Appendix A40.6 – Red Squirrel Survey

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1 Introduction

1.1 General Background

1.1.1 This report is one of the appendices supporting Chapter 40 (Ecology and Nature Conservation) of the AWPR Environmental Statement (ES). It considers the potential impacts on red squirrel populations associated with the Fastlink of the proposed scheme. The results of the surveys carried out for the purpose of this assessment are also presented and are shown on Figures A40.8a-f.

1.1.2 The three component route sections in this report for the Fastlink of the proposed scheme are as follows:

- Section FL1: Stonehaven to Howieshill (ch0-3200);
- Section FL2: Howieshill to Cookney (ch3200-6300); and
- Section FL3: Cookney to Cleanhill Junction (ch6300-10200).

1.1.3 All tables and figures for this report are structured in this manner.

1.1.4 The Ecological Impact Assessment (EcIA) was undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volumes 10 and 11 (Highways Agency 2001) and the Environmental Impact Assessment (Scotland) Regulations 1999, along with cognisance of draft Institute of Ecology and Environmental Management (IEEM) guidelines.

1.1.5 These studies included desk-based consultation to collate existing information about red squirrel populations in the study area for the proposed scheme and field surveys to provide current data about the status of red squirrel populations and the habitats that support them.

1.1.6 Cumulative impacts are assessed in a separate report combining the predicted impacts for all habitats and species over the proposed route (refer to Part E: Cumulative Assessment, of the ES).

Aims

1.1.7 The purpose of the survey and assessment was to:

- assess the presence and status of red squirrel populations and their habitats in the study area;
- identify potential impacts on red squirrel populations;
- provide recommendations to mitigate for potential impacts;
- identify any residual impacts on red squirrels.

1.2 Background to Assessment

Biology

1.2.1 The red squirrel *Sciurus vulgaris* is distributed throughout the Northern Palaearctic. The last 50 years has seen a drastic decline in their numbers and distribution over their geographic range in the British Isles. They are now restricted to Scotland, Ireland, Northern England and small pockets in Wales and Southern England. There are estimated to be around 160,000 red squirrels within the United Kingdom. Scotland has an estimated population of around 120,000 (Harris et al., 1995) and as such, holds the core of the United Kingdom population.

1.2.2 The red squirrel is the only squirrel native to the United Kingdom. They have fur colour varying from bright ginger through to red and dark brown in the summer, or black tinged with grey in winter. Other distinguishing features are the large ear tufts, which appear in mid-winter and disappear by the summer (Corbett and Southern, 1977). The other species present is the grey squirrel (*Sciurus carolinensis*) introduced to Britain in the 19th century, which may compete with the red squirrel in some habitat types.

1.2.3 The continuing spread of the grey squirrel is regarded as a major threat to the survival of red squirrels. Red and grey squirrels occupy a similar ecological niche and so are often in direct competition with each other for habitat and food resources (termed inter-specific competition). Grey squirrels appear to be better adapted to the current fragmented British Woodland and so out-compete the native reds (see paragraph 1.2.9 for more details), typically displacing them within 15 years of their arrival to an area. Furthermore, grey squirrels carry squirrel poxvirus (SQPV), which is potentially fatal to red squirrels but does not appear to affect greys. This together with habitat loss and fragmentation, and changes in woodland management practices are all considered to be contributing factors to the observed red squirrel decline (Scottish Squirrel Group, 2004).

1.2.4 In North East Scotland, red squirrels are considered to be widespread. Forestry Commission Records (Legge, 2002) suggest that North East Scotland has the largest area in the UK in which red squirrels have been continuously present between 1973 and 1992.

1.2.5 Red squirrels are territorial and active during the daytime, spending about three-quarters of their active time above ground in trees and shrubs. Their main foods are tree seeds such as hazel nuts and seeds from conifer cones, although they also eat tree flowers, shoots and fungi. They often suffer periods of food shortage especially during July. They live in dreys, which are constructed of twigs in a tree fork, or hollow or above a whorl of branches close to the stem of a conifer (Trittensor, 1970). Dreys are lined with soft hair, moss and dried grass. Several squirrels may share the same drey or use the same drey on different days. In addition, one squirrel may also use several dreys.

1.2.6 Breeding can begin in mid-winter and continue through the summer, depending on the weather and food availability (Holm, 2000). Females have one or two litters a year, usually of about 2-4 young. Juveniles are weaned at around 10 weeks, but do not breed until they are one year old. In favourable habitat, red squirrels typically live at a population density of one squirrel per hectare of woodland, however, population densities in North East Scotland are higher than this and range between 1.81 squirrels per hectare and 2.1 squirrels per hectare (Legge, 2002), although populations vary each year depending on the seed crop. They can survive for up to six years in the wild.

1.2.7 Red squirrels can be found in broadleaved woodland (comprising small-mast tree species such as silver birch, ash, willow, aspen, alder, yew and hawthorn), but tend to be found at higher densities in mature coniferous woodland This trend is often a response to the presence of grey squirrels in the area, as competition from grey squirrels is considered to be less pronounced in coniferous woodlands (see paragraph 1.2.10), rather than due to habitat preferences. In coniferous woodland, their optimum habitat requirement is mature conifer species such as Scot's pine, Norway spruce and European larch. Their preference is for mature Scot's pine. Red squirrels are not usually found in immature plantations of Sitka spruce (at the thicket stage), but can be found in mature, thinned plantations at low densities. Beech trees in particular are favoured by grey squirrels. The size and type of woodland and the connectivity between woodland patches are important factors in maintaining the persistence of red squirrels.

1.2.8 Despite the well-documented displacement of red squirrels by greys (paragraph 1.2.3), it appears that in some Scottish woodlands red and grey squirrels have co-habited the same woodland for decades as shown in Craigvinean Forest in Dunkeld, Perthshire, which has been studied in detail over several years (Bryce and MacDonald, 2000). It appears that habitat type plays a crucial role in the success of this red squirrel population. Observations suggest that, not only are there tree species mixes (small-mast producing species) that favour red squirrel survival, but also that the physical layout of the woodlands might be important. Not enough is yet understood about the potential for habitat partitioning between red and grey squirrels, and considerable benefits could be gained from close monitoring of squirrels in these areas (Scottish Squirrel Group, 2004).

1.2.9 Grey squirrels in woods containing broad-leaved trees (specifically oak) can take greater advantage of the autumn seed crop than red squirrels, increasing their weight by around 20% (Kenward and Tonkin, 1986) thus enabling them to be in better breeding condition in the spring (Wauters and Dhondt, 1989). Consequently, grey squirrels in mixed and deciduous woods may still breed in years when red squirrels do not and may displace the red squirrel population in these woods over successive years (Skelcher, 1997).

1.2.10 As red squirrels are predominantly associated with conifer forests where food remains in the canopy for most of the year, a large weight increase is likely to be a disadvantage in this environment as squirrels have to be light to reach seeds at the ends of tree branches (Gurnell, 1987). An adult red squirrel weighs around 350g compared with approximately 570g for grey squirrels (Bryce et al., 2002). Consequently, the breeding success of grey squirrels will be less pronounced in coniferous woodland, which is possibly why red and grey squirrels have been seen to co-exist in these types of woodland (Skelcher, 1997). In such situations, it seems that small blocks or belts of seed-producing broad-leaf trees within extensive conifer forests enable grey squirrel colonisation. They then act as survival habitats from which grey squirrels can expand and contract into and out of conifer stands according to prevailing seed supplies (Gurnell, 1996). Controlling grey squirrel numbers, either by culling them or removing large-masted tree species, means that not only will inter-specific competition between reds and greys be reduced but also that the probability of diseases such as squirrel poxvirus being transmitted to red squirrels could be decreased.

