many cases it will be appropriate to undertake monitoring studies. The methods, duration and frequency will need to be determined at the outset, dependent on the purpose of the monitoring and the scale of the impact (monitoring effort should be proportionate to the impact). In most cases, monitoring will be required to ensure that water vole mitigation measures are implemented effectively and to allow remedial action to be undertaken if necessary. Monitoring may also provide information on the success or failure of a mitigation technique, although this can be difficult to determine without detailed studies, and therefore would be disproportionately expensive for small-scale schemes. Examples of appropriate methods, duration and frequency of monitoring are provided in Box 4. It may be beneficial to undertake monitoring in collaboration with another project, where this would generate more valuable data.

6.1.2. Water vole monitoring will need to be undertaken at an appropriate time of year, based on the aims of the survey. Where repeat annual latrine counts are to be undertaken, these should be carried out in the same month each year, and related to a pre-construction baseline survey undertaken at the same time of year. However, it should be noted that field signs indicating the presence of water voles should not be interpreted as evidence of the survival of relocated animals, unless they are recorded within a fenced receptor site.

6.1.3. Monitoring will need to be budgeted in advance and requires appropriate long-term access to the site.

6.1.4. The results of monitoring surveys should be set out in a written report, provided to the local authority ecologist and the local team of the relevant SNCO. Any new records of water voles should also be provided to the local environmental/Biodiversity Records Centre.

6.1.5. Opportunities should be sought to undertake monitoring which contributes towards an understanding of the effectiveness of mitigation measures (see Section 7).

Box 4: Monitoring methods, frequency and duration		
Example of project	**Purpose of monitoring**	**Monitoring methods, frequency and duration**
Works affecting up to 50m of watercourse from which water voles are displaced	To confirm re-instatement of habitat post-works for areas temporarily affected	Single visit to confirm establishment of habitat and search for field signs of water voles within the affected area (in year following re-instatement). Survey during the breeding season and at the same time of year as pre-construction surveys to allow comparison between the results.
Works requiring water voles to be relocated by trapping to an on-site receptor site	1) To confirm survival of released colony during the project 2) To confirm overall conservation benefit for water voles in the long term	Annual field sign surveys and habitat assessment post-relocation. Commence in year of relocation operation and continue for a minimum of 3 further years (longer where necessary to confirm an overall conservation benefit). Survey during the breeding season and at a consistent time of year (so that field sign survey results can be compared with pre-construction survey data).
Works requiring culverting of watercourses within the parameters known to be used by water voles, as described in 4.5.2	To confirm use of the culverts by water voles	Annual field sign surveys of areas of habitat on either side of the culvert and within culverts (where health and safety considerations allow) for a minimum of 3 years post-construction (or until use of the culvert by water voles has been confirmed if this occurs sooner). Survey during the breeding season – ideally during late summer/autumn.
Works requiring culverting of watercourses which fall outside the parameters known to be used by water voles, as described in 4.5.2	To confirm use of the culverts by water voles	Annual field sign surveys of areas of habitat on either side of the culvert and within culverts (where health and safety considerations allow). Survey during the breeding season – ideally during late summer/autumn. In addition, monitor the culvert using remote cameras (where possible) over a period of 4 weeks during early spring and 4 weeks during late summer/ autumn. Duration of monitoring should be up to 5 years.
Large-scale works – water voles taken into captivity and released at an off-site receptor site (or re-introduced)	1) To confirm successful establishment of released population 2) To confirm success of on-site habitat creation (where applicable)	Annual field sign surveys and habitat assessment post-release (at the release site) for up to 5 years (during the breeding season and each survey at a consistent time of year). Annual field sign surveys and habitat assessment (within recreated habitat at the development site, where applicable) for up to 5 years. Survey during the breeding season and at a time of year when field sign survey results can be compared with pre-construction survey data. For re-introductions it may also be appropriate to undertake post-release trapping to assess the survival, breeding condition and juvenile presence in late September in the year of release, by catching micro-chipped individuals (and captures of new, non-chipped, individuals).

Notes:

1) Some projects may fall into more than one category and will need to produce a monitoring programme that covers all of the applicable elements.
2) The duration of monitoring specified is a guide only; consideration will need to be given to the scale of the impact of a project on water voles to ensure that monitoring is not disproportionately expensive.

7. Research Requirements

7.1.1. Further research is required to test the effectiveness of the displacement technique in relocating water voles. This should take the form of controlled experiments involving a variety of habitat manipulation methods, timings and extents, combined with radio tracking of individual affected water voles to determine individual responses to habitat works and the ultimate fate of each animal.

7.1.2. Further research is required to test the effectiveness of using water draw-down in parallel with, or instead of, vegetation strimming as part of the displacement technique.

7.1.3. Further research is also required to determine which types, sizes and designs of culverts are most suitable for avoiding/minimising fragmentation effects on water voles, and in establishing the frequency of use of each.

7.1.4. The ecology and habitat preferences of terrestrial water voles are not well understood, and further research is therefore required to inform future guidance on survey, impact assessment and mitigation in relation to terrestrial populations.

8. References and Bibliography

CIEEM (2016). *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd Edition.* Chartered Institute of Ecology and Environmental Management, Winchester.

CIEEM (2013a). *Guidelines for Preliminary Ecological Appraisal.* Technical Guidance Series. Chartered Institute of Ecology and Environmental Management, Winchester.

CIEEM (2013b). *Competencies for species surveys: water vole.* Technical Guidance Series. Chartered Institute of Ecology and Environmental Management, Winchester.

