



Appendix 25.6 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 25 (Ecology and Nature Conservation) of the AWPR Environmental Statement (ES). It considers the potential impacts on red squirrel populations associated with the Southern leg 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 A25.8a-h.
- 1.1.2 The six component route sections in this report for the Southern Leg of the proposed scheme are as follows:
- Section SL1: Charleston to Bishopston (ch207200 - 203150);
 - Section SL2: Bishopston to Burnhead (ch203150 - 200600);
 - Section SL3: Burnhead to the A93 (ch200600 - 102870);
 - Section SL4: A93 to Beanshill (ch102870 - 105900);
 - Section SL5: Beanshill to South Kingswells Junction (ch105900 - 108500); and
 - Section SL6: South Kingswells Junction to Derbeth Overhills (ch108500 - 111200).
- 1.1.3 All tables and figures for this report are structured in this manner.
- 1.1.4 The Ecological Impact Assessment (EclA) was undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 10 and 11 (Highways Agency, 2005) and the Environmental Impact Assessment (Scotland) Regulations 1999, along with cognisance of draft Institute of Ecology and Environmental Management (IEEM) guidelines 2002.
- 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 Environmental Statement).

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; and
 - provide recommendations to mitigate for identified potential impacts; and
 - identify any potential 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 (Corbert 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 squirrels 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 vary 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.

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- 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 may 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. 1997, 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;

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- 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 to establish whether red and/or grey squirrels were present in 19 woodland areas within a corridor approximately 18.7km long and 1km wide (see Figures A25.8a–h). Surveys were undertaken between 10 April and 10 August 2006. In addition, survey data collected as part of previous field surveys for the EIA have also been used in this report. These initial surveys were conducted during June 2004 and June 2005.
- 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 centreline of the route.

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- 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 also 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 proposed scheme corridor (see Figures A25.8a-h) 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;

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- 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 2.2.16 for details); and
- sticky blocks were retrieved after 7 – 14 days inline with Gurnell et al. (2001) with the exception of the surveys in Blue Hill Plantation and Drumth Whacket in 2004, where the hair-tubes remained in the field for 27 days (Table 1). However, this was not considered to have any bearing on results (refer to Section 3).

2.2.10 Some woodland areas were subject to more than one hair-tube survey (see Table 1) due to the lack of results after the first hair-tube surveys were completed.

Dates of Hair-Tube survey

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

Table 1– Dates of Hair-Tube Surveys

Hair-Tube Survey	Woodland Areas Surveyed	Date of Hair-Tube Deployment	Date of Hair-Tube Collection	Number of Days Hair-Tubes left in Field
2004 survey	Blue Hill Plantation Drumth Whacket	25/5/04	8/6/04	27
	Kingshill Wood Hillhead of Derbeth	24/6/04	24/6/04	14
2005 survey	Duff's Hill Plantation	9/6/05	24/6/05	14
1	Clochandighter Cleanhill Wood Durris Forrest Kingcausie Guttrie Hill Wood Gairnhill Wood Moss of Auchlea	10/4/06 – 13/4/06	24/4/06 – 28/4/06	14
2	Clochandighter Hill of Blairs Gairnhill Wood Silverburn Wood Moss of Auchlea	24/4/06 – 28/4/06	8/5/06 – 12/5/06	14
3	Sunnyside Wood Hill of Blairs	29/5/06 – 2/6/06	12/6/06 – 16/6/06	14
4	Greenloaning Plantation Milltimber Wood Beanshill Wood	12/6/06 – 16/6/06	26/6/06 – 30/6/06	14
5	Whitestone Wood Cleanhill Wood Kingcausie	26/6/06 – 30/6/06	10/6/06 – 14/6/06	14

(Note: surveys 1-5 were conducted during 2006, refer to paragraph 2.2.1)

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Visual Surveys

- 2.2.12 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.
- 2.2.13 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.
- 2.2.14 The level of survey effort applied to each woodland area for both the hair-tube surveys and visual surveys is shown in Table 2.