Legal Status

1.2.11 Enhanced statutory protection for red squirrels in the United Kingdom is provided under Schedules 5 and 6 of the Wildlife and Countryside Act (1981) (as amended). This Act has recently been further amended by the Nature Conservation (Scotland) Act 2004, which includes the term 'recklessly' to the list of prohibited actions. Under Sections 9 and 11 of this Act, it is an offence to:

- intentionally (or recklessly) kill, injure, take or possess a wild red squirrel;
- intentionally (or recklessly) damage, destroy or obstruct access to any structure or place used by a red squirrel for shelter or breeding;
- intentionally (or recklessly) disturb a red squirrel while it is occupying a structure or place that it uses for protection;
- sell, offer for sale, expose for sale or have for the purpose of sale, any red squirrel, or to infer that red squirrels can be bought or sold; and
- kill or capture red squirrels by indiscriminate methods such as snaring or poisoning.

1.2.12 Section 18 of the Act states that attempting to commit any such offence is legally the same as committing the offence.

1.2.13 In certain circumstances, licences can be granted under Section 16 (3) for the destruction or removal of red squirrels for instance: to prevent serious damage to livestock, crops, growing timber or any other property; to prevent the spread of disease; for science and education purposes; or for conservation. Control of red squirrels without such a licence is an offence.

1.2.14 The red squirrel is also protected under the Wild Mammals (Protection) Act 1996, which makes it illegal to subject them to any wilful act of cruelty or abuse.

1.2.15 This species is listed under Appendix III of the Bern Convention but, in view of its more favourable conservation status in mainland Europe, is not listed on the EC 'Habitats' Directive (EEC/92/43).

1.2.16 The red squirrel is listed on the UK Biodiversity Action Plan as a Priority Species and has a UK Species Action Plan (SAP). The red squirrel is considered to require local action to conserve and enhance populations in the Local Biodiversity Action Plan for North East Scotland and therefore also has a Local SAP. In addition, a Scottish Red Squirrel Action Plan 2006-2011 has been prepared under the auspices of the UK Biodiversity Action Plan and the Scottish Biodiversity Strategy.

2 Approach and Methods

2.1 Consultation

2.1.1 The following individuals and organisations were consulted during the course of the desk study in order to collate any existing information on the distribution of red squirrels within the proposed route corridor:

- North East Scotland Biological Records Centre (NESBReC) – Lesley Cropper;
- Aberdeen City Council – James Hale;
- NES Biodiversity Partnership: Local Biodiversity Officer, Maria Hardy;
- Scottish Natural Heritage (SNH);
- The Forestry Commission (FC)– Woodland Officer, Gavin Legge; and
- The Grampian Squirrel Group – Chairman, Gavin Legge.

2.2 Survey Methods

2.2.1 Squirrel surveys were undertaken between the 12 April and 13 July 2006 to establish whether red and/or grey squirrels were present in five woodland areas within a corridor approximately 11.5km long and 1km wide (see Figures 40.8a-f).

2.2.2 Results from Stage 1 surveys (23 – 27 January 2006), consultation and professional judgement were used to identify woodlands that would be subject to survey for the Stage 3 assessment. The survey corridor extended along the study area in a 500m wide corridor either side of the proposed centre line of the route.

2.2.3 Survey effort was concentrated on woodland areas deemed most suitable for supporting red squirrel populations, considering factors such as size of woodland, degree of isolation and tree species present.

2.2.4 According to the North East Scotland Biodiversity Red Squirrel Local Species Action Plan (Legge, 2002), red squirrels have come to be associated mainly with coniferous woods in the North East. In line with this information, the surveys were primarily undertaken in coniferous woodlands, although mixed and broad-leaved woodlands were also surveyed. Verbeylen et al (2003) have shown that the minimum size of woodland necessary to support a viable population of red squirrels is 3.5ha (provided squirrels are able to access other nearby woodland areas, using hedgerows and tree lines as commuting corridors). Therefore, highly isolated woodland areas smaller than 3.5ha were not subject to survey.

2.2.5 There are four indirect methods of studying squirrels in the field: visual counts, hair-tube surveys, drey counts and feeding transects. The surveys consisted of a combination of visual counts and hair-tube surveys as only these methods can distinguish between red and grey squirrels. It has been demonstrated that combining these methods provides good results (Gurnell et al., 2004). Moreover, using two different methodologies is likely to increase the probability of detecting red squirrel presence. Drey counts and feeding transects were not applied as these methods cannot differentiate between red and grey squirrels.

2.2.6 Visual sightings are often just a fleeting glimpse of an animal as it moves through the tree canopy and it is not always easy to distinguish red from grey squirrels, even though adult grey squirrels are about a third larger than red squirrels (Gurnell et al., 2001). In light of this fact and due to the large amount of woodland to be surveyed, hair–tube surveys were also employed.

2.2.7 Although not the primary focus of this study, the presence of grey squirrels was also recorded. The purpose of this was to incorporate the potential for inter-specific competition with any red squirrels co-existing in the same woodland area and the resultant detrimental effects on the local red squirrel population.

Hair-tube Surveys

2.2.8 Hair-tube surveys were carried out in accordance to the methods outlined by Gurnell et al. (2001). It should be noted that although squirrel presence is confirmed by finding hairs in at least one of the tubes, the number of squirrel hairs left in a tube is not necessarily related to the number of individuals visiting the tube. Furthermore, one squirrel may visit many tubes and the sampling area of each tube is not known (Gurnell et al., 2001). As such, this exercise did not aim to provide an estimate of red and grey squirrel population sizes, but rather an indication of the presence/absence of the species in the various woodland areas surveyed.

2.2.9 Hair-tubes were placed in suitable locations in order to maximise their success rate in detecting the presence of red squirrels. The hair-tubes were set out to cover as much area of suitable woodland habitat as possible whilst concentrating on those woodland areas that could be directly affected by the proposed route corridor. Tubes were placed outside of the route corridor (see Figures 40.8a -f) where it was considered necessary in order to identify the status of red squirrels within woodland areas of interest. The following process was used for the hair-tube surveys:

- each hair-tube used for the survey was 300mm long and made out of 65mm by 65mm square ended, PVC down pipe;
- two wooden blocks (25mm x 25mm x 5mm) covered by double sided sticky tape were placed inside the roof at either end of each tube, approximately 3cm from the entrance;
- coated wire was used to attach a hair-tube to a horizontal branch of a tree at a height of approximately 2m;
- the tube was then baited with peanuts, hazel nuts, sunflower and pumpkin seeds;
- each hair-tube was systematically placed between 100m to 200m apart in woodlands identified as providing suitable red squirrel habitat;
- as the squirrel enters the tube to get the food, it leaves a few of its hairs on the tapes, which are removed for later examination under a microscope (see paragraph 2.2.15 for details); then
- the sticky blocks were retrieved after 7 to 14 days inline with Gurnell et al. (2001) (see Table 1).