Countryside Council for Wales (2009). *Water voles and development.* CCW, Bangor.

Dean, M. (2003). Development mitigation for water voles: a research project into the effectiveness of 'displacement' as a mitigation technique. *In Practice* **39:** 10–14.

Dean, M., Gow, D. and Andrews, R. (2014). Water voles – a preview of new guidelines for survey and mitigation. *In Practice* **84:** 20–22.

Gow, D., Andrews, R. and Smith, D. (2012). Water vole mitigation guidance: important updates for evidence-based good practice. *In Practice* **77:** 29–34.

Jefferies, D.J. (2003). *The water vole and mink survey of Britain 1996-1998 with a history of the long-term changes in the status of both species and their causes.* Vincent Wildlife Trust, London.

Joint Nature Conservation Committee (2010). *Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit.* JNCC, Peterborough.

Markwell, H. (2008). Large scale mitigation: a case study using water voles. *In Practice* **62:** 7–10.

National Species Reintroduction Forum (2014). *Scottish Code for Conservation Translocations.* http://www.snh.gov.uk/protecting-scotlands-nature/reintroducing-native-species/scct/

Natural England (2011). *Water voles and development: licensing policy*. TIN042 Second Edition. Natural England, Peterborough.

Strachan, R., Moorhouse, T. and Gelling, M. (2011). *Water Vole Conservation Handbook.* Third Edition. Wildlife Conservation Research Unit, Oxford.

Strachan, R. and Jefferies, D.J. (1993). *The water vole* Arvicola terrestris *in Britain 1989-1990: its distribution and changing status.* The Vincent Wildlife Trust, London.

Appendix 1: Displacement protocol

Displacement is undertaken by removing all vegetation from the working width. All standing vegetation both on the bank(s) and in the water must be cut and all the arisings removed as described below (see also Photographs 9a and 9b).

It is recommended that displacement is attempted in early spring.

In England, the Class Licence for displacing water voles specifies a time window of 15th February to 15th April inclusive. There is an extension to 30th April in the counties of Northumberland, County Durham, Tyne and Wear, North Yorkshire, Cumbria and Lancashire if necessary to ensure displacement only takes place in suitable weather conditions and when there is sufficient forage available to support displaced water voles. Further to this, we do not recommend displacement after 31st March in south-east England as the animals are likely to be breeding earlier than in other parts of the UK. Conversely, in northern England displacement before 1st March is not recommended.

In Wales, the recommended period for displacement for lowland sites is 15th February to 15th April inclusive, and 1st March to 15th April inclusive for upland sites. In Scotland, the recommended period is 15th March to 30th April inclusive.

Displacement must not be attempted during very cold weather conditions (maximum daytime temperatures below 5^{o}C), or when there is snow on the ground or a heavy frost. Works should be delayed if such conditions occur on the planned day of a displacement operation.

In situations where developments affect only one bank of a watercourse:

- In most cases it will be necessary to remove vegetation from both banks because the water voles will have territories encompassing the entire width of the watercourse.
- For very wide watercourses (such as the lower reaches of major rivers) where individual water vole territories are unlikely to include both banks, it may only be necessary to remove vegetation from one bank.

Note that displacement works should only be undertaken under a licence issued by the relevant Statutory Nature Conservation Organisation (SNCO).

Steps of the displacement process:

i. Before vegetation removal, identify and mark the position of all burrows in the working area so that these can be located later to ensure that they are not blocked. Confirm the absence of other constraints to the works, such as nesting birds;

ii. Remove vegetation on the bank face within the area subject to development works, plus at least an additional 3m either side of the working area, and on the bank top (i.e. at least 3m back from the bank). This should be achieved using a strimmer until only bare earth remains. If feasible, also cut the emergent aquatic vegetation located along the water margin to below water level;

iii. Rake off and remove any arisings from the cleared area;

iv. Check that burrow entrances have not become blocked and remove any latrines or feeding remains;

v. If feasible and environmentally acceptable, combine with de-watering of the affected section of watercourse;

vi. Leave the strimmed area intact for 5 days to allow animals time to relocate;

vii. Re-survey the site for fresh evidence of water voles. If there is no evidence that water voles are still present, undertake a destructive search of the burrows (under the supervision of a suitably experienced ecologist) as follows:

a. Excavate burrows to ensure that no animals are present. Hand tools should preferably be used, and excavation should extend as far as possible, bearing in mind practical health and safety constraints (see Photograph A1);
b. Using an excavator with a toothed bucket, rake through the turf and topsoil on the bank face and top on the side that the excavator is positioned. Then with a second or third sweep of the bucket, remove the turf and topsoil to a depth beyond which any burrows would be present (see Photograph A2);
c. Remove in-channel vegetation within 50cm of the toe[7] of the bank to prevent regrowth;
d. Smooth the surface of the bank using an excavator with a ditching bucket (or the back of the toothed bucket). Ensure that any lumps of topsoil that might provide a refuge for water voles are removed;
e. Repeat the process for the opposite bank (if necessary).