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)
		2004 2005 survey	1	2	3	4	
Section SL1							
Blue Hill Plantation (SLW1)	NO 923000	(7)					0 woodland unsuitable for visual surveys (too dense)
Drumth Whacket (SLW2)	NO 917002	(5)					0 woodland unsuitable for visual surveys (too dense)
Duff's Hill Plantation (SLW3)	NO 920993	(12)					0 woodland unsuitable for visual surveys (too dense)
Section SL2							
Clochandighter (SLW4)	NO 894985		(11)	(11)			3 (13/4/06, 11/5/06, 26/5/06)
Sunnyside Wood (SLW5)	NO 895989				(6)		3 (31/5/06, 13/6/06, 16/6/06)
Greenloaning Plantation (SLW6)	NO 893995					(7)	3 (27/5/06, 30/5/06, 27/6/05)
Hill of Blairs (SLW7)	NO 882992			(4)	(20)		3 (10/5/06, 1/6/06, 13/6/06)

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Wood Name (Wood Code)	Grid Reference (approximate)	Hair-Tube Surveys Conducted (Number of Tubes Deployed)					Number of Visual Surveys (Dates Conducted)	
		2004 2005 survey	1	2	3	4		5
Whitestone Wood (SLW8)	NO 880987						(6)	3 (29/6/06, 13/7/06, 14/7/06 9/8/06, 10/8/06)
Section SL3								
Cleanhill Wood (SLW9)	NO 868991		(24)				(24)	3 (12/4/06, 25/4/06, 28/6/06)
Kingcausie (SLW10)	NO 864998		(36)				(36)	3 (12/4/06, 25/4/06, 28/6/06)
Durris Forest (SLW11)	NO 863988		(14)					3 (11/4/06, 26/4/06, 9/5/06)
Section SL4								
Milltimber Wood (SLW12)	NJ 855017						(8)	1 (27/6/06)
Guttrie Hill Wood (SLW13)	NJ 844018		(7)					0 incidental sighting of red squirrel made
Beanshill Wood (SLW14)	NJ 848035						(6)	3 (15/6/06, 27/6/06, 30/6/06)
Section SL5								
Gairnhill Wood (SLW15)	NJ 853046		(17)	(17)				4 (11/4/06, 24/4/06, 1/6/06, 15/6/06)
Silverburn Wood (SLW16)	NJ 845045			(5)				2 (27/4/06, 9/5/06)
Moss of Auchlea (SLW17)	NJ 848053		(6)	(6)				3 (10/5/05, 2/6/06, 15/6/06)
Kingshill Wood (SLW18)	NJ 857057	(20)						0 Red squirrel presence recorded by hair-tube surveys
Section SL6								
Hillhead of Derbeth (SLW19)	NJ 861088	(20)						0 – no visual surveys conducted in 2004/2005 surveys

Squirrel Hair Analysis

2.2.15 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

- 2.2.16 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.
- 2.2.17 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 observations made during the Phase 1, otter, badger and bird surveys conducted for the Southern Leg in 2006 and for the (now altered) Northern Leg in 2004 and 2005. These incidental observations were made on an ad-hoc basis and did not follow a set survey method.

Habitat Evaluation

- 2.2.18 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.
- 2.2.19 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.

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- 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 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

- 2.2.20 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 5000ha 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 200-300ha, 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 200ha (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).
- 2.2.21 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 3.5ha. However, this is providing there are vegetated corridors with sufficient cover to aid dispersal to other woodland areas.

Population Density

- 2.2.22 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

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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 been recently 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 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 and are evaluated as being of county or local value.

Table 3 – Evaluation of Ecological Receptor

Ecological Importance	Attributes of Ecological Receptor
International (European)	<p>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.</p> <p>Species Any regularly occurring population of an internationally important species, which is threatened or 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.</p>
National (Scottish)	<p>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.</p> <p>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.</p>
Regional (North East Scotland)	<p>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.</p> <p>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</p>

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Ecological Importance	Attributes of Ecological Receptor
	maintaining populations of internationally/nationally important species that are not threatened or rare in the region or county.
<p>Authority Area (e.g. County or District) Aberdeenshire/ City of Aberdeen</p>	<p>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.</p> <p>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.</p>
<p>Local (Immediate local area or village importance)</p>	<p>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.</p> <p>Species Populations/assemblages of species that appreciably 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.</p>
<p>Less than Local (Limited ecological importance)</p>	<p>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.</p>

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 an impact has been assessed for each element of the development. A definition of the 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 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

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on. As a result, in some woodland areas tubes were placed closer together and in others they were placed farther apart (although never farther apart than 200m). A number of woodlands did not have rides (gaps existing between trees e.g. 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 explained previously, 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. With the exception of Culter House Wood and West Hatton Wood, none of the un-surveyed woodlands were larger than the minimum 3.5ha area. Both Culter House Wood and West Hatton Wood are areas of deciduous woodland comprising species such as beech, rowan and sycamore. Large-masted broadleaved species, such as beech, favour grey squirrels. This lack of suitable red squirrel habitat resulted in these woodlands being considered unsuitable for surveying.
- 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 21 occasions (out of a total of 542 blocks) and so was not considered to be of great significance for the purposes of this assessment. It should also be noted that no block displacement occurred during the surveys of Drumth Whacket and Blue Hill Plantation and leaving the hair-tubes in-situ for 27 days (see Table 1) did not appear to have any bearing on results.