Dates of Hair-Tube survey

2.2.10 The dates of the red squirrel hair-tube surveys are presented in Table 1.

Table 1 – Dates of Hair-Tube Surveys

Hair-Tube Survey Number	Woodland Areas Surveyed	Date of Hair-Tube Deployment	Date of Hair-Tube Collection	Number of Days Hair-Tubes left in Field
1	Megray Wood Fishermyre Wood North Fishermyre Wood Limpet Burn Wood	29/5/06 – 2/6/06	12/6/06 – 16/6/06	14
2	East Crossley Wood	16/6/06	26/6/06	10
3	Craigentath Wood	29/6/06	13/7/06	14

Visual Surveys

2.2.11 Visual surveys were carried out in accordance with the methodology described by Gurnell et al. (2001). Surveyors walked along a route predetermined prior to the survey based upon consultation of 1:25000 OS maps and knowledge of the area from previous site visits. The transect routes encompassed paths and rides in and along the edge of the woodland. This was done to increase visibility and also so that surveyors would cause less disturbance when moving through the woodland, thus increasing the probability of observing squirrels. Surveys commenced at first light to coincide with the time period when red squirrels are most active and continued for two hours after. Transects were walked at a speed of 100m per five minutes with observers stopping at 100m intervals for five minutes. All squirrel sightings were recorded, together with species, time, location and squirrel behaviour. Visual surveys were only conducted in suitable weather conditions as squirrels are typically inactive in heavy rain, strong winds and when it is very cold.

2.2.12 Visual surveys were conducted throughout the survey period. At least three repeats were carried out in each woodland area surveyed (see Table 2) in order to allow for differences in weather conditions and variation in squirrel activity. Woodlands were subjected to more than three visual surveys when feeding signs and/or dreys were observed but it was unclear whether this was due to the presence of red or grey squirrels. In these cases additional visual surveys were carried out where possible, ensuring every effort was made to identify the species present.

2.2.13 The level of survey effort applied to each woodland area for both the hair-tube surveys and visual surveys is shown in Table 2. There was considered to be no suitable areas of red squirrel habitat in Section FL2 and therefore no woodland areas in this section were subject to survey.

Table 2 – Level of Survey Effort applied to each Woodland

Wood Name (Wood Code)	Grid Reference (approximate)	Hair-Tube Surveys conducted (number of tubes deployed)			Number of Visual Surveys (Dates conducted)
		1	2	3	
Section FL1					
Limpet Burn Wood (FLW1)	NO 883889	(8)			3 (12/4/06, 31/5/06 ,14/6/06)
Megray Wood (FLW2)	NO 872888	(4)			3 (13/4/06, 31/5/06, 14/6/06)
Fishermyre Wood (FLW3)	NO 868898	(11)			5 (13/4/06, 2/6/06, 14/6/06, 27/6/06, 30/6/06)
North Fishermyre Wood (FLW4)	NO 864903	(5)			5 (13/4/06, 2/6/06, 14/6/06, 27/6/06, 30/6/06)
Section FL3					
East Crossley Wood (FLW5)	NO 878967		(5)		3 (28/6/06, 29/6/06, 13/7/06)
Craigentath Wood (FLW6)	NO 878977			(6)	3 (28/6/06, 29/6/06, 13/7/06)

Squirrel Hair Analysis

2.2.14 As part of the surveys, squirrel hair analysis was undertaken in order to determine whether grey squirrels are present. Gurnell et al. (2001) state that: 'It is not possible to separate red and grey squirrel hairs on the basis of colour, and the hairs have similar cuticle scale patterns and medullas.' However, when viewed under a phase contrast microscope (x400) the cross-section differs. Red squirrel hairs have a concave or dumb-bell shaped cross-section whereas grey squirrels have a round one. Staining a sample of hairs with ink enabled the type of cross-section to be seen more easily (Gurnell and Pepper, 1994; Dagnall et al., 1995; and Teerink, 1991).

Negative Staining Technique

2.2.15 The negative staining technique that was applied is described below:

- tapes were placed in warm water containing a strong detergent and left to soak overnight;
- ten representative hairs from each identifiable cluster were removed with forceps. Very fine, small underfur hairs and cracked or damaged hairs were avoided. Hairs less than 1.5mm long were discarded, as it is likely that these belonged to either mice or voles;
- complete hairs were then measured from bulb to tip, making a note of the colour bands along the hair using a binocular microscope (x80) to do so;
- hairs were placed in a 5:1 solution of Indian ink: water;
- two or three hairs were placed on a slide together with a few drops of ink solution;
- the hairs were then covered with a coverslip and examined at the widest part (the shield region) using a light microscope (x400);
- mounts that showed a continuous dark band along the shield region were likely to be red squirrel; and
- mounts that did not show a continuous dark band along the shield region were likely to be grey squirrel.

2.2.16 In addition to the hair-tube and visual surveys, ecologists also recorded any sightings of red squirrels, dreys and feeding signs of either species within the proposed route corridor. These included incidental observations made during the Phase 1, otter, badger and bird surveys conducted for this proposal in 2006. These incidental observations were made on an ad-hoc basis and did not follow a set survey method.

Habitat Evaluation

2.2.17 In addition to the hair-tube and visual surveys, data relating to the quality of red squirrel habitats was researched so that a general assessment could be made as to the suitability of the habitat for red squirrels. Factors that are likely to influence the survival of local red squirrels are judged to be of the greatest importance when assessing habitat value. Areas with successful drey sites are therefore of key importance. Also, as red squirrel populations may be limited by foraging opportunities (Gurnell and Pepper, 1993), areas possessing or allowing access to optimal foraging habitat are also judged to be of key importance. Areas possessing sub-optimal foraging habitat but other favourable habitat attributes (e.g. low levels of disturbance, low abundance of large-masted tree species and low presence of grey squirrels) are of lesser importance as they are less likely to be vital to local red squirrel survival.

2.2.18 Details of how values of importance to the local red squirrel population have been derived are provided below. It should be noted that coniferous woodland habitat is generally regarded as being of higher value for red squirrels compared with broadleaved woodland. This is not because of the active selection of coniferous woodland by red squirrels as a preferred habitat type. It is rather that due to the limited success of grey squirrels in coniferous woodlands, inter-specific competition with grey squirrels is considered to be less pronounced in coniferous woodlands than woodlands containing broadleaved species. Red squirrel habitat value has been determined as:

- Very High Value – A locally unique key resource, vital for the maintenance of existing red squirrel populations. Optimal foraging and breeding habitat in a large area of contiguous woodland provided by favourable tree species mix and varied age structure. This is in conjunction with an absence of grey squirrels and therefore lack of inter-specific competition.
- High Value - Optimal foraging habitat owing to locally abundant conifers and small-mast producing broad-leaved trees coupled with low disturbance and suitable woodland habitat for cover and dreys.
- Medium Value - Despite abundant foraging opportunities, location is considered sub-optimal due to either moderate disturbance levels, lack of cover, abundance of large-masted broad-leaved tree species or the presence of grey squirrels.
- Low Value - Location offers sub-optimal foraging opportunities, has poor cover, presence of grey squirrels or suffers from disturbance.

Size of Woodland Required for Red Squirrel Conservation

2.2.19 The size and type of woodland and the connectivity between woodland patches are important factors in maintaining red squirrel populations. An area of conifer forest between 2000 and 5000 hectares is considered ideal to conserve a population of red squirrels. It may be possible to support a small viable red squirrel population in core reserves of 200-300 hectares, providing a suitable age structure of trees and shrubs is maintained and where necessary, numbers of grey squirrels are controlled (Pepper and Paterson, 1998). Contiguous areas of coniferous woodland over 200 hectares (with very narrow gaps, i.e. for power lines or minor roads can be seen in the context of contiguous cover) comprising a variety of tree species (e.g. pines, spruces, firs and larches) which ensures there is food for red squirrels throughout the year. As such, these areas are considered to be important areas for conserving red squirrels (Reynolds and Bentley, 2004).