Notes:

- If monitoring prior to the destructive search finds evidence of water voles, repeat steps i to vi, or consider trapping water voles instead. Note that changing from displacement to trapping is likely to result in project delays as it will be necessary to apply for a licence (a different licence is required to that issued for displacement), and to allow time for the vegetation to regrow: trapping on bare earth is unlikely to be successful.
- During the destructive search, the excavator should work in the direction that water voles should be encouraged to move in (i.e. towards retained habitat).
- Any water voles seen should be encouraged to move ahead of the excavator into adjacent retained habitat. It may be necessary to capture the animals by hand, in which case they must be kept in a suitable container with bedding and food and released into unaffected adjacent vegetation as soon as works are completed (and in all cases, the same day).

viii. Ensure that water voles do not return prior to the development works commencing by:

- Undertaking the works within 5 days of completing the destructive search; or
- In-filling the channel immediately following the destructive search; or
- Maintaining the works area as bare ground until the works have taken place. This is likely to require a repeat scraping/smoothing of the banks; or
- Covering the ground with a suitable matting to ensure that vegetative regeneration cannot occur; or
- Installing suitable water vole resistant fencing to prevent water voles returning.

[7] The toe of the bank is defined here as the area of the bank at, and immediately above, water level.

Photographs of destructive searches in progress

	**Photograph A1:** Burrows being dug back by hand. © Derek Gow
	**Photograph A2:** Bankside habitat being scraped using a tracked excavator with a toothed bucket as part of a destructive search for water voles (following a trapping and relocation operation). The watercourse has been bunded off and drained as far as possible by pumping. The excavator is working towards retained habitat. The channel was in-filled immediately following completion of this operation. © Mike Dean

Appendix 2: Trapping protocol

Trapping of water voles can only be undertaken by a person licensed to do so by the relevant Statutory Nature Conservation Organisation (SNCO), and should only be carried out by those with sufficient experience to ensure the welfare of the animals.

Before any water vole trapping project begins the site must be checked and verified clear of the presence of mink. If mink are present then they must be eliminated before water vole trapping begins wherever practical (failure to do so can result in their killing captured water voles).

Time of year/weather conditions

Trapping of water voles should only be undertaken at an appropriate time of year (see 4.6.4).

Trapping should also not be undertaken during the following conditions:

- Cold conditions – night-time temperatures below freezing ($0^{o}C$);
- Hot conditions – daytime temperatures above $20^{o}C$;
- High rainfall/flooding – where water level rises could be sufficient to flood the traps (the use of floating platforms may allow trapping to continue during minor water level fluctuations, but not during major flooding events which will capsize the rafts).

The weather forecast should be monitored daily during a trapping exercise, and the traps should be securely closed or removed if adverse weather conditions arise or are forecast.

Traps

An ideal metal trap type for capturing water voles is constructed from 1cm × 1cm weld mesh with an aluminium or wooden shelter at one end (see Photographs A3 and A4). Its basic dimensions are 50cm long × 15cm wide × 15cm high. The aluminium shelter sits over the far end of the trap and is 215 mm in length. The traps do not have a spring-loaded mechanism allowing a very light treadle weight and have a simple locking bar fitting in their doors which activates on closure. These traps are light and easy to handle.

Other trap types which have been used for water voles include folding metal traps, such as those produced by Sherman (see Photograph A5). These are relatively small in size, and therefore have limited space for bedding and bait, which means that the mechanisms can become fouled and need to be checked regularly; they should only be used by those with considerable experience.

Traps should be thoroughly cleaned, disinfected, rinsed in clean water and dried after use and between trapping sites. In areas with bovine tuberculosis (TB), care needs to be taken to ensure that the agent is effective against mycobacteria (e.g. Trigene © is an effective agent whereas Virkon is not).

Trapping terrestrial water voles is difficult and specialist advice will be required.

	**Photograph A3:** Water vole trap. © Derek Gow
	**Photograph A4:** Water vole trap with a wooden nest chamber. © Julia Massey
	**Photograph A5:** Sherman trap on a floating platform. © Mike Dean

If trapping is undertaken during inclement weather conditions then wooden covers over the nesting areas of the trap help to insulate the bedding area. These can be additionally insulated with a covering of 'bubble wrap' if poor weather conditions persist.

Traps must be checked prior to use to ensure that they are in complete working order. Any traps which break or malfunction should be immediately replaced. Each trapping team should have sufficient traps to allow for a replaceable reserve.

Locating and securing traps

Traps should be placed at a density of at least one per 10m of bank, and should be located parallel to the bank edge and immediately adjacent to latrine sites or in areas where runs are obvious. The ground beneath the trap should be flattened as far as possible without damaging the bank, to allow the trap to sit securely, but ideally placed on a slight incline with the nest chamber highest, to prevent submersion in the event of minor fluctuations in water level. All traps should be secured with pegs, to prevent them being dislodged.

Traps must not be set in precarious positions where the movement of captured animals could lead them to fall into water, or in situations where human interference is likely to occur. Where it is necessary to trap water voles in locations used by the public, they should be set in locations that are difficult to reach and be covered with vegetation.

Traps can also be set on floating platforms (such as mink rafts, or purpose-built structures, such as shown in Photograph A5). This approach is particularly helpful in capturing animals from wetland habitat where there is no bank; where the bank is too steep to allow traps to be set safely; where most of the latrines are located some distance from the bank on floating vegetation; or where water levels are likely to fluctuate, such as downstream of an outfall or in an artificially or tidally impounded reach. Floating platforms are also useful where the disturbance of traps by dogs or foxes is likely. They must be sufficiently buoyant and stable to ensure that they can support a water vole's weight (or that of any non-target species), and therefore must be of higher specification than those simply used for undertaking surveys (3.3.13). The traps must be secured to the platform, to ensure that they do not roll into the water, and the platforms must be secured using canes or similar, to prevent them floating away. They also need to be tethered in a way which allows them to rise and fall with changes in water level, and they should not be used in situations where there is significant water wash from boat traffic, which could cause them to capsize.

