Appendix A10.14 – Water Shrew

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Contents

1 Introduction

1.1 General Background

1.1.1 This Appendix reports the assessment of potential impacts on water shrew populations in the vicinity of the Northern Leg of the proposed scheme.

1.1.2 To aid the interpretation of the assessment, impacts are considered for five component route sections for the Northern Leg as follows:

- Section NL1 ch314800 – 316000 (Derbeth to Tulloch Road);
- Section NL2 ch316000 – 317400 (SAC Craibstone);
- Section NL3 ch317400 – 322600 (A96 to Nether Kirkton);
- Section NL4 ch322600 – 325370 (Nether Kirkton to Corsehill); and
- Section NL5 ch325370 – 331000 (Corsehill to Blackdog).

1.1.3 The study area is defined as all watercourses, standing waterbodies and other riparian zones within 250m of the alignment.

1.1.4 Studies on water shrews were included as part of the Ecological Impact Assessment (EcIA), and were undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volumes 10 and 11 and the Environment Impact Assessment (Scotland) Regulations 1999. The three stages of EcIA have been modified to be directly applicable to the proposed scheme, and are based on matrices from an early draft version of IEEM guidance on EcIA (IEEM, 2002) and Transport Advisory Guidance (STAG and WEBTAG). The bulk of the assessment for the AWPR Northern Leg was undertaken before the 2006 issue of the IEEM guidelines. This assessment therefore follows the general approach described in the IEEM 2002 guidelines, with cognisance of the later 2006 guidelines.

1.1.5 These studies included desk-based consultation to collate existing information about water shrews in the area potentially affected by the proposed scheme and field surveys to provide current data about the status of water shrew populations.

1.2 Aims

1.2.1 The water shrew (*Neomys fodiens*) is widespread but patchily distributed across the UK (Harris et al., 1995) and is known to be present in the Aberdeenshire region (pers. comm. Lesley Cropper, North East Scotland Biological Records Centre). The proposed scheme (and a defined area around the alignment –the 'route corridor') was surveyed to evaluate and mitigate for, any potential impacts on water shrew populations present.

1.2.2 The objectives of the study were to:

- determine the presence or absence of water shrew along the route corridor;
- evaluate landscape features in relation to water shrew;
- assess the potential impacts of the proposed scheme on any water shrew populations present along the route corridor; and
- identify mitigation measures to ameliorate any significant negative impacts predicted.

1.3 Background

Biology

1.3.1 The water shrew is found throughout mainland Britain but appears to have a patchy, localised distribution, particularly in northern Scotland (Greenwood et al., 2002 and Harris et al*.,* 1995). The water shrew is semi-aquatic, using most types of freshwater aquatic habitat including field drains, rivers, streams, ponds, reed beds and fenland. Water shrew can also be found far from water in woodlands or rough grassland (Churchfield, 1986). However, it has been suggested that such populations are only transitory, either in search of alternative food sources or using these terrestrial habitats to disperse from their natal ranges (Harris et al., 1995). Water shrews live in burrows and principally hunt freshwater invertebrates for their food. Water shrews have low population densities compared with other small mammals (Churchfield, 1984; cited in Harris et al., 1995).

1.3.2 Water shrew are solitary animals and strictly territorial during the non-breeding season. However, during the breeding season males disperse whilst females maintain their territorial boundaries (Cantoni, 1993). Breeding takes place during late spring and summer with females producing two or three litters of up to 15 young (Mammal Society, 2004). Adult water shrews generally die off after breeding with the young shrews maintaining the population through the winter. Water shrews do not hibernate, but continue foraging throughout the winter.

Status

1.3.3 The conservation status of water shrew in the UK, its population trends and numbers are currently unknown. The Mammal Society is undertaking a national survey of water shrew, however no previous national survey has taken place. The water shrew was identified as a Species of Conservation Concern on the Species Long List by the UK Biodiversity Group (UK Biodiversity Partnership 2005). However it was not considered to be of such concern as to warrant its inclusion in the Species Short List and thus required to be the subject of a specific national Biodiversity Action Plan (BAP).

1.3.4 Despite this, the water shrew is protected under Schedule 6 of the Wildlife and Countryside Act (1981) (as amended) and the Nature Conservation (Scotland) Act (2004). As such, water shrew cannot be killed or taken by certain methods, effectively meaning that in Scotland, water shrew can only be captured by those in possession of a Scottish Natural Heritage (SNH) license.

1.3.5 The North East Scotland Biodiversity Partnership (NESB Partnership) does not have a specific action plan for water shrew within the Local Biodiversity Action Plan (LBAP). However, the NESB Partnership aims to implement a series of conservation measures for water shrew through the key habitats used by water shrew under its 'Wetland and Freshwater Action Plan'. This LBAP is still in preparation (pers. comm., Maria Hardy, NESB).

2 Methods

2.1 Existing data

2.1.1 There are no known records of water shrew in the study area. There are very few records of water shrew for the entire North East Scotland area, however this lack of information may well be due to a lack of surveys rather than an absence of water shrew (pers. comm. Lesley Cropper, North East Scotland Biological Records Centre (NESBReC)).