2.2.20 It has been shown (Verbeylen et al., 2003) that viable populations of red squirrels can be maintained in an area of woodland as small as 3.5 hectares. However, this is providing there are vegetated corridors with sufficient cover to aid dispersal to other woodland areas.

Population Density

2.2.21 It is not practical to give an estimate of the red squirrel population size in the woodland areas surveyed, as this requires calibration with trapping in the same areas (Garson and Lurz, 1998, in Gurnell et al., 2004). However, the Local Species Action Plan (Legge, 2002) states that: ’Typical population densities in North East Scotland vary between 1.81 per ha and 2.1 per ha, with populations varying from year to year depending on the seed crop.’ There is however, no information specific to red squirrel population densities in woodlands surveyed within 500m of the proposed scheme.

2.3 Evaluation of Nature Conservation Value

2.3.1 The method for assessing the value of an ecological receptor uses the information collated to determine the baseline status of the resource. The ecological evaluation of a receptor is determined through reference to statutory and non-statutory site designations, the results of 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 3. 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 national or local Biodiversity Action Plans. 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, which are protected by international 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 which all contribute to the ecological importance of the receptor.

2.3.4 Red squirrels are listed under Appendix III of the Bern Convention but, in view of its more favourable conservation status in mainland Europe, the species is not listed on the EC 'Habitats' Directive (EC/92/43). Red squirrels in the United Kingdom are protected under Schedules 5 and 6 of the Wildlife and Countryside Act (1981) (as amended), which has recently been further amended by the Nature Conservation (Scotland) Act 2004. The red squirrel is listed as a Priority Species on the UK BAP and is also a Local BAP species.

2.3.5 Red squirrels are therefore considered a species of national conservation concern and are threatened in North East Scotland. Habitats supporting populations of red squirrels in the Aberdeen area are therefore, assessed as being of regional ecological value as they are regularly occurring, locally significant populations of a nationally important species, which occurs in a Regional and UK BAP. Habitats maintaining locally significant populations are evaluated as being of national importance. Habitats not currently supporting a locally significant red squirrel population and/or are considered to be potentially suitable for the species are considered to appreciably enrich the habitat resource within the local context are evaluated as being of county or local value.

Table 3 – Evaluation of Ecological Receptor

Ecological Importance	Attributes of Ecological Receptor
International (European)	Habitats An internationally designated site or candidate site i.e. Special Protection Area (SPA), provisional SPA (pSPA), Special Areas of Conservation (SAC), candidate SAC (cSAC), Ramsar site, Biogenetic/Biosphere Reserve, World Heritage Site or an area which meets the published selection criteria for such designation. A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat that 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 an internationally important species, which is threatened or

Ecological Importance	Attributes of Ecological Receptor
	rare in the UK, i.e. a UK Red Data Book species or listed as occurring in 15 or fewer 10km squares in the UK (categories 1 and 2 in the UK BAP) or of uncertain conservation status or of global conservation concern in the UK BAP. A regularly occurring, nationally significant population/number of any internationally important species.
National (Scottish)	Habitats A nationally designated site i.e. Site of Special Scientific Interest (SSSI), Areas of Special Scientific Interest (ASSI), National Nature Reserve (NNR), Marine Nature Reserve, or a discrete area, which meets the published selection criteria for national designation (e.g. SSSI selection guidelines). A viable area of a priority habitat identified in the UK Biodiversity Action Plan (UK BAP), or of smaller areas of such habitat that 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 A regularly occurring, regionally or county significant population/number of an internationally/ nationally important species. Any regularly occurring population of a nationally important species that 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 that 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 such habitat that are essential to maintain the viability of a larger whole. Viable areas of key habitat identified as being 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 10km 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 that are recognised by local authorities e.g. Sites of Interest for Nature Conservation (SINS) and District Wildlife Sites (DWS). 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 0.25ha. 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 that is listed in a County/District BAP on account of its regional rarity or localisation. A regularly occurring, locally significant population of a county/district important species (particularly during a critical phase of its life cycle). Sites supporting populations of internationally/nationally/regionally important species that are not threatened or rare in the region or county, and are not integral to maintaining those populations. Sites/features that are scarce within the county/district or which appreciably enrich the county/ district habitat resource
Local (immediate local area or village importance)	Habitats Areas of habitat considered to appreciably enrich the 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 of such habitats within the local area are not considered for the above classifications. Semi-natural ancient woodland smaller than 0.25ha. 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.
Less than Local (limited ecological value)	Sites that retain habitats and/or species that are 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.

2.4 Impact Assessment

2.4.1 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

2.4.2 The magnitude of impacts has been assessed for each element of the development. A definition of impact magnitude impacts is presented in Table 4 and includes positive impact criteria in accordance with IEEM guidance (2002). The magnitude of each impact was assessed independently of value or statutory status.

Table 4 – Magnitude of 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 integrity of an ecological receptor, but the effect 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 species assemblage or populations but not affect the 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. Impacts are unlikely to result in changes to the species assemblage or populations, but core species more vulnerable to future impacts
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

2.4.3 The significance of an impact was determined according to the matrix of importance and magnitude as illustrated in Table 5.

Table 5 – Significance of Impact

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
County	Moderate	Moderate	Minor	Negligible	Minor	Moderate
Local	Minor	Minor	Minor	Negligible	Minor	Minor
Less than Local	Minor	Negligible	Negligible	Negligible	Negligible	Negligible

2.4.4 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. 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.

2.5 Limitations to Assessment

2.5.1 In the survey methodology, Gurnell et al. (2001) state: 'up to 20 tubes may be used to survey one piece of woodland by deploying them 100m to 200m apart in lines or in the pattern of a grid. The number of tubes used for each site in any survey should be standardised.' This was done as far as was practicable, although it was not always possible to find suitable tree species to place the tubes on. As a result, in some woodland areas tubes were placed closer together and in others they were placed farther apart (although never further apart than 200m). A number of woodlands did not have rides (i.e. existing between trees such as fire breaks) or were too dense to place tubes in the interior of the wood. In these situations, the tubes tended to be placed on trees at the edge of the woodland. The shape of some woodland areas was not conducive to placing the tubes in a grid pattern. Placing the tubes in a grid pattern may have provided greater information regarding population density. However, as this survey was only interested in determining the presence of red squirrels, this is not considered to be a significant issue.

2.5.2 Although considered the most efficient methods for detecting squirrel presence/absence within woodlands (Gurnell et al., 2001), it is possible that the hair-tube and visual surveys failed to detect the presence of squirrels in some locations. The presence of feeding signs and dreys was therefore also noted by surveyors. It is recognised that these signs cannot distinguish between red or grey squirrels, however, they are indicative of squirrel activity within a woodland and as such can be used to help verify positive/negative hair-tube results. This was of particular significance for woodlands where the tubes were placed in trees at the woodland edges.

2.5.3 As set out in paragraph 2.2.3, not every area of woodland throughout the proposed route corridor was surveyed. Surveys concentrated on woodland areas of a size to support a red squirrel population, woodland where red squirrel records exist, woodland areas that could potentially be directly affected and those woodland areas where suitable red squirrel habitat has been identified.

2.5.4 When setting the hair-tubes, surveyors noticed on a few occasions that birds were entering the tubes to feed on the nuts inside. It is therefore unclear how long the nuts remained in the tubes after they were deployed. It may have been the case that birds sometimes ate the nuts soon after tube deployment, leaving no encouragement for the squirrels to enter the tubes for the remainder of the two week survey period and therefore compromising the success of the survey.