Each trap must be uniquely numbered with indelible pen and either clearly marked using flags (where interference by the public is unlikely) or their locations mapped accurately to ensure they can be relocated. Ideally, all trap locations should also be recorded using a hand-held GPS.

Provisioning traps

Traps must be provisioned with dry straw bedding and half a fresh, sweet apple. Additional food can also be provided (e.g. pieces of carrot). These materials must be checked daily and changed at least every second day.

Checking traps

Traps should be checked at least twice daily:

- Early morning check, between 6am and 10am, with all traps checked by 10am; and
- Late afternoon/evening check, before dusk.

During warm weather conditions a third check in the middle of the day should be undertaken.

Handling captured animals

Where captured water voles are to be released into an on-site receptor area, they should be examined upon release from the trap to determine their sex and approximate size/weight (animals can also be weighed when necessary, but this procedure should be avoided if unnecessary to reduce the stress for the animals). They should be placed in a suitable container for transportation, such as a standard rodent laboratory cage. Animals should also be marked (either by fur clipping or by the insertion of micro-transponders by appropriately trained individuals) to ensure that any animals which escape from the release site can be identified. As with trapping, water voles can only be handled and marked by individuals holding an SNCO licence for the work, or their accredited agents.

Where captured water voles are to be released at an off-site receptor area or taken into captivity, they may be transported to a central care facility in their traps or appropriate holding cage as described above. If traps are used for transport, then the doors must be secured using wire or cable ties prior to movement.

When water voles are captured, traps should be replaced on the same spot, as it is likely that more than one animal will be present. Particular care should be taken to ensure that more than a single trap is placed side by side at any location where very small juveniles (30–50g in weight) have been captured. The chance of catching other sibling litter mates at the same point is high. These can be placed in holding cages together if they are captured at the same location, but should not be mixed with any other adults.

All field staff should be aware that water voles can carry leptospirosis, and be familiar with its symptoms, pathways for transmission to humans, and the precautions necessary when handling water voles to minimise the risk of infection.

Completion of trapping

Trapping can be considered to be complete once there has been a period of 5 days or more when overnight temperatures are above freezing, with no captured animals, AND there are no field signs within the capture site. Once completed a destructive search of the area should be undertaken (parts vi and vii of the displacement protocol – Appendix 1). Any animals found during the destructive search should be captured with nets or by hand and transported as described above.

For large trapping exercises it may be appropriate to consider completing trapping in some parts of the site before others, to prevent the chances of animals recolonising the cleared areas.

Note on radio tracking

In some projects, it will be useful to gather information on the fate of relocated animals through radio tracking. Any such work may only be conducted under a project-specific Home Office Licence by persons who also hold a personal Home Office Licence. The work must also be agreed by the relevant SNCO.

Appendix 3: Care of captive animals protocol

Holding facility

All facilities and care regimes for water voles must be fully compliant with the legislative requirements present in the Welfare of Animals Act 2006. Ideally animals should be held by organisations registered with the British and Irish Association of Zoos and Aquariums (BIAZA) or in similar facilities which can maintain a consistently high standard of captive care and maintenance.

High standards of cleanliness must be maintained, with all animal feed in enclosed containers. It must be secure against human intrusion and also be secure against water vole escape and secure against intrusion from other animals which may predate water voles or transmit disease (including birds, rats, cats, grey squirrels, and wild populations of small mammals). The holding facility must be well ventilated and cool. Standard metal shipping containers are generally unsuitable as they are prone to significant, rapid rises and decreases in temperature.

Operatives

All operatives handling water voles must be suitably experienced and use appropriate equipment. They must wash their hands with a veterinary hand wash (e.g. Hibiscrub or similar) before and after doing so to prevent disease transmission, or wear disposable gloves.

Recording and provisioning captive water voles

Each incoming animal must be weighed, sexed and recorded on the daily record capture sheet.

All captured animals must have fresh, sweet apple and commercial alfalfa-rich rabbit feed daily (quarter of an apple and 1 tablespoon of rabbit food per vole). Standard rodent seed-based diets are not suitable for water voles.

Water voles should be provided with a source of water for drinking. When provided with drinking bottles it may be necessary to clean the holding cages daily as the bottles can readily drain into their bedding. For animals being held in captivity for short periods of time sufficient water can be obtained from the daily provision of apple.

Animals must be housed individually unless they are juvenile siblings of similar weight (30–50g individuals) which have been captured at the same trapping position.

Water voles can be held in captivity for short periods of time (up to 2 weeks) in standard rodent laboratory cages constructed from polypropylene bases with a stainless steel lid. These lids lock into the base and have bars which are approximately 1cm apart. An ideal size is 58cm long × 37cm wide × 18cm deep. Larger purpose-built enclosures should be used for holding animals for longer periods.

Water voles should be cleaned out every week if they are in individual cages and more frequently (as required) when in sibling groups. Waste bedding must be disposed of appropriately in a skip or incinerator. Wood shavings and straw are the best bedding materials for water voles.

In the event that pregnant water voles are captured, their cage should be left in a quiet, dark place and covered with a Hessian sack. Only the shavings at the front of the cage should be removed during cleaning with all other bedding being retained undisturbed. Any juveniles which are born must be retained in captivity until they attain a weight of 120 grams or more.