2.2 Survey Methods

Tube Surveys

2.2.1 DMRB does not give specific guidance on water shrew survey techniques, therefore the survey methods followed those described in 'A new survey method for Water Shrews (Neomys fodiens) using baited tubes' (Churchfield et al., 2000). This survey method is based upon the observation that water shrew will investigate novel objects and frequently defecate inside them. The droppings of water shrew can then be analysed in order to identify any prey remains. Water shrew droppings can be distinguished from other shrew species as they contain aquatic invertebrate prey remains, terrestrial shrew species rarely feeding on these prey species (Churchfield et al., 2000).

2.2.2 All watercourses, standing waterbodies and other riparian zones offering suitable water shrew habitat within 250m of the alignment were surveyed for water shrew. Watercourses were identified from Ordnance Survey maps, aerial photographs and through a walk over survey. The walkover survey also selected which waterbodies were unlikely to contain water shrews and would therefore not be surveyed. Such locations included several dry farmland ditches and Kepplehill Burn (which was largely dry at the time of the walkover survey). Locations of survey stations are recorded in Table 4, and shown on Figures 10.8 a-g.

2.2.3 Three baited tubes were placed 10m apart at each survey station. Along watercourses, separate stations were placed at approximately 75m intervals. Baited tubes consisted of a 150mm length of 30mm diameter white plastic tubing, with a nylon net baffle at one end secured by an elastic band. Each tube was baited with approximately 30 pre-frozen (to prevent emergence) blowfly pupae. Tubes were placed within 1m of the water's edge amongst vegetative cover.

2.2.4 Tubes were checked after two weeks (as recommended by Churchill et al., 2000), then left out and rechecked after a further two weeks. The contents of the tubes were stored in plastic cotton wool lined containers and, once dry, examined with a hand lens under a light source for identification.

Habitat Assessment

2.2.5 Habitat, water and invertebrate quality of each watercourse was assessed based on water quality and invertebrate data acquired from the Freshwater report (see Appendix A10.16).

2.2.6 Water shrew habitat quality designations were assigned as follows:

- **High** – Suitable vegetation, with either water of good or excellent quality or high invertebrate scores.
- **Medium** – Some suitable vegetation, with either average water quality or medium invertebrate scores.
- **Low** – Poor quality or inappropriate vegetation with low water quality and low invertebrate scores.

2.2.7 Vegetation was assessed for suitability by examining the potential cover it offered to foraging water shrews. Areas of open ground were classified as being of a poor suitability for water shrew; areas with limited cover (i.e. beech woodland or pasture) were assessed as being of moderate suitability for water shrew whilst areas which offered dense cover to water shrew (i.e. abundant emergent vegetation, tall herbs etc) were classified as being of good suitability for water shrew.

2.2.8 Water quality was assessed using the published SEPA river water quality classifications (these are determined by SEPA through chemical and ecological surveys).

2.2.9 Food resource availability was considered with reference to the invertebrate scores, based upon the abundance of invertebrates (total number of invertebrates caught) at each site and the number

of taxa found at each site. With less than 5 invertebrate taxa and less than 15 invertebrates representing a low invertebrate score; 5 - 12 taxa and 16 - 40 invertebrates representing a moderate invertebrate score, and greater than 13 taxa and over 40 invertebrates representing a high invertebrate score.

2.2.10 Annex 1 provides the vegetation assessments, SEPA water quality classifications and the invertebrate scores.

2.2.11 In addition to assessing individual waterbodies, the network of watercourses were evaluated using professional judgement taking into account the quality of each watercourse for water shrew, and the connectivity, size and distribution of the network throughout the wider landscape.

2.2.12 The survey was undertaken between June and July 2004. Any time of year is suitable for undertaking water shrew surveys, as they are active throughout the year. However, summer is, the optimal survey period, as densities of water shrew will be at their highest owing to the adult populations being augmented by juveniles. The survey results were also reviewed against the current design, and no further surveys were considered necessary to undertake this assessment.

2.3 Evaluation of Ecological Importance

2.3.1 The ecological evaluation of a receptor is determined by reference to statutory and non-statutory site designations, the results of the consultations, literature review and field surveys. The evaluation method incorporates a geographical framework where ecological receptors are assessed according to a series of criteria that are presented in Table 1. These criteria are based on the Ratcliffe Criteria (Ratcliffe, 1977) used in the selection of biological Sites of Special Scientific Interest (SSSI) and include size (extent), naturalness, rarity, typicality, vulnerability and position in an ecological/ geographical unit.

2.3.2 The criteria used in the ecological evaluation process include reference to the legal protection conferred on species or habitats as well as the conservation status of the receptor, such as presence on UK BAPs or LBAPs. These factors give rise to a level of conservation importance being assigned to species/habitats that reflects the geographical framework used in the evaluation process. Thus, for example species such as otters and bats are protected by european legislation, are referred to as internationally important in terms of their conservation status. Other species such as wych elm, which are identified as priority species in the NE Scotland BAP are referred to as regionally important species.

2.3.3 The ecological evaluation of a feature or area of habitat takes into account the level of conservation importance of the species, as well as other factors such as the level of use of the habitat or feature by a species, whether the species or habitat is locally or regionally common or rare, as well as other criteria that contribute to a feature's importance. In this way, the method of evaluation provides a system that combines legislative protection on species and/or habitats and conservation parameters that all contribute to the ecological importance of the receptor.

2.3.4 The ecological importance of the local water shrew population was determined in terms of nature conservation value by reference to any designations and the results of the consultations, literature review and field surveys.

2.3.5 The importance of water shrew habitats was based not only on the valuation of the species as a whole but also the evaluation of the habitats derived from the habitat assessment.