2.5.5 When surveyors went to retrieve the sticky blocks from the hair-tubes some of these blocks had fallen out of the tubes and were found on the ground. It is possible they became dislodged as a squirrel passed through the tube and failed to trap any hair. This only happened on seven occasions (out of a possible 78 blocks) and was not considered to be of great significance for the purposes of the assessment.

3 Baseline

3.1 Consultation Information

3.1.1 The consultation exercise yielded no records of red squirrels within or in the vicinity of the 500m survey corridor for the Fastlink section of the AWPR.

3.2 Survey Results

3.2.1 This section describes the results of the visual and hair-tube surveys that were carried out between April and July 2006. The results of the visual surveys and hair-tube surveys are presented in Table 6 and Table 7 respectively (refer to Figures 40.8a-f for both visual and hair-tube survey locations).

3.2.2 Jacobs ecologists recorded one incidental sighting of a red squirrel within the study area (see also Figure 40.8b):

- an individual was seen in a broadleaved woodland strip on the west side of the B979, approximately 50m west of Megray Wood (grid reference NO 87158869) on the 5 July 2006.

Table 6 – Overall Visual Survey Results showing Squirrel Presence

Wood Name (Wood Code)	Approximate Grid Reference	First Visual Survey	Second Visual Survey	Third Visual Survey	Fourth Visual Survey	Fifth Visual Survey	Red Squirrel	Grey Squirrel
Section FL1								
Limpet Burn Wood (FLW1)	NO 883889	Absent	Absent	Absent	n/a	n/a	None recorded	None recorded
Megray Wood (FLW2)	NO 872888	Absent	Absent	Absent	n/a	n/a	None recorded*	None recorded
Fishermyre Wood (FLW3)	NO 868898	Absent	Absent	Absent	Absent	Absent	None recorded	None recorded
North Fishermyre Wood (FLW4)	NO 864903	Absent	Absent	Absent	Absent	Absent	None recorded	None recorded
Section FL3								
East Crossley Wood (FLW5)	NO 876964	Absent	Absent	Absent	n/a	n/a	None recorded	None recorded
Craigentath Wood (FLW6)	NO 878977	Absent	Absent	Absent	n/a	n/a	None recorded	None recorded

* Although no red squirrels were observed in Megray Wood, an individual was sighted in close proximity to the woodland – see paragraph 3.2.2.

Table 7 – Overall Hair-Tube Survey Results

Wood Name (Wood Code)	Approximate Grid Reference	No. of Hair-Tubes Deployed	No. of Hair-Tubes with Red Squirrel Hairs	No. of Hair-Tubes with Grey Squirrel Hairs	Red Squirrel Present	Grey Squirrel Present
Section FL1						
Limpet Burn Wood (FLW1)	NO 883889	8	0	0	None recorded	None recorded
Megray Wood (FLW2)	NO 872888	4	0	0	None recorded	None recorded
Fishermyre Wood (FLW3)	NO 868898	11	0	0	None recorded	None recorded
North Fishermyre Wood (FLW4)	NO 864903	5	0	0	None recorded	None recorded
Section FL3						
East Crossley Wood (FLW5)	NO 876964	5	0	0	None recorded	None recorded
Craigentath Wood (FLW6)	NO 878977	6	0	0	None recorded	None recorded

3.3 Summary of Survey Results

3.3.1 Visual and hair-tube surveys provided no evidence of red squirrel presence within the six woodlands surveyed. However, a red squirrel was sighted approximately 50m west of Megray Wood in an area of broadleaved woodland on the edge of the study area – see paragraph 3.2.2 and Table 8.

Table 8 – Summary of Red Squirrel Records within 500m of the Proposed Scheme

Wood Name	Wood Code	Approximate Grid Reference	NESBReC / Grampian Squirrel Group Records (post 2000)	Jacobs Hair-Tube Survey 2006	Jacobs Visual Sightings 2006	Unrecorded Sightings (Personal Communication)
(Next to) Megray Wood	n/a	NO 87158869	None recorded	Not surveyed as over 500m from proposed route	Yes (incidental sighting)	None recorded

4 Evaluation

4.1 Introduction

4.1.1 In this section of the assessment, woodland areas showing the presence of red squirrel (as the result of consultation, literature review and field surveys) are assigned an evaluation of national or regional importance depending on whether the area is considered to be a core or non-core reserve for red squirrels. This is based on Ratcliffe Criteria (Ratcliffe, 1977) see Table 3. Evaluation of each woodland area's nature conservation value for red squirrel is shown in Table 9. The ecological evaluations have been derived from data regarding the presence of red squirrel populations from consultation information and from survey results, as well as the habitat suitability of woodland habitat areas. Full details of the method of evaluation are provided in Section 2.2.

Habitat Type

4.1.2 The description of Habitat Areas and their evaluation has been extracted from the Phase 1 Habitat survey information for the Fastlink section of the AWPR. Detailed botanical information on woodland habitat types, including dominant tree species, and descriptions of ground flora can be found in Appendix A40.1 (Terrestrial Habitat Report).

Table 9 – Woodland Evaluation

Wood Name (Wood Code)	Habitat Area (from A40.1 Terrestrial Habitat Report)	Age and Type of Woodland	Evaluation of Habitats (from A40.1 Terrestrial Habitat Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
Section FL1						
Limpet Burn Wood (FLW1)	F7	Semi-mature – mature Broad-leaved semi-natural woodland	Regional	Low	Less than Local	Limited foraging opportunities for red squirrels due to low diversity of tree species, woodland is dominated by birch. Woodland is directly adjacent to Megray Wood, a dense Sitka plantation, but otherwise isolated. No records of red squirrels in this woodland and as such this area is considered to be of less than local importance
Megray Wood (FLW2)	F6	Mature Coniferous Plantation Sitka spruce	Regional	Medium	County	Foraging opportunities for red squirrels restricted due to plantation being dominated by Sitka spruce. Mature Sitka will produce mast but this monoculture is unlikely to provide a year round food resource. Red squirrel sighted approximately 50m away in nearby broadleaved woodland (see paragraph 3.2.2) but no records of red squirrels within Megray Wood. It is possible however, that red squirrels may utilise the woodland intermittently and therefore it is assessed as being of county importance.
Fishermyre Wood (FLW3)	F10	Immature – semi-mature Broadleaved Plantation with some areas of Scots Pine Birch, Rowan	Regional	Low	Less than local	Woodland with low value habitat for red squirrels due to limited foraging opportunities and lack of cover. High connectivity to North Fishermyre Wood, but otherwise isolated. This woodland habitat does not currently support populations of red squirrels and so is considered to be of less than local importance.
North Fishermyre Wood (FLW4)	F11	Semi-mature – mature Broadleaved Plantation with some areas of Scots Pine	Regional	Low	Less than local	Limited foraging and breeding opportunities due to dominance by broadleaved species. High connectivity to Fishermyre Wood, but otherwise isolated. This woodland habitat does not currently support populations of red squirrels and so is considered to be of less than local importance.