3 Baseline

3.1 Consultation Information

- 3.1.1 Red squirrel records (post 2000), held by the North East Scotland Biological Records Centre (NESBReC) and Gavin Legge (Woodland Officer from the Forestry Commission and Chairman of the Grampian Squirrel Group) are shown in Table 6 and on Figures A25.8a–h. Grid references for red squirrel sightings in woodlands outside the 500m buffer are marked with an *.

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Table 6 – NESBReC and Grampian Squirrel Group Records of Red Squirrel Presence in Local Woodlands

Wood Name	Grid Reference	Section
Craigingles Wood	NO 880995*	SL 2
Durris Forest	NO 858992*	Outwith SL 3
Durris Forest	NO 860992*	Outwith SL 3
Durris Forest	NO 864991	SL 3
Cleanhill Wood	NO 871989	SL 3
Milltimber Wood	NJ 854016	SL 4
Dalmunzie Wood	NJ 872029*	Outwith SL 4
Blacktop Woods	NJ 868044*	Outwith SL 5
Gairnhill Wood	NJ 855045	SL 5
Gairnhill Wood	NJ 854044	SL 5
Kingshill Wood	NJ 856056	SL 5

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 August 2006. The results of the visual surveys are presented in Table 7 (refer to Figures A25.8a-8h). The results of the hair-tube surveys are presented in Table 8 (refer to Figures A25.8a-h).
- 3.2.2 Jacobs ecologists recorded four incidental sightings of red squirrels within the study area (see also Figures A25.8a-h):

Section SL3

- An individual red squirrel was seen in Kingcausie at NO 86809957 on the 27 June 2006.

Section SL4

- An individual red squirrel was seen in Guttrie Hill Wood (NJ 84750190) on 26 April 2006.

Section SL5

- Two red squirrels were seen in Gairnhill Wood (NS 85290455 and NS 85440447).

Section SL6

- An individual red squirrel was seen in an ash woodland strip northeast of Fairly Home Farm (NJ 86150810) on the 20 October 2006.

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Table 7 – Overall Visual Survey Results showing Squirrel Presence

Wood Name (Wood Code)	Approximate Grid Reference	1 st Visual Survey	2 nd Visual Survey	3 rd Visual Survey	4 th Visual survey	5 th Visual survey	Red Squirrel Present	Grey Squirrel Present
Section SL1								
Blue Hill Plantation (SLW1)	NO 923000	Woodland unsuitable for visual surveys – too dense					None recorded	None recorded
Drumth Whacket (SLW2)	NO 917002	Woodland unsuitable for visual surveys – too dense					None recorded	None recorded
Duff's Hill Plantation (SLW3)	NO 920993	Woodland unsuitable for visual surveys – too dense					None recorded	None recorded
Section SL2								
Clochandighter (SLW4)	NO 894985	Absent	Absent	Absent	n/a	n/a	None recorded	None recorded
Sunnyside Wood (SLW5)	NO 895989	Absent	Absent	Absent	n/a	n/a	None recorded	None recorded
Greenloaning Plantation (SLW6)	NO 893995	Absent	Absent	grey squirrel	n/a	n/a	None recorded	Yes See Figure A25.8b
Hill of Blairs (SLW7)	NO 882992	Absent	grey squirrel	Absent	Absent	n/a	None recorded	Yes See Figure A25.8c
Whitestone Wood (SLW8)	NO 880987	Absent	Absent	Absent	Grey squirrel	Grey squirrel	None recorded	Yes See Figure A25.8c
Section SL3								
Cleanhill Wood (SLW9)	NO 868991	Absent	grey present	Absent	n/a	n/a	None recorded	Yes See Figure A25.8c
Kingcausie (SLW10)	NO 864998	Absent	Absent	red and grey squirrels	n/a	n/a	Yes See Figure A52.8c	Yes See Figure A25.8c
Durris Forest (SLW11)	NO 863988	Absent	Absent	Absent	n/a	n/a	None recorded	None recorded
Section SL4								
Milltimber Wood (SLW12)	NJ 855017	red squirrels	n/a	n/a	n/a	n/a	Yes See Figure A25.8e	None recorded
Guttrie Hill Wood* (SLW13)	NJ 844018	n/a	n/a	n/a	n/a	n/a	Yes* See Figure A25.8e	None recorded
Beans Hill Wood (SLW14)	NJ 848035	Absent	Absent	Absent	n/a	n/a	None recorded	None recorded
Section SL5								
Gairnhill Wood (SLW15)	NJ 853046	Absent	Absent	Absent	red squirrels	n/a	Yes See Figure	Yes See Figure