Table 1 – Evaluation of Ecological Receptor

Value/ Importance	Criteria
International (European)	Habitats An internationally designated site or candidate site (SPA, pSPA, SAC, cSAC, Ramsar site, Biogenetic/Biosphere Reserve, World Heritage Site) or an area which would meet the published selection criteria for designation. A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat which are essential to maintain the viability of a larger whole. Any river classified as excellent A1 and likely to support a substantial salmonid population. Any river with a Habitat Modification Score indicating that it is Pristine or Semi-Natural or Obviously Modified. Species Any regularly occurring population of internationally important species, threatened or rare in the UK. i.e. a UK Red Data Book species categories 1& 2 of UK BAP) or of uncertain conservation status or of global conservation concern in the UK BAP. A regularly occurring, nationally significant population/number of an internationally important species.
National (Scottish)	Habitats A nationally designated site (SSSI, ASSI, NNR, Marine Nature Reserve) or a discrete area which would meet the published selection criteria for national designation (e.g. SSSI selection guidelines). A viable area of a priority habitat identified in the UK BAP, or of smaller areas of such habitat essential to maintain wider viability. Any river classified as excellent A1 and likely to support a substantial salmonid population. Any river with a Habitat Modification Score indicating that it is Pristine or Semi-Natural or Obviously Modified. Species A regularly occurring, regionally or county significant population/number of an internationally/nationally important species. Any regularly occurring population of a nationally important species which is threatened or rare in the region or county (see local BAP). A feature identified as of critical importance in the UK BAP.
Regional (North East Scotland)	Habitats Sites which exceed the County-level designations but fall short of SSSI selection criteria. Viable areas of key habitat identified in the Regional BAP or smaller areas of habitat essential to maintain wider viability. Viable areas of key habitat identified as of Regional value in the appropriate SNH Natural Heritage Future area profile. Any river classified as excellent A1 or good A2 and capable of supporting salmonid population. Any river with a Habitat Modification Score indicating that it is significantly modified or above. Species Any regularly occurring, locally significant population of a species listed as being nationally scarce which occurs in 16-100 10 km squares in the UK or in a Regional BAP or relevant SNH Natural Heritage Future area on account of its regional rarity or localisation. A regularly occurring, locally significant population/number of a regionally important species. Sites maintaining populations of internationally/nationally important species that are not threatened or rare in the region or county.
Authority Area (e.g. County or District) Aberdeenshire/ City of Aberdeen	Habitats Sites recognised by local authorities (e.g.) District Wildlife Sites (DWS) and Sites of Interest for Nature Conservation (SINS). County/District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves (LNR). A viable area of habitat identified in County/District BAP or in the relevant SNH Natural Heritage Future area profile. A diverse and/or ecologically valuable hedgerow network. Semi-natural ancient woodland greater than 0.25 ha. Any river classified as good A2 or fair B and likely to support coarse fishery. Any river with a Habitat Modification Score indicating that it is significantly modified or above. Species Any regularly occurring, locally significant population of a species listed in a County/District BAP due to regional rarity or localisation. A regularly occurring, locally significant population of a County/District important species. Sites supporting populations of internationally/nationally/regionally important species that are not threatened or rare in the region or county, and not integral to maintaining those populations. Sites/features scarce in the County/District or which appreciably enrich the County/ District habitat resource
Local (immediate area or local village importance)	Habitats Areas of habitat that appreciably enrich the local habitat resource (e.g. species-rich hedgerows, ponds etc). Sites that retain other elements of semi-natural vegetation that due to their size, quality or the wide distribution within the local area are not considered for the above classifications. Semi-natural ancient woodland smaller than 0.25 ha. Any river classified as fair B or poor C and unlikely to support coarse fishery. Rivers with a Habitat Modification Score indicating that it is severely modified or above. Species Populations/assemblages of species that appreciable enrich the biodiversity resource within the local context. Sites supporting populations of county/district important species that are not threatened or rare in the region or county, and are not integral to maintaining those populations.

Value/ Importance	Criteria
Less than Local (Limited ecological importance)	Sites that retain habitats and/or species of limited ecological importance due to their size, species composition or other factors. Any river classified as impoverished D and/or and with a Habitat Modification Score indicating that it is severely modified.

Impact Assessment

2.3.6 In the assessment of significance of impact, consideration has been given both to the magnitude of impact and to the sensitivity of the receiving environment or species. The sensitivity of a feature was determined with reference to its level of importance although other elements have been taken into account where appropriate. Methods of impact prediction used indirect measurements, correlations, expert opinion, and information from previous developments. Impacts include those that are predicted to be direct, indirect, temporary, permanent, cumulative, reversible or irreversible.

Impact Magnitude

2.3.7 A definition of the magnitude impacts is presented in Table 2 and includes positive impact criteria in accordance with IEEM guidance (2002). The magnitude of each impact was assessed independently of its value or statutory status.