Wood Name (Wood Code)	Habitat Area (from A40.1 Terrestrial Habitat Report)	Age and Type of Woodland	Evaluation of Habitats (from A40.1 Terrestrial Habitat Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
Section FL3						
East Crossley Wood (FLW5)	F24	Immature – Semi-mature Broadleaved woodland/ with scattered Coniferous species. Birch, Scots Pine, Sitka Spruce	County	Low	Less than local	Isolated woodland with low value habitat for red squirrels due to poor foraging opportunities and lack of cover. This woodland habitat does not currently support populations of red squirrels and so is considered to be of less than local importance.
Craigentath Wood (FLW6)	none	Mature Coniferous Plantation with Broadleaved species at edges Scots Pine, Rowan, Oak	none	High	County	Abundant foraging and breeding opportunities for red squirrels provided by dominance of mature coniferous species, which provide both direct and indirect benefit for red squirrels (see paragraph 2.2.18). Isolated woodland with little connectivity to surrounding woodland areas. Surveys did not produce positive results of red squirrel presence, but this woodland habitat is regarded to be potentially suitable for the species due to the mixture of tree species present. This woodland is considered to appreciably enrich the habitat resource within the local context. Therefore, red squirrels that may occur here are evaluated as being of county importance.

4.2 Evaluation of Habitat

4.2.1 A red squirrel was sighted approximately 50m from Megray Wood, in a neighbouring broadleaved woodland on the edge of the survey corridor (see paragraph 3.2.2 for more details). Hair-tube and visual surveys within Megray Wood did not reveal any evidence of red squirrel presence. It is possible that red squirrels are crossing the B979 and utilising Megray Wood, but that this behaviour was undetected by the surveys. Red squirrel home ranges are considered to vary between 1.5ha (Wauters and Dhondt, 1987) and 13.4ha (Corbett and Southern, 1977) and so indeed it is possible that Megray Wood falls within the squirrel's home range. In light of this, Megray Wood is considered to be of county importance for red squirrels.

4.2.2 Megray Wood is dominated by Sitka spruce, which is thought to provide poor foraging habitat for red squirrels due to its unpredictable coning cycle. The trees in Megray Wood are more than 30 years old (land owner personal communication, 2006) and so are mature enough to produce mast. Once mature, Sitka spruce can support red squirrel populations, albeit at very low densities, and can thus potentially serve as a refuge habitat type for red squirrels. Although this type of habitat is only partially suitable for red squirrels, it is considered entirely unsuitable for grey squirrels (Scottish Squirrel Strategy, 2004). However, due to its dominance by just one tree species, this plantation is unlikely to provide a year-round food resource for red squirrels, as even aged plantations dominated by Sitka spruce are considered to only support low densities of red squirrels. It is therefore more probable that red squirrels are using Megray Wood intermittently (if at all) and are commuting into the study area along Cowie Water from Fettereso Forest to the west. Fettereso Forest (NO 790870) is an expansive area of coniferous forest that is known to maintain a significant red squirrel population (Forestry Commission website: www.forestry.gov.uk).

4.2.3 No red squirrels were recorded in Limpet Burn Wood, Fishermyre Wood, North Fishermyre Wood or East Crossley Wood. These woodland habitats are dominated by broadleaved species and are considered to be of limited value to red squirrels. Limpet Burn Wood is predominantly comprised of birch and although red squirrels are known to feed on birch-mast, the dominance by this deciduous species means it is unlikely that this area of woodland can provide red squirrels with a reliable year-round food supply. East Crossley Wood, Fishermyre Wood and North Fishermyre Wood are all predominantly made up of immature trees and whilst there are some stands of mature Scots pine present at East Crossley Wood and Fishermyre Wood, it is not considered a sufficient amount to provide suitable cover and year-round foraging opportunities for red squirrels. Therefore these woodland areas are considered to be of less than local importance.

4.2.4 Although no squirrels were recorded in Craigentath Wood, feeding signs were observed throughout the woodland indicating that red and/or grey squirrels are indeed present. The woodland habitat is of high value to red squirrels comprising mature coniferous species such as Scots Pine and Sitka spruce and thus providing refuge and foraging opportunities for red squirrels. Craigentath Wood is therefore considered to have high potential for supporting a red squirrel population and as such is deemed to be of county importance.

5 Potential Impacts

5.1 Introduction

5.1.1 This section describes the types of impacts on red squirrels and provides a summary of the main impacts that may potentially arise from the construction and operation of the proposed scheme in the absence of appropriate mitigation.

5.1.2 There are no specific references to red squirrels in the Highways Agency network ecological information. An Advice Note on the red squirrel in the DMRB was targeted for publication in 2006, but as yet no date has been finalised.

5.1.3 According to the Scottish Strategy for Red Squirrel Conservation (SSG, 2004) the following have been identified as likely factors in red squirrel decline. However, the precise significance of each factor and the interactions between them is as yet unknown:

- competition from the introduced grey squirrel, *Sciurus carolinensis*;
- changes in woodland habitat;
- conflicting management objectives for woodland habitats;
- disease (e.g. squirrel poxvirus, a potentially fatal virus for the red squirrel; the grey squirrel appears unaffected by the virus and is thought to be a carrier of the disease); and
- road kills.

5.1.4 Development of the roads transport infrastructure contributes to the process of habitat fragmentation as a consequence of:

- direct mortality;
- habitat loss and isolation; and
- disturbance and avoidance due to noise, pollution and visual stimuli.

5.1.5 Plant and animal populations most severely affected by habitat fragmentation are those (such as red squirrels) that exist as metapopulations, i.e. where they maintain their genetic diversity by moving between habitat patches. Sub-populations inhabit patches of habitat, but there is some immigration and emigration between patches. Where sub-populations die out, normally they are replaced by immigration from other patches, but this process is hindered or prevented by isolation due to habitat fragmentation. Reducing the connectivity of patches may cause permanent loss of sub-populations (particularly in small patches which may not be able to maintain a viable population). If losses occur in several patches over a short period, metapopulations without a 'mainland' habitat could become extinct.

5.1.6 As they are small, sub-populations are more likely to fluctuate over time and will have a higher probability of extinction. The possibility of recolonisation of severed or fragmented habitat is also likely to be reduced due to the resistance to animal dispersal posed by structures such as roads. By their linear nature, roads have considerable potential to fragment and isolate nature conservation resources in addition to the more direct effects of habitat destruction and modification. A wide range of mitigation measures have been instigated across the country in recent years in an attempt to reduce such adverse effects on wildlife, as well as to maximise any enhancement opportunities (Highways Agency, 2004).

5.2 General

5.2.1 The range of potential impacts of road schemes and their significance on nature conservation will depend on the individual circumstances of each scheme. However, it is possible to identify a number of main areas of concern, which have general applicability (Highways Agency, 1999). These are set out in this section in the following order: direct mortality, habitat loss, habitat fragmentation and isolation, disturbance, pollution and indirect impacts.

5.2.2 It should be noted that the impacts associated with the operational phase of the scheme are considered to be permanent. Temporary impacts, which are only apparent while the road is being built, are discussed in association with the construction phase (without mitigation).

Direct Mortality

Construction

5.2.3 Direct mortality due to construction of the proposed scheme could be occur in areas where red squirrels are present. They could suffer direct mortality during construction through tree felling, by works traffic clearing the site or indirect mortality through stress.

Operation

5.2.4 Direct mortality during the operational phase could represent a major potential impact in areas where red squirrels are currently present. As red squirrels have overlapping ranges and juvenile females aged from 10 to 18 weeks can move distances as much as 1.5km away from their parental woodland (Gurnell, 1994), there will be movement throughout the year. Red squirrels might attempt to cross the carriageway during the operational phase of the road and therefore be at increased risk of mortality resulting from traffic. Mortality might increase in areas where the carriageway either fragments or isolates areas of woodland. This impact could affect a high proportion of the local population. For example, according to the North Merseyside Action Plan for red squirrels, up to 50 animals per year have been killed in the Formby area of North Merseyside alone (The Highways Agency BAP, undated).