Appendix 4: Soft-release protocol

Introduction

Water voles which are relocated by trapping should be released into their receptor site using a soft-release technique. Although there is a lack of good evidence of the additional benefits of soft-release versus hard-release (or indeed of the potential benefits of a longer-term soft-release than that described below), it is the opinion of the authors that the use of soft-release pens is likely to increase the number of animals surviving at release sites by providing animals with time to adjust to their new location. There are two basic methodologies for this process:

- The creation of pens with no base that are sunk into the ground to a depth of at least 25cm adjacent to the water's edge. These can be complete (fold-up) units or constructed from separate materials.
- Complete cages positioned in the riparian vegetation next to the water's edge from which animals cannot escape until a front section (with 6cm diameter holes in either side of a predator-proof baffle) is fitted.

Although both systems can work well each has its advantages and disadvantages.

Pens with no base

Using this release technique, the voles burrow out of the holding pen. Studies of radio-collared individuals (P. Franklin, personal communication) demonstrate that they will remain under these structures, in the burrow systems they have established, for many days before moving out into the wider environment. Once in position these cages are difficult to move and if water levels fluctuate they can rapidly be submerged. In addition, if they are not designed as complete units and their construction materials leave gaps in the overall structure then the voles can readily escape before they have settled. Under certain ground conditions, such as stony soils, they can be hard to reliably install. They need to be covered at least partially from the weather, and securing predator-proof lids can be difficult. A successfully used design of 'pen with no base' is provided in Box 9E (p.112) of the *Water Vole Conservation Handbook* (Strachan *et al.*, 2011) (see also Photograph A6).

A successfully used design is constructed from aluminium, which folds down for transport, and has a hinged lid for feeding access (see Photograph A7). It is completely weather proof, with a floor area of approximately 45cm × 45cm and a maximum height of 25cm. Once dug in, these pens are fitted with a cardboard sheet (5mm thick) in their base through which the water voles have to gnaw to access the soil beneath. The top lid functions as an access door for feeding and maintenance. These cages needed to be well shaded to avoid them heating up excessively so they should be located to avoid direct or dappled sunlight.

Complete cages

Using this technique the voles are completely contained. Although they cannot establish burrow systems they will rapidly come and go from both their own and adjacent cages once the fronts are folded under the main cage and a baffle (to deter large predator access) is placed in position. These types of release cages are easier to install in some cases (such as stony soils) and are easier to move if this is needed during the release. The voles are released from this structure by folding the front section under the main cage and then fitting a baffle with 6cm diameter holes at either side. See Photograph A8.

These cages can also be used as an **on-site holding facility** in situations where the release of water voles needs to be delayed, such as to allow vegetation within the receptor site to become better established. In such cases the cages must have a covered section on their top, back and sides to

prevent the bedding getting damp. This can be achieved by partially covering the cage with a tarpaulin. The pens must be positioned in an entirely secure location where they cannot be removed or interfered with in any way by predators or people. Their position in a receptor habitat must be well above the level of any potential rises in water level.

	**Photograph A6:** Release pen with no base. © Darren Tansley
	**Photograph A7:** Aluminium release pen with no base. Corrugated card cut to size is placed in the bottom void to delay burrowing out. These cages must be positioned as near to the edge of a watercourse as practicable to allow the burrows to extend quickly into the bank. ©Derek Gow
	**Photograph A8:** Complete cage (timber and wire mesh). © Derek Gow

Release

If groups of siblings are being released together, up to seven individuals can be released using either pen design described above. Family groups of a mother and young can also be released together. In other circumstances, water voles should be released as individuals rather than in groups. Individuals of the same sex should be separated by a minimum of 40m intervals along the waterway (two pens, one containing a male, one a female, per 40m length). The pens should be sited as close to the water as possible, in (or near) tall vegetation. Release pens should be situated away from public access; if this is impossible then a security fence may be required to prevent interference.

Provisioning

Release pens must be checked daily during the relocation operation to ensure that the animals have sufficient food. They should be supplied with a straw-bale-section (one-sixth of a bale) to provide cover and bedding. In the experience of the authors, each vole should be provided with quarter of a sweet apple, half a carrot and cut external vegetation daily; and the animals should be supported with food for 8 days in the dug-in cage system before these are removed, leaving the old bedding in place. In the complete cage system they should be supported with food for 5 days, released on the sixth day and then fed for another 3 days. Once again, all the old bedding from these pens should be left *in situ* on the bank. In situations where water voles are to be held in complete cages for longer than 6 days, as an on-site holding facility (see above), they should also be provided daily with a small bowl of dry alfalfa-rich rabbit feed and drinking water (clip-on water bottles should be attached to the side of the cage). Shallow metal trays, 60cm long × 30cm wide × 10cm deep can also be provided as swimming trays. The cages will need to be checked daily to ensure that they are intact, and food and water must be replenished daily.

Appendix 5: Fence design

Dimensions and materials

Fencing barriers for water voles should have a minimum height of 1.2m above ground and be buried to a depth of at least 0.5m (see indicative design). Typically, 2.4m × 1.2m plywood boards are used, requiring supporting posts. A wire mesh (maximum 1.5cm wide holes) should be attached to the fence 25cm above ground level and continue to the base of the fence (buried at least 0.5m below ground level), and then returned out 50cm from the base of the fence. For receptor sites, the below ground return should be positioned on the inside of the fence. The wire mesh should not extend more than 25cm above ground level, as it could aid climbing. It should be securely attached without gaps between the plywood and wire mesh, and without damaging the plywood boards.