Table 2 – Impact Magnitude

Impact Magnitude	Criteria
High negative	The change is likely to permanently, adversely affect the integrity of an ecological receptor, in terms of the coherence of its ecological structure and function, across its whole area that enables it to sustain the habitat, complex of habitats and/or the population levels of species of interest.
Medium negative	The change is not likely to permanently adversely affect the ecological receptor's integrity but the effect on the receptor is likely to be substantial in terms of its ecological structure and function and may be significant in terms of its ecological objectives. Likely to result in changes in the localised or temporary distribution of a species but not affect its population status at a regional scale or permanently.
Low negative	The change may adversely affect the ecological receptor, but there will probably be no permanent effect on its integrity and/or key attributes and is unlikely to be significant in terms of its ecological objectives.
Negligible	The change may slightly adversely affect the receptor but will have no permanent effect on the integrity of the receptor or its key attributes. There are no predicted measurable changes to the species assemblage or population and the effect is unlikely to result in an increased vulnerability of the receptor to future impacts
Positive	The change is likely to benefit the ecological receptor, and/or enhance the biodiversity resource of the receptor.
High positive	The change is likely to restore an ecological receptor to favourable conservation status, contribute to meeting BAP objectives (local and national) and/or create a feature that is of recognisable value for biodiversity.

Impact Significance

2.3.8 The significance of an impact was determined according to the matrix of importance and magnitude as illustrated in Table 3.

Table 3 – Impact Significance

Magnitude / Importance	High Negative	Medium Negative	Low Negative	Negligible	Positive	High Positive
International	Major	Major	Moderate	Negligible	Moderate	Major
National	Major	Major	Moderate	Negligible	Moderate	Major
Regional	Major	Moderate	Minor	Negligible	Minor	Moderate
Authority Area	Moderate	Moderate	Minor	Negligible	Minor	Moderate
Local	Minor	Minor	Minor	Negligible	Minor	Minor
Less than Local	Minor	Negligible	Negligible	Negligible	Negligible	Negligible

2.3.9 The level of significance of impacts predicted on ecological receptors is an important factor in influencing the decision-making process and determining the necessity and/or extent of mitigation measures. Impacts can be beneficial or adverse, either improving or decreasing the ecological status health or viability of a species, population or habitat.

2.3.10 In general, an impact significance greater than or equal to Moderate would require specific mitigation to be undertaken to ameliorate the impact significance to acceptable levels.

Survey Limitations

2.3.11 The baited tube methodology is suitable for determining presence or absence of water shrew and determining habitat use, however it does not give information about population numbers nor is it able to detect water shrew in terrestrial habitats.

2.3.12 Two weeks of survey is the recommended duration of survey. Surveying was completed for these two weeks and 75% of sites were checked. No evidence of water shrew was recorded at any of the sites (over 100 tubes) therefore tubes were left out for a further two weeks. During the second two weeks 50% of the shrew tubes were washed away. However the total surveying effort exceeded that recommended in Churchfield et al. (2000). Once again, no evidence of water voles was recorded within any of the tubes.

2.3.13 It cannot be guaranteed that all habitats used by water shrew will be detected using this method or any other method (i.e. live trapping) particularly if water shrew are present in particularly low densities.

2.4 Baseline

Data Search

2.4.1 Data searches found no records of water shrew within 10km of the study area and few records for water shrew in North East Scotland as a whole, although the lack of information may be due to a lack of survey data rather than an absence of water shrew (pers. comm. Lesley Cropper, North East Scotland Biological Records Centre).

Incidental Observations

2.4.2 A dead shrew was found outside of the study area on Elrick Burn at NJ 889 169. This is approximately 1km north of the study area, north of the confluence of Elrick and Goval Burn.

Survey Results

Tube Surveys

2.4.3 Table 4 presents the names, grid reference, location, figure reference and results of the water shrew surveys.

2.4.4 The main water features comprised: West Brimmondside Pond, Gough Burn, Craibstone Burn, Green Burn, Bogenjoss Burn, River Don, Goval Burn, Red Moss Burn and Blackdog Burn. No evidence of water shrew was recorded within any of the identified water features in the study area.

Table 4 – Watercourses Surveyed for Water Shrew (Sections NL1 – NL5)

Section	Site Number	Grid Reference	Location	Figure	Result
NL1	1	NJ 857 081	West Brimmondside Pond	10.8a	Negative
NL2	2	NJ 869 101	Gough Burn	10.8b	Negative
	3	NJ 871 102	Gough Burn	10.8b	Negative
	4	NJ 867 107	Craibstone College (burn)	10.8b	Negative
	5	NJ 869 107	Craibstone College (burn)	10.8b	Negative
	6	NJ 867 109	Craibstone College (pond)	10.8b	Negative
	7	NJ 865 111	Green Burn	10.8b	Negative
	8	NJ 869 111	Green Burn	10.8b	Negative
	9	NJ 872 111	Green Burn	10.8b	Negative
NL3	10	NJ 859 134	Bogenjoss Burn	10.8c	Negative
	11	NJ 859 141	Bogenjoss Burn	10.8c	Negative
	12	NJ 859 144	Bogenjoss Burn	10.8d	Negative
	13	NJ 862 147	Bogenjoss Burn	10.8d	Negative
	14	NJ 860 150	Bogenjoss Burn	10.8d	Negative
NL4	15	NJ 877 150	River Don	10.8d	Negative
	16	NJ 878 147	River Don	10.8d	Negative
	17	NJ 880 145	River Don	10.8d	Negative
	18	NJ 885 143	Goval Burn	10.8d	Negative
	19	NJ 885 147	Goval Burn	10.8d	Negative
	20	NJ 889 148	Goval Burn	10.8d	Negative
	21	NJ 890 151	Goval Burn	10.8d	Negative
	22	NJ 893 149	Goval Burn	10.8d	Negative
	23	NJ 894 154	Goval Burn	10.8d	Negative
NL5	24	NJ 923 141	Field Drain feeding into Corby Loch	10.8e	Negative
	25	NJ 922 157	Field Drain feeding into Corby Loch	10.8f	Negative
	26	NJ 944 145	Blackdog Burn	10.8g	Negative
	27	NJ 946 144	Blackdog Burn	10.8g	Negative
	28	NJ 948 142	Blackdog Burn	10.8g	Negative
	29	NJ 949 142	Blackdog Burn	10.8g	Negative
	30	NJ 953 139	Blackdog Burn	10.8g	Negative
	31	NJ 956 139	Blackdog Burn	10.8g	Negative