Habitat Loss

Operation

5.2.5 Habitat loss could represent a key impact in areas where red squirrels are present. Although occurring during the construction phase, habitat loss is regarded as an operational impact as the loss would be permanent. The total amount of landtake required in order to construct the Fastlink of the proposed scheme is estimated at approximately 1.20km^2 / 120ha. Table 10 shows the estimated total pre-construction and post-construction areas of Phase 1 Habitats present within the proposed landtake of the scheme. The post-construction figures take into account both anticipated habitat loss to construction and habitat that would be created or changed as a result of mitigation.

5.2.6 The loss of woodland habitat due to the proposed scheme might represent a substantial loss of red squirrel breeding and foraging habitat and could affect the long-term viability of woodland areas to support red squirrels. Red squirrels can be prone to starvation and any reduction in habitat might decrease the available food supply and increase the likelihood of starvation (Gurnell, 1987). In woodland areas where there is a presence of a mixture of coniferous tree species (Scot's pine, Douglas fir, European larch and Norway spruce), red squirrels can forage throughout the year and the loss of any one of these tree species might lead to a gap in foraging opportunities for red squirrel.

5.2.7 Edge effects along the road could result in an increase of noise, disturbance and pollution which might result in the abandonment of a greater area of woodland by red squirrels than that lost directly by the footprint of the road.

Habitat Fragmentation and Isolation

Construction

5.2.8 Construction processes associated with the proposed scheme have the potential to fragment and isolate red squirrel habitats. Inappropriate siting of construction compounds and storage facilities might lead to a reduction and/or severance of red squirrel home ranges. This might also result in restricting the movement of red squirrels that could be reluctant to travel through noisy and/or open areas.

Operation

5.2.9 Where the proposed scheme would either fragment or isolate woodland, there would be potential for impacts on the long-term genetic diversity of the local red squirrel population. This barrier might cut off populations by restricting movement of red squirrels either during population dispersal, during the breeding season or when red squirrels are foraging throughout their range. Red squirrels would be likely to become stressed by any disruption to, or change in, their home range. There is also the potential for cumulative impact of further development on the red squirrel population isolated on the eastern side of the road (see Cumulative Impact Assessment, Part E: Cumulative Assessment, of the ES).

Disturbance

Construction

5.2.10 Disturbance due to construction operations could represent a significant impact in areas where red squirrels are present. Blasting will not be implemented during construction of the proposed scheme. However, noise from machinery and vehicles, light for night working, dust and the presence of humans can all have adverse effects. Impacts could be exacerbated by the inappropriate siting of construction compounds or storage sites during the construction phase, e.g. close to dreys.

5.2.11 It has been documented that red squirrels may attempt to avoid any periodic disturbance and move away from affected habitat areas, which could result in the effective loss of these sites. However, construction disturbance would be temporary, although it is not known if future re-colonisation would occur once construction is complete.

Operation

5.2.12 During the operational phase of the proposed scheme, red squirrels would potentially suffer disturbance from traffic noise as well as from road lighting. This disturbance would be likely to increase with proximity to the proposed scheme and might prompt squirrels to move away from the carriageway to forage and/or breed. As a result, this might expose both migrant and any resident red squirrels in areas farther away from the proposed scheme to increased levels of stress, intra and inter-specific competition and starvation due to increased pressure for limited resources.

Pollution and Other Indirect Impacts

Construction and Operation

5.2.13 Any accidental spillage, polluted runoff, airborne or light pollution could have an impact on red squirrel populations in the area. As red squirrels spend approximately 75% of their time in the canopy (Gurnell, 1987), they would be more likely to be affected by indirect impacts such as pollution of food sources or food caches.

5.2.14 Pollution and other indirect impacts during the construction and operational phases of the carriageway are considered to be Negligible to red squirrel populations in woodlands throughout the route corridor.

Table 10 - Phase 1 Habitat Areas Pre and Post Construction

Phase 1 Habitat Description	Phase 1 Habitat Categories within proposed scheme landtake	
	Pre-construction (ha)	Post-construction (ha)
Woodland mixed plantation	2.46	13.23
Woodland broadleaved plantation (including standard trees)	0.10	0.78
Woodland broadleaved semi-natural	2.11	0.55
Woodland coniferous plantation	1.28	0.31
Scattered scrub	0.59	1.20
Dense continuous scrub	3.58	7.17
Riparian woodland	0	3.37
Acid grassland semi-improved	0.15	0.13
Acid grassland unimproved	0.40	0.19
Improved grassland	46.29	26.39
Marshy grassland	5.21	2.87
Neutral grassland semi-improved	0.26	0.21
Poor semi-improved grassland	2.96	1.51
Disturbed amenity grassland	0.83	0.37
Arable	49.21	19.64*
Built up areas (buildings)	0.49	0.49
Fen	3.87	1.41
Heath - acid grassland dry mosaic	1.88	1.67
Total	**121.67**	**81.49**

**Figure assumes all potential return to agriculture is achieved.*

5.3 Specific Impacts

5.3.1 The potential impacts (in the absence of appropriate mitigation) associated with the construction and operational phases of the proposed scheme on local red squirrel populations at specific locations in the study are provided in Table 11. The significance of the impact is derived from the impact assessment process described in Section 2.4.

Section FL1

5.3.2 In this section, the greatest potential for impact on red squirrels as a result of the proposed scheme is likely to be the increased risk of direct mortality, either through woodland clearance during construction or through Road Traffic Accidents (RTAs) during the operational phase of the scheme. However, if red squirrels are utilising Megray Wood, it is considered extremely unlikely that they would attempt to cross the carriageway in this section as there are no suitable areas of red squirrel woodland habitat on the eastern side of the carriageway. Direct mortality is therefore considered to represent an adverse impact of low magnitude and Minor significance.

5.3.3 Medium value red squirrel habitat comprising Sitka spruce plantation would be lost where the scheme alignment runs along the edge of Megray Wood (refer to Table 15 in Appendix A40.1: Terrestrial Habitats for information regarding specific habitat loss). Increased disturbance during both the construction and operational phases of the scheme is also predicted. No red squirrels were recorded in Megray Wood during surveys, however it is possible that they are utilising the area, as an individual was sighted approximately 50m away. These impacts are considered to be of low negative magnitude and Minor significance.

5.3.4 The other woodland areas surveyed in this section (Limpet Burn Wood, Fishermyre Wood and North Fishermyre Wood) are considered to provide low value habitat for red squirrels. In addition, no signs of red squirrel presence was evident during surveys. As such, no impacts on red squirrels are predicted in these areas.

Section FL2

5.3.5 No suitable areas of red squirrel habitat were identified in this section and therefore no impacts are predicted.

Section FL3

5.3.6 No potential impacts have been predicted for red squirrels in this section of the Fastlink due to the distance of East Crossley Wood and Craigentath Wood from the proposed scheme.