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Wood Name (Wood Code)	Approximate Grid Reference	1 st Visual Survey	2 nd Visual Survey	3 rd Visual Survey	4 th Visual survey	5 th Visual survey	Red Squirrel Present	Grey Squirrel Present
							A25.8f	A25.8f
Silverburn Wood (SLW16)	NJ 845045	Absent	red squirrel	n/a	n/a	n/a	Yes See Figure A25.8f	None recorded
Moss of Auchlea (SLW17)	NJ 848053	Absent	Absent	Absent	n/a	n/a	None recorded	None recorded
Kingshill Wood** (SLW18)	NJ 857057	n/a	n/a	n/a	n/a	n/a	None recorded	None recorded
Section SL6								
Hillhead of Derbeth (SLW19)	NJ 861088	Not subject to visual surveys due to the isolation of the woodland, sub-optimal tree species mix present, and lack of red squirrel records in the area.					None recorded	None recorded

* An incidental sighting of red squirrel was made on 26/4/06 by Jacobs ecologists (see Figure A25.8e and paragraph 3.2.1) therefore, Guttrie Hill Wood was not subject to visual surveys.

** Visual surveys were not required in Kingshill Wood as results from the hair-tube survey showed the presence of red squirrels.

Table 8 – 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 SL1						
Blue Hill Plantation (SLW1)	NO 923000	7 2004 survey	0	0	None recorded	None recorded
Drumth Whacket (SLW2)	NO 915998	5 2004 survey	0	0	None recorded	None recorded
Duff's Hill Plantation (SLW3)	NO 920993	12 2005 survey	0	1	None recorded	Yes
Section SL2						
Clochandighter (SLW4)	NO 894985	11	0	1	None recorded	Yes
Sunnyside Wood (SLW5)	NO 895989	6	0	2	None recorded	Yes
Greenloaning Plantation (SLW6)	NO 893995	7	0	1	None recorded	Yes
Hill of Blairs (SLW7)	NO 882992	24	0	1	None recorded	Yes
Whitestone Wood (SLW8)	NO 880987	6	0	0	None recorded	None recorded
Section SL3						
Cleanhill Wood (SLW9)	NO 868991	24	1	6	Yes	Yes
Kingcausie (SLW10)	NO 864998	36	1	3	Yes	Yes
Durriss Forest (SLW11)	NO 863988	14	0	2	None recorded	Yes

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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 SL4						
Milltimber Wood (SLW12)	NJ 855017	8	4	0	Yes	None recorded
Guttrie Hill Wood (SLW13)	NJ 844018	7	2	0	Yes	None recorded
Beans Hill Wood (SLW14)	NJ 848035	6	0	0	None recorded	None recorded
Section SL5						
Gairnhill Wood (SLW15)	NJ 853046	17	1	3	Yes	Yes
Silverburn Wood (SLW16)	NJ 845045	5	1	0	Yes	None recorded
Moss of Auchlea (SLW17)	NJ 848053	6	0	0	None recorded	None recorded
Kingshill Wood (SLW18)	NJ 857057	20 2004 survey	1	2	Yes	Yes
Section SL6						
Hillhead of Derbeth (SLW19)	NJ 861088	20 2004 survey	0	0	None recorded	None recorded

3.3 Summary of Survey Results

3.3.1 Red squirrels were found to be present in a total of ten out of the 19 woodlands surveyed within the study area, while grey squirrels were found to be present in 11 of the woodlands surveyed. Furthermore, red and grey squirrels were found to co-exist in seven of the surveyed woodland areas (see Table 9). An incidental sighting of a red squirrel was also made near Hillhead of Derbeth (SLW19) northeast of Fairly Home Farm (see paragraph 3.2.2). As this woodland strip is contiguous with Hillhead of Derbeth Woodland, a precautionary approach has been taken assuming that red squirrels are present here also.