The supporting posts are likely to aid climbing by water voles and must therefore be positioned on the side that water voles are to be excluded from. In the case of a receptor site perimeter fence, this will normally mean positioning posts on the outside of the fence. However, in some cases there may be a high risk of water voles climbing the fence to gain access into the receptor site and colonising it, prior to a relocation operation occurring, in which case the posts should be positioned on the inside (e.g. where the receptor site, and fence, are required to be in place for a prolonged period prior to the relocation operation occurring).

Fencing barriers within the water should be of strong construction, ideally sheet metal piling sunk to a depth of 2.4 m. This material can be pressed in by a digger and will present an unclimbable fence, which will stand water wash and deter burrowing. Fencing can be angled to deter climbing further.

Fencing across a water channel should ideally be avoided when designing the mitigation. If it is unavoidable, the fencing must be strong enough to account for the water flow. Fencing across channels could be achieved by designs which would allow for water flow through and yet deter recolonisation. Approaches could include the following:

- Sheets of heavy gauge 1.5cm × 1.5cm weld mesh sunk to a depth of 1 m across the channel and topped with boards to prevent climbing.
- Sheets of marine plywood sunk to a depth of 1m and extending at least 0.5m above water level, with grilles fitted to enable water flow (mesh size of 1.5cm^2 or less) – as shown in Elevation B of the indicative fence design.

An alternative approach is to lay a plastic drainage pipe or pipes (at least 2m in length) along the channel so that it will be completely submerged below the water level allowing the water to flow. Then the pipe or pipes should be covered with suitable material to form a secure bund (i.e. the bund should extend above the water level). A fence is then constructed on the bund over the top of the pipe(s). The pipes need to be of sufficiently small diameter to deter water voles swimming through them.

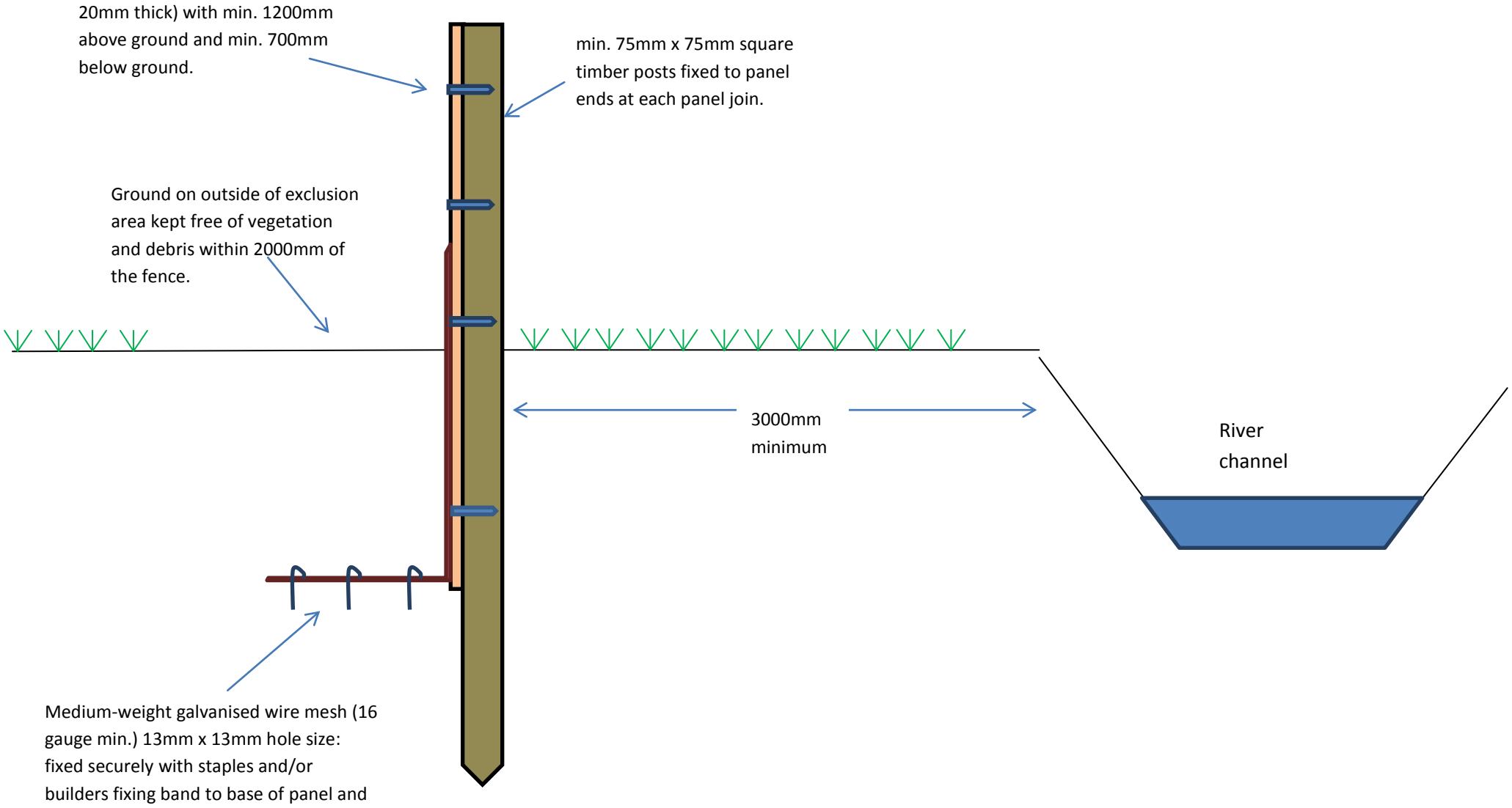
It will be necessary to ensure that the relevant consents (such as flood defence consent) have been obtained before installing fencing within a watercourse.