Table 11 – Specific Impacts on Red Squirrels

Habitat Area	Woodland Name (Code) and Evaluation	Phase of Scheme	Description of Impact	Impact Magnitude/ Significance
Section FL1				
F7	Limpet Burn Wood (FLW1) Less than Local	Construction and operation	Woodland habitat is of low value to red squirrels and so no significant impacts are predicted.	Negligible/Negligible
F6	Megray Wood (FLW2) County	Construction	Risk of red squirrel mortality during clearance of woodland is low as no red squirrels were recorded in this woodland*.	Low negative/Minor (refer to section 5.3.2)
			Minimal disturbance likely as no red squirrels were recorded within this woodland area.*	Low negative/Minor
		Operation	Minimal increased risk of direct mortality through RTAs where scheme passes alongside woodland due to the lack of use of this area by red squirrels.*	Low negative/Minor (refer to section 5.3.2)
			Loss of approximately 0.12ha of medium value red squirrel habitat comprising Sitka spruce (refer to the Specific Impacts Chapter in the Terrestrial Habitats report (Appendix A40.1) for information regarding specific habitat loss).	Low negative/Minor
			Minimal disturbance likely as no red squirrels were recorded within this woodland area.*	Low negative/Minor
F10	Fishermyre Wood (FLW3) Less than Local	Construction and Operation	Woodland habitat is of low value to red squirrels and so no significant impacts are predicted.	Negligible/Negligible
F11	North Fishermyre Wood (FLW4) Less than Local	Construction and Operation	Woodland is situated 100m away from the proposed scheme and therefore no significant impacts are predicted.	Negligible/Negligible
Section FL2				
No potential impacts for red squirrels predicted				
Section FL3				
F24	East Crossley Wood (FLW5) Less than Local	Construction and Operation	Woodland is situated 500m away from the proposed scheme and therefore no significant impacts are predicted.	Negligible/Negligible
None	Craigentath Wood (FLW6) County	Construction and Operation	Woodland is 500m away from the proposed scheme and therefore no significant impacts are predicted.	Negligible/Negligible

* Although no red squirrels were recorded in Megray Wood during the surveys, it is possible they are utilising the wood as a red squirrel was sighted 50m away in woodland nearby. Potential impacts have been assessed accordingly.

6 Mitigation

6.1 Introduction

6.1.1 This section describes the mitigation proposed to address the potential impacts that have been identified in Section 5. The most suitable mitigation for minimising the potential impacts of the proposed scheme involves the selection of the least damaging route alignment combined with sensitive scheme design. The underlying principles of mitigation are avoidance of damage or direct effects or, if this cannot be achieved, mitigation of impacts. Where impacts cannot be fully mitigated, compensation may be necessary (COST 341, 2002).

6.1.2 All of the mitigation measures described in this chapter have been developed in consultation with the appropriate statutory advisory organisation, i.e. SNH and will compliment the Species Management Plan that will be prepared. The Species Management Plan will include details on habitat management and methodologies to promote long-term conservation objectives.

Avoidance and Reduction of Impacts at the Project Planning Stage

6.1.3 Carrying out Environmental Impact Assessments (EIA) on projects ensures that environmental considerations are taken into account at an early stage. All major projects, including infrastructure projects, are subject to EIA according the EU Council Directive (97/11/EC of 3 March 1997).

6.1.4 The alignment of the Fastlink was determined in part by the need to avoid environmentally sensitive areas and features.

6.2 General

Direct Mortality

Construction

6.2.1 Pre-construction surveys must be undertaken in order to ensure that previous data is still relevant and that areas for specific mitigation are identified ahead of construction. Surveys must be undertaken by an experienced ecologist immediately prior to tree felling works to confirm the presence/absence of active dreys. All drey trees must be marked and avoided during felling.

6.2.2 In woodland areas that are to be removed, phased tree clearance would be carried out to avoid both the felling of drey trees and disturbance to red squirrels. This will avoid direct squirrel mortality from construction works and minimise the risk of stress-induced mortality from increased levels of disturbance associated with the construction phase. Tree clearance works in sensitive red squirrel sites will conducted outside the red squirrel breeding season. Such activities must be undertaken from September to December only, in order to minimise stress to red squirrels during this sensitive period.

6.2.3 A method statement is being prepared by Jacobs in liaison with SNH to set out the general procedures to be implemented should any active drey be present in the vicinity of the proposed carriageway or other area of proposed works. This will be developed specific to each drey.

Operation

6.2.4 As direct mortality of red squirrels has not been assessed as being a potential impact for the Fastlink section of the scheme, no mitigation measures are proposed.

Habitat Loss

6.2.5 Vegetation removal will be kept to a minimum, and where practicable all tree clearance works will be undertaken from September to November only in order to minimise stress to red squirrels during the breeding season. Ideally, all construction compounds and storage areas will be located away from areas of woodland used by red squirrels. Where this is not possible, surveys will be carried out to ensure that the potential for disturbance is minimised.

6.2.6 At the start of the construction period, all personnel on site will be made aware of the mitigation requirements for specific areas and their responsibilities to ensure that high standards of ecological management are achieved.

6.2.7 As well as the Species Management Plan for red squirrel, in advance of any work starting, contractors will provide a Method Statement outlining how tree-felling will be undertaken, which will be submitted to SNH. A proposed schedule of work will be supplied to the Ecological Clerk of Works at an early stage, and will be regularly updated. The Ecological Clerk of Works will be informed at least one week in advance of any works proposed in ecologically sensitive areas.

6.2.8 Temporary fencing will be erected to define the working area (in agreement with the Ecological Clerk of Works) and to prevent habitat damage or loss out with the working area. The fence will be erected prior to the start of any works (including site clearance). Contractors will be held responsible for reinstating any habitat loss (to a standard acceptable to the Ecological Clerk of Works) that may occur beyond the agreed working area.

Habitat Fragmentation and Isolation

6.2.9 Due to the lack of suitable habitat in the study area and the distance of the scheme from known red squirrel woodlands, habitat fragmentation is not considered to be a potential impact for red squirrels in the Fastlink section of the proposed scheme. Therefore, no specific mitigation is required for this section of the scheme.

Disturbance

Construction

6.2.10 Mitigation measures intended to minimise disturbance to red squirrels located within adjacent woodland habitats to the proposed carriageway are to include, where applicable, a walk-over survey of the proposed road alignment, undertaken by an experienced ecologist to confirm the presence / absence of active dreys. Should any drey be present within the vicinity of the proposed carriageway or other area of proposed works, then consultation with SNH will be required to agree proposed mitigation measures. Suitable mitigation measures must be put in place if active dreys are found in the areas where red squirrels are present. This is likely to include restricting plant and personnel to a prescribed working corridor away from any occupied drey. The size of this exclusion zone will be specific to each drey and will depend on the type of construction activities that are to be carried out.

6.2.11 Disturbance will also be minimised with temporary fencing erected to define an exclusion zone to prevent habitat damage out with the road alignment (to be supervised by an Ecological Clerk of Works – see below). This will be erected prior to the start of any works, including site clearance.

Operation

6.2.12 In the short-term, it will be impossible to avoid disturbance to red squirrels during the operational phase of the scheme. In the long-term, however, it is possible that red squirrels will become habituated to the noise of traffic associated with the proposed scheme.

6.3 Specific Mitigation

6.3.1 It is considered that the mitigation described previously is sufficient to ameliorate for any potential impacts. Therefore no further, specific mitigation is proposed for red squirrels in the Fastlink section of the proposed scheme.

6.4 Mitigation Summary

6.4.1 In order to ensure compliance with relevant legislation regarding disturbance or destruction of a red squirrel drey, a red squirrel drey method statement will be developed in liaison with SNH. The method statement will detail the procedures to be followed on site during construction. It is essential to ensure that all personnel working on site are aware of the protocols to be followed and legal obligations.

7 Residual Impacts

7.1.1 Following the application of the mitigation proposed, no residual impacts on red squirrels are expected to occur as a result of the Fastlink section of the scheme.

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