Habitat Assessment

2.4.5 The habitat assessment (Table 5) found all watercourses to provide high quality water shrew habitat.

Table 5 – Water Shrew Habitat Quality Assessment (Sections NL1 – NL5)

Section	Water Body	Water Width (m)	Water Depth (m)	Suitability of Vegetation / Cover	Quality of Invertebrates	Overall Quality of Habitat
NL1	West Brimmondside Pond	0.5-1	0.30	Good	Assumed high	High
NL2	Gough Burn	1.5	0.05	Good	High	High
	Craibstone Burn	1.5	0.50	Good	Assumed high	High
	Craibstone Pond	N/A	1+	Good	Assumed high	High
	Green Burn	2	0.10	Good	High	High
NL3	Bogenjoss Burn mid-site (NJ 85959 14269)	1	0.40	Good	High	High
	Bogenjoss Burn mid-site (NJ 85892 13360)	0.75	0.10	Good	Assumed high	High
	Bogenjoss Burn mid-site (NJ 85959 14269)	1	0.40	Good	High	High
	Bogenjoss Burn mid-site (NJ 85892 13360)	0.75	0.10	Good	High	High
NL4	River Don	22	0.30	Moderate	High	High
	Goval Burn	3	0.30	Good	Assumed high	High
NL5	Red Moss Burn	1.5	No data	Moderate	high	High
	Black Dog Burn	1	0.15	Good	high	High

Survey Results Summary

Incidental Observations

2.4.6 During additional otter surveys (October 2004) a dead water shrew was found on an emergent boulder on Elrick Burn at NJ 889 169. This is approximately 1km north of the Northern Leg study area.

Tube Surveys

2.4.7 Over 175 survey tubes were recovered and investigated for water shrew droppings. No evidence of water shrew was recorded from any of the watercourses.

2.4.8 Suitable water shrew habitat was identified throughout the study area.

Habitat Assessment

2.4.9 All watercourses were assessed to provide high quality water shrew habitat by the habitat assessment.

3 Ecological Evaluation

Rationale

3.1.1 The ecological importance of the local water shrew population was determined in terms of nature conservation value by reference to any designations and the results of the consultations, literature review and field surveys.

3.1.2 The importance of water shrew habitats was based not only on the valuation of the species as a whole but also the evaluation of the habitats derived from the habitat assessment.

Species

3.1.3 Although the water shrew survey using baited tubes found no evidence of water shrew within the study area, the discovery of a dead water shrew remote from the study area does demonstrate that the species is present in Aberdeenshire. The dead water shrew was found on Elrick Burn, a tributary of Goval Burn. Although this burn was surveyed using the baited tube methodology, no water shrew were detected.

3.1.4 All locations surveyed offered suitable water shrew habitat, with much of this habitat representing high quality habitat for water shrew with high aquatic invertebrate densities. As, after the initial two week baited tube survey period, water shrew were not recorded within this suitable habitat, a further two week long survey was undertaken. Once again, no water shrew were recorded. Evidence that some of the baited tubes had been visited by small mammals was detected (the nylon baffle had been chewed through in several instances) and in many cases all the blowfly pupae had been removed, however no droppings of any kind were recorded. Churchfield et al. (2000) carried out comparisons of baited tube surveys and live trapping surveys and found the baited tube method to be more successful in revealing the presence or absence of water shrew than the live trapping method.

3.1.5 The presence of an incidental dead water shrew despite an absence of water shrew signs from baited tubes indicates that where suitable habitat is supported, it is likely that water shrew are present. It is therefore assessed that water shrew are present in other parts of the proposed scheme and for the purposes of assessment considered that they may be present throughout all areas of suitable habitat within the study area.

3.1.6 Should water shrew be present in the study area they are assessed to be of **local** ecological importance using the criteria detailed in Table 1 as the species is not of conservation concern, there is no recorded trend showing a decline in numbers, they are not afforded any specific legal protection on account of their conservation status and they do not feature in any local or national biodiversity action plan.

Sections NL1-NL5

3.1.7 Each of the five route sections are evaluated as being of **local** ecological importance for water shrews. The network of waterbodies that flow through the sections would be of primary importance to any water shrew that are present. This evaluation is based on the finding that of 13 waterbodies surveyed, all were assessed as providing high quality water shrew habitat (all with high invertebrate scores). In addition, they provide the main landscape feature around which water shrew territories would be based and the primary means by which water shrew could disperse throughout the landscape.

3.1.8 Other terrestrial linear features, such as hedgerows, field margins and woodlands may also represent an important dispersal route, particularly for dispersing juveniles.

4 Potential Impacts

4.1 Introduction

4.1.1 Although no water shrew were recorded within the study area, suitable habitat is present, and as noted in the evaluation above, it is assumed for the purposes of assessment that water shrew may be present. Mitigation is therefore provided below following a precautionary approach.