Maintenance and monitoring

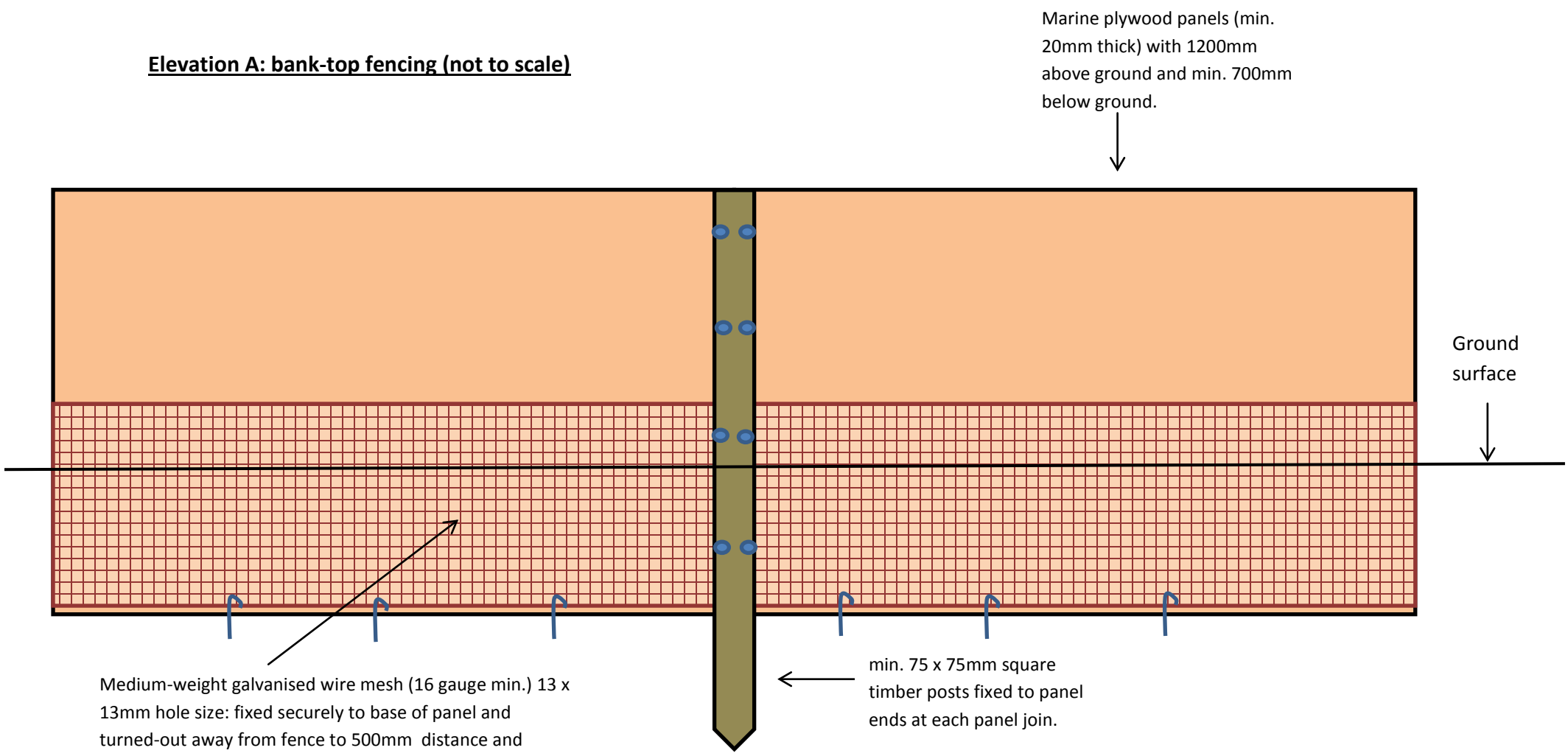
The entire fence-line should be checked at least every 2 to 3 days for evidence of burrow construction, and to ensure that there is no damage or other weak spots. The vegetation within 2m of the fence on either side should be maintained as short grass to deter water voles from approaching the fence. During the summer months it is likely that the vegetation will need to be strimmed weekly.