4.2 Generic Impacts

Direct Mortality

Construction

4.2.1 Water shrew could suffer direct mortality during construction through direct habitat loss resulting from site clearance, or through the pollution of watercourses. Water shrew may also become trapped in any small-aperture receptacles left lying around on construction sites, in addition to uncovered pits and trenches.

Operation

4.2.2 Water shrews are unlikely to cross the carriageway during the operational phase of the proposed road, as they are averse to crossing areas of open ground. Therefore any mortality resulting from traffic is predicted to be low. Some additional increased water shrew mortality may result from water shrew becoming trapped in discarded bottles, from any increase in roadside litter associated with the road. As water shrew are territorial for most of the year these impacts would potentially affect a small proportion of any local population (i.e. water shrew with territories close to the road, male shrew within approximately 250m of the road and dispersing juveniles could all suffer an increased risk of premature death).

Habitat Loss

Operation

4.2.3 Habitat loss during construction is likely to be widespread, in particular associated with the installation of culverts and/or bridges on the majority of watercourses crossed by the proposed scheme. Although this habitat loss would occur during the construction phase of the scheme, it is regarded as an operational impact since the loss would be permanent. However it should be noted that the amount of habitat loss would represent a small proportion of suitable water shrew habitat where the road crosses each watercourse (between 30m and 240m of watercourse habitat depending upon the angle at which the road crosses the watercourse and whether the road is in embankment or cutting). At its greatest, this size of habitat loss is equivalent to the size of 1-2 water shrew territories on each waterbody. Assuming that there is a water shrew territory on each suitable watercourse impacted by the scheme it is estimated that a minimum of 31 territories would be lost.

4.2.4 Any further habitat loss during the operational phase of the proposed scheme would be likely to be minimal and mostly associated with routine mowing of roadside verge or during clearance to gain maintenance access to culverts and/or bridges.

4.2.5 A summary of areas of land-take by Phase I habitat category is provided in the Terrestrial Habitats report (Appendix A10.1).

Habitat Fragmentation, Isolation and Severance

Construction

4.2.6 Habitat fragmentation, isolation and severance of water shrew populations resulting from habitat loss and in-channel works during the construction of culverts and/or bridges is likely to be considerable on affected watercourses. It should be noted that the magnitude of impacts affecting movement and dispersal will temporarily increase when watercourses are diverted prior culvert installation.

Operation

4.2.7 The proposed scheme during operation would represent a barrier between potential populations either side of the alignment restricting dispersal of young, and the movements of males during the breeding season. Both of these impacts may restrict gene flow and could result in the loss of isolated fragments of the water shrew population.

Disturbance

Construction

4.2.8 Water shrew populations on watercourses and/or other suitable habitats would be likely to incur disturbance during construction of the proposed scheme mostly associated with pre-construction habitat clearance in the vicinity of watercourse crossings. It is possible that disturbance may result in the redistribution of some water shrew territories although this would depend on the magnitude of disturbance.

Operation

4.2.9 Disturbance during operation of the proposed scheme would be likely to be minimal, and mostly associated with routine mowing of roadside verge or during clearance to gain maintenance access to culverts and/or bridges.

Pollution and Other Indirect Impacts

Construction

4.2.10 Pollution events could occur during the construction of the proposed scheme. Pollution events could include toxic spill events and increased sedimentation of watercourses during the construction of bridges, culverts and watercourse diversions.

4.2.11 Increased sedimentation and accidental spills could have an adverse impact on any local water shrew population inhabiting the affected watercourse or connected watercourses downstream of a spill event. Increased sedimentation could render sections of watercourses unsuitable for many aquatic invertebrates thereby severely depleting the water shrew's main source of food in addition to directly poisoning water shrew themselves. Both increased sedimentation and accidental spills could potentially render large areas of habitat unsuitable for water shrew.

Operation

4.2.12 Potential impacts during the operation of the proposed scheme may include adverse impacts related to road runoff. Runoff from the road could contain Polychlorinated Biphenyls (PCBs), heavy metals or oils. Steady build-ups of these can effect mammalian reproduction rates, directly poison them, poison aquatic invertebrates or affect the waterproofing abilities of the water shrew's coat. All of these factors can increase mortality rates and restrict water shrew population growth representing a severe negative impact on the local population of water shrew.

4.2.13 Significant pollution of local watercourses by runoff, sedimentation and spill events have been assessed as unlikely (refer to ES Chapter 9: Water Environment).

4.3 Specific Impacts

4.3.1 Water shrews in the study area may experience the generic impacts described above. Impact significance is assessed for Sections NL1-NL5 by taking these generic impacts into account and combining them with the potential specific impacts. Specific impacts relate exclusively to habitat loss, fragmentation of habitat and severance of water shrew territories and dispersal routes.

Section NL1 (Derbeth –Tulloch Road)

4.3.2 In Section NL1, no watercourses would be crossed by the proposed scheme. Consequently the impact of the proposed scheme is assessed as being of low negative magnitude. Since in relation to water shrew the waterbodies in this Section have been evaluated as being of local ecological value, these potential impacts are assessed as being of **Minor** significance.

Section NL2 (SAC Craibstone)

4.3.3 In Section NL2, the proposed scheme would cross four watercourses, resulting in loss, fragmentation and severance of potential water shrew habitats. These include:

- approximately 60m of Kepplehill Burn (ch315200);
- approximately 60m of Gough Burn (ch316390) would be severed; ;
- approximately 175m of Craibstone Burn (ch316990) would be severed; and
- approximately 150m of Green Burn (ch317300) would be severed, Green Burn would also be severed a further three times to the east of ch317400 at the A96 interchange, with the loss of a further 300m.

4.3.4 Consequently the impact magnitude is assessed as being high negative. Since in relation to water shrew the water bodies in this section have been evaluated as being of local ecological value, these potential impacts are assessed as being of **Minor** significance.

Section NL3 (A96 – Nether Kirkton)

4.3.5 In Section NL3, two lengths (approximately 100m each) of Bogenjoss Burn would be crossed by the proposed scheme at ch319940 and ch320900. This would potentially result in the fragmentation of water shrew habitats and water shrew dispersal routes.

4.3.6 Consequently the impact magnitude is assessed as being medium negative. Since in relation to water shrew the waterbodies in this section have been evaluated as being of local ecological value, these potential impacts are assessed as being of **Minor** significance.

Section NL4 (Nether Kirkton - Corsehill)

4.3.7 In Section NL4, approximately 100m of the River Don (ch323050), 200m of Goval Burn and 100m of Goval Mill Lade (ch323610, ch324400 and A947 offline) would be crossed by the proposed scheme, resulting in fragmentation of potential water shrew habitats and water shrew dispersal routes.

4.3.8 Consequently the impact magnitude is assessed as being high negative. Since the waterbodies in this section have been evaluated as being of local ecological value to water shrew, these potential impacts are assessed as being of **Minor** significance.

Section NL5 (Corsehill - Blackdog)

4.3.9 In Section NL5 approximately 100m of Red Moss Burn (ch327500) and 60m of Blackdog Burn (ch329950) would be crossed by the proposed scheme, resulting in fragmentation of potential water shrew habitats and water shrew dispersal routes.

4.3.10 Consequently the impact magnitude is assessed as being medium negative. Since the waterbodies in this section have been evaluated as being of local ecological value to water shrew, these potential impacts are assessed as being of **Minor** significance.

5 Mitigation

Rationale

5.1.1 The mitigation measures outlined below comprise prevention/avoidance, reduction and offset/compensation measures, which form a hierarchy of measures that should be adopted, preferably in this order.

5.1.2 Generally, where site-specific impacts on a receptor species and their habitats are predicted to be of greater than or equal to Moderate significance it is recommended that measures are taken to ameliorate the impact significance to acceptable levels. In the case of water shrew, none of the impacts are predicted to constitute an impact significance greater than 'Minor', and thus site-specific mitigation measures are not required. However generic mitigation measures that are proposed for other species will directly / indirectly ameliorate the adverse impacts of the proposed scheme described above on water shrew populations. These are described below.

Generic Mitigation

Direct Mortality

5.1.3 Risk of direct mortality during construction will be reduced by following best practice guidelines and SEPA pollution prevention guidelines (PPG1, PPG2 and PPG6) (SEPA, 2004). These will ensure that accidental spills are prevented and the maintenance of a tidy construction site, free of any objects in which water shrew could become trapped.

Habitat Loss

5.1.4 Riparian habitat loss will be reduced where watercourses are crossed using bridges at the River Don (ch323050) and three bridges at Goval Burn (ch323610, ch324400 and ch324620). Culverts will be installed at all other watercourse crossings, which will result in habitat loss that cannot be prevented or reduced further. However, as described in Chapter 9 of the ES (Water Environment), these will be depressed invert box culverts which maintain bed substrate through the culvert.

5.1.5 In the course of mitigating impacts on otter, amphibian and freshwater environments through the design of road drainage areas of wetlands and riparian zones will be created throughout the proposed scheme (refer to Appendices A10.6, A10.9 and A10.16). These reports recommended the creation of riparian / wetlands habitats at the following approximate chainages in order to offset the loss of aquatic habitat: ch320500, ch324300–324600 and ch325450.

5.1.6 Recommended riparian / wetland habitat is shown on Figures 11.5 a-p (Landscape and Ecology Mitigation). These habitats will be designed to maximise their ecological value. Features that will be included in the design process that will benefit water shrew include:

- soft banks into which water shrew can burrow;
- heavily vegetated banks (tall herb or grass dominated vegetation as opposed to trees or scrub) to provide cover;

- extensive areas of marginal habitat (i.e. areas of shallow water no more than 20-30mm deep). To achieve this and ensure that such areas remain wet all year round margins should have a very shallow gradient, so that as water levels fluctuate the areas of suitable marginal habitat are retained. These marginal habitats are of importance to aquatic invertebrates on which water shrew feed and provide a habitat suitable for foraging; and
- connectivity where possible with the wider landscape, especially watercourses, through creation of linear, semi-natural features such as wildflower buffer strips, rough grassland or hedgerows/dry stone walls. These features will provide sheltered corridors along which shrew can disperse.