Water vole exclusion fencing - indicative design

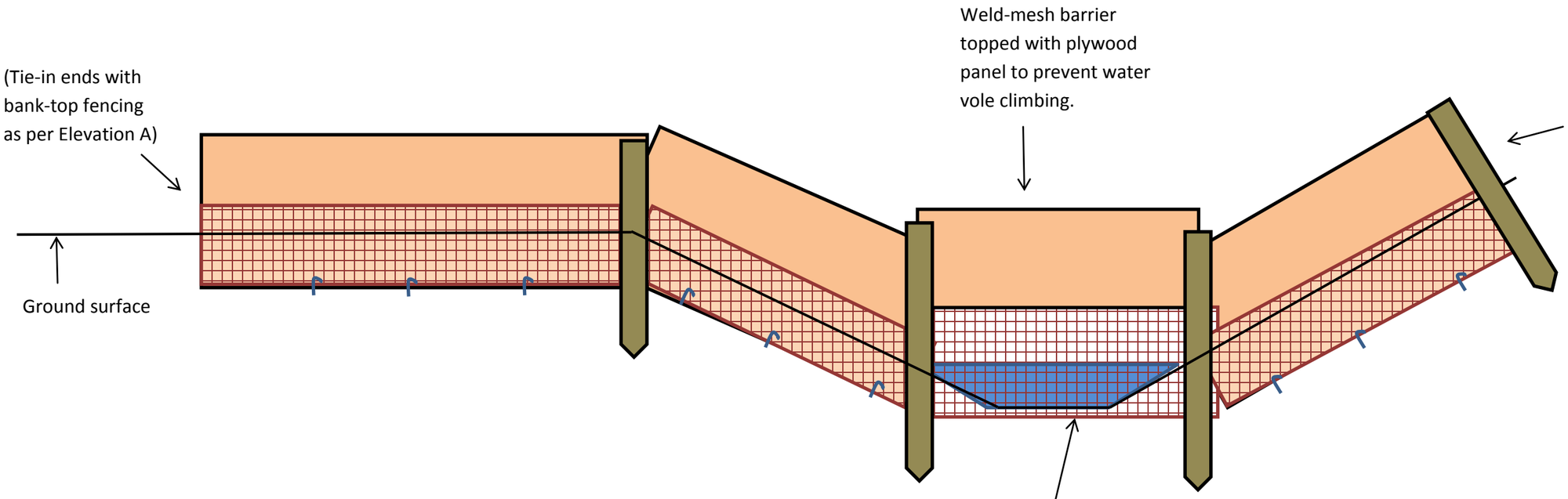
Profile/Cross-section (not to scale)



Elevation A: bank-top fencing (not to scale)



Elevation B: Channel crossings (not to scale) – refer to main elevation (A) and profile for dimensions, fixings and materials.



NOTE: Mesh **must be kept clear of debris build-up** to allow free flow of water through.

Appendix 6: Health Screening

Basic health assessment

If an individual water vole is in obvious poor condition, then veterinary advice should be sought and translocation of that individual halted. Symptoms that should trigger concern include the animal exhibiting diarrhoea, being underweight, having an open wound, dental issues (e.g. an obvious abscess or over-grown teeth), significant fur loss or skin infection, noticeable harsh breathing, discharge, a heavy ectoparasite load or tumours.

If more than 10% of animals die whilst being trapped or held in captivity, then every effort should be made to preserve cadavers and veterinary advice should be sought.

Translocation distances

Water voles being translocated short distances within the same catchment would not normally be required to be health screened but should be held for release as cohesive populations at the same time. However, if significant numbers display symptoms of concern (see above) or die, then veterinary advice, together with detailed examination of cadavers, blood and faeces would be advised before any release.

Water voles caught within areas known to have bovine tuberculosis (TB) in badgers and cattle must not be translocated to other identified bovine TB-free regions of the UK. However, such individuals can be translocated to other bovine TB-positive regions with the consent of the Statutory Nature Conservation Organisation (SNCO).

Where water vole populations are being translocated to other catchments or receptor sites outside the catchment, or are being re-introduced from captive bred populations the option of submitting a proportion of the population for fuller health screening should be considered. In the event that any significant conditions such as hantavirus or tularaemia are identified in these populations the licensing SNCOs must be informed immediately and specialist advice must be sought regarding the most appropriate course of action.

Information on the baseline prevalence of a range of parasites and pathogens in water vole populations, against which screening results can be contextualised is available (Gelling *et al*., 2012, 2015).

No movement of Scottish animals to England or vice versa for release should be attempted, without evidence that the animals being moved are of the same genetic origin as in the release location, through genotyping. Movement of intermediate populations with range overlap zones such as North Wales, Cumbria or Northumberland should be agreed in advance with the relevant SNCOs, and may also require genotyping.

General sampling

Faeces can be stored for microbiology and parasitology. Faeces from each individual should ideally be stored separately, though combined samples from groups of animals can also be usefully examined to assess the presence or absence of a disease within the group. Any stored faeces should be labelled with the date of collection, collection point and the contact details of the individual responsible for the collection.

Any blood sampling for screening should only be taken by a qualified veterinary surgeon (only permissible if the sampling is to inform directly the care of individual animals), or under a suitable Home Office Licence (if the sample is for a scientific purpose, such as understanding baseline parasite prevalence prior to release, without providing individual treatment as a consequence of the

data collected). Note that for parasites and pathogens where the diagnostic test takes longer than the anticipated period of captivity, then blood sampling for disease screening would need to be conducted under Home Office Licence.

If disease is suspected within any group then cadavers can be frozen for screening. Advice should be sought from a pathologist or veterinary surgeon before freezing as some tests require fresh rather than frozen tissue. It is essential to avoid putrefaction of the sample, and therefore cadavers must be kept chilled.

In the event of conditions of significant disease being identified in this species the SNCOs, via The Mammal Society (www.mammal.org.uk), will provide an update to this handbook.

References

Gelling, M., Macdonald, D.W., Telfer, S., Jones, T., Bown, K., Birtles, R. and Mathews, F. (2012). Parasites and pathogens in wild populations of water voles (*Arvicola amphibius*) in the UK. *European Journal of Wildlife Research* **58**: 615-619.

Gelling, M., Zochowski, W., Macdonald, D.W., Johnson, A., Palmer, M. and Mathews, F. (2015). Leptospirosis acquisition following the reintroduction of wildlife. *The Veterinary Record* **177**: 440-440.

Appendix 7: Flowchart for considering water voles as part of a planning application