Habitat Fragmentation and Isolation

5.1.7 The impacts of habitat fragmentation, severance and isolation will be lessened through the construction of culverts where the road crosses a watercourse. Mammal ledges are required for all culverts as part of the mitigation proposals for protected species (as part of otter mitigation measures (refer to Appendices A10.2: Badger and A10.6: Otter) and may also enable water shrew and other species to disperse. As noted above, the depressed invert design will also retain bed substrate connectivity between upstream and downstream sections of the culverted watercourse. and may be used by other species. However, the incorporation of ledged culverts will only partially reduce the impact of isolation and water shrew dispersal route severance, and it is considered that culverts generally would only be used infrequently and by a small number of water shrews, particularly where culverts are long. Shrews will avoid areas of open habitat, preferring to travel through areas offering vegetative cover in order to avoid predators (Churchfield, 1986). This could result in the isolation of water shrew populations either side of the road alignment.

5.1.8 Where the proposed scheme would cross the River Don, a wide span bridge will be used that leaves lengths of soft, vegetated bank habitat intact. Bridges will also be constructed where the proposed scheme or associated side roads cross the Goval Burn, and in these areas the barrier effects would therefore be reduced.

Disturbance

5.1.9 Disturbance of suitable habitat for water shrew will be prevented as far as practical by the installation of temporary fencing around habitats of high value to water shrew (the location and extent of which will be determined by the Ecological Clerk of Works) and by mowing vegetation due to be cleared prior to removal with the aim of displacing water shrews into undisturbed adjacent habitats.

5.1.10 Disturbance at night will be prevented as far as practical by minimising night time working in habitats of high value to water shrew.

5.1.11 Disturbance to stream and riverbeds will be minimised as far as practical through the adoption of best working practices and SEPA pollution prevention guidelines (PPG1, PPG2 and PPG6).

Pollution and Other Indirect Impacts

5.1.12 During construction, measures will be adopted to minimise the risk and impacts of sedimentation and spill events. These measures are described in detail in Chapter 9 (Water Environment).

5.1.13 During operation, effective drainage systems will minimise the impacts of road runoff and reduce the risk and impact of spill events. These are outlined in detail in Chapter 9 (Water Environment). Drainage systems will include features to divert runoff into drains, soak-aways and balancing ponds thus avoiding contamination of watercourses.

6 Residual Impacts

6.1.1 Although evidence of water shrew was not found within the study area, a precautionary approach has been adopted and it is considered likely that they may be present where habitat is suitable. While the lack of data makes it difficult to quantify residual impacts following mitigation, it is considered likely that there would be an overall degradation in the quality of potential water shrew habitat available. This reduced habitat quality would be largely due to the loss of habitat and the barrier effects of the proposed scheme. While the creation of riparean and wetland habitats will result in an overall increase in aquatic habitat available to any water shrew, these may not provide such high quality foraging habitat as the invertebrate rich flowing water that will be culverted and degraded.

6.1.2 In summary, the residual impacts of the proposed scheme on water shrew populations if present, are assessed as of **Minor** significance.

7 References

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Annex 1 – Habitat and Invertebrate data

Annex Table 1 – Vegetation Assessment

Waterbody	In Channel Vegetation	Dominant Bankside Vegetation (5m)	Suitability For Water Shrews
West Brimmondside Pond	No data	Reed bed	good
Gough Burn	Liverworts/ mosses/ lichens	Broadleaf/ mixed woodland	good
Burn at Craibstone College	No data	Broadleaf/mixed woodland	good
Pond at Craibstone College	No data	Marginal vegetation	good
Greenburn	Liverworts/ mosses/lichens	Broadleaf/ mixed plantation	good
Bogenjoss Burn mid-site (NJ 8595914269)	Liverworts/ mosses/ lichens	Broadleaf/mixed woodland	good
Bogenjoss Burn mid-site (NJ 8589213360)	Liverworts/ mosses/ lichens	Broadleaf/ mixed woodland, unimproved grassland/ pasture, coniferous plantation, scrub & shrubs	good
Bogenjoss Burn mid-site (NJ 8595914269)	Liverworts/ mosses/ lichens	Broadleaf/mixed woodland	good
Bogenjoss Burn mid-site (NJ 8589213360)	Liverworts/ mosses/ lichens	Broadleaf/ mixed woodland, unimproved grassland/ pasture, coniferous plantation, scrub & shrubs	good
Don River	Emergent reeds/sedges/ rushes/ grasses/ horsetails, submerged broad-leaved & fine-leaved, amphibious, submerged linear leaved & filamentous algae.	Unimproved grassland/ pasture; improved/semi-improved grassland	moderate
Goval Burn	Liverworts/ mosses/lichens	Tall herb/rank vegetation	good
Field Drain feeding into Corby Loch	Little in channel vegetation	Herb vegetation	moderate
Black Dog Burn	Liverworts/ mosses/ lichens & filamentous algae present	Tall herb/rank vegetation	good

Annex Table 2 – Invertebrate Assessment

Waterbody	Invertebrate Abundance	Number of Invertebrate Taxa	Water Quality Classification	Suitability for Water Shrews
Den Burn	20	7	Poor	moderate
West Brimmondside Pond	No data	No data	No data	Assumed high
Gough Burn	83	18	Excellent	high
Burn at Craibstone College	No data	No data	No data	Assumed high
Pond at Craibstone College	No data	No data	No data	Assumed high
Greenburn	63	25	Excellent	high
Bogenjoss Burn	50	19	Excellent	high
Bogenjoss Burn	50	19	Excellent	high
Don River	114	18	Good	high
Goval Burn	116	14	Excellent	high
Field Drain feeding into Corby Loch	No data	No data	No data	Assumed high
Black Dog Burn	87	21	Good	high