Table 9 – Summary of Woodland Areas with Red Squirrel Records within 500m of the Proposed Scheme (data are from 2006 surveys unless otherwise stated)

Wood Name (Wood Code)	Approximate Grid Reference	NESBReC / Grampian Squirrel Group Records (post 2000)	Jacobs Hair-Tube Survey	Jacobs Visual Sightings	Unrecorded Sightings (Personal Communication)
Duff's Hill (SLW3)	NO 920993	None recorded	None recorded 2005 survey	None recorded	Yes (local resident personal communication)
Hill of Blairs (SLW7)	NO 882992	None recorded	None recorded	None recorded	Yes (local resident personal communication.)
Cleanhill Wood (SLW9)	NO 868991	Yes	Yes	None recorded	Yes (local resident personal communication)
Durris Forest (SLW11)	NO 863988	Yes	None recorded	None recorded	None recorded
Kingcausie (SLW10)	NO 864998	None recorded	Yes	Yes	Yes (local resident personal communication)

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Wood Name (Wood Code)	Approximate Grid Reference	NESBReC / Grampian Squirrel Group Records (post 2000)	Jacobs Hair-Tube Survey	Jacobs Visual Sightings	Unrecorded Sightings (Personal Communication)
Milltimber Wood (SLW12)	NJ 855017	Yes	Yes	Yes	Yes (local resident personal communication)
Guttrie Hill Wood (SLW13)	NJ 844018	None recorded	Yes	Yes	Yes (local resident personal communication)
Gairnhill Wood (SLW15)	NJ 853046	Yes	Yes	Yes	Yes (local resident personal communication)
Silverburn Wood (SLW16)	NJ 845045	None recorded	Yes	Yes	None recorded
Kingshill Wood (SLW18)	NJ 857057	Yes	Yes 2004 survey	None recorded	Yes (local resident personal communication)
(Near to) Hillhead of Derbeth	NJ 86150810	None recorded	None recorded 2004 Survey	Yes (incidental sighting)	None recorded

4 Evaluation of Habitat Areas

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 10. The ecological evaluations have been derived from data regarding the presence of red squirrel populations from consultation information and survey results, as well as the habitat suitability of woodland habitat areas. Full details of the method of evaluation is provided in Section 2.3.

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 Southern Leg. Detailed botanical information on woodland habitat types, including dominant tree species, and descriptions of ground flora can be found in Appendix A25.1 (Terrestrial Habitats).

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Table 10 – Woodland Evaluation

Wood Name (Wood Code)	Habitat Area (from A25.1 Terrestrial Habitat Report)	Age and Type of Woodland	Evaluation of Habitats (from A25.1 Terrestrial Habitat Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
Section SL1						
Blue Hill Plantation (SLW1)	S6	Semi-mature Coniferous plantation Sitka spruce, Scots Pine	Local/County	Low - Medium	Local	Small stands of Scots pine, but limited foraging opportunities due to plantation being dominated by Sitka spruce. At the thicket stage and therefore unfavourable to red squirrels. Anecdotal records of red squirrels in nearby woodland, Duff's Hill (local resident pers. comm). This woodland habitat does not currently support populations of red squirrels and so is considered to be of local importance.
Drumth Whacket (SLW2)	S6/S9	Semi-mature Coniferous Plantation Sitka spruce	Local	Low - Medium	Local	Limited foraging opportunities due to plantation being dominated by semi-mature Sitka spruce which is not a favoured food resource for red squirrels due to its unpredictable coning cycle. This woodland habitat does not currently support populations of red squirrels and so is considered to be of local importance.
Duff's Hill Plantation (SLW3)	S7	Semi-mature - Mature Coniferous Plantation Lodgepole pine, Sitka spruce	Local	Medium	County	Some foraging opportunities are provided by presence of small-masted coniferous species. Anecdotal records of red squirrels (local resident pers. comm) (refer to paragraph 4.1.4). Grey squirrels are present (ongoing inter-specific competition). Taking the precautionary approach this woodland habitat is considered to support populations of red squirrels, however, due to the isolated nature of the woodland it is considered unlikely to support a locally significant red squirrel population. Therefore, red squirrels that occur here are evaluated as being of county importance.
Section SL2						
Clochandighter (SLW4)	S14	Mature Coniferous Plantation Scot's pine, Sitka spruce, European larch, Lodgepole pine	County	Medium - High	Local	Isolated woodland. Good foraging opportunities provided by presence of mixture of small-masted coniferous species. Grey squirrels present. This woodland habitat does not currently support red squirrels, but is regarded to be potentially suitable for the species and is considered

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Appendix A25.6 - Red Squirrel

Wood Name (Wood Code)	Habitat Area (from A25.1 Terrestrial Habitat Report)	Age and Type of Woodland	Evaluation of Habitats (from A25.1 Terrestrial Habitat Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
						to partially enrich the habitat resource within the local context. Therefore, red squirrels that may occur here are evaluated as being of local importance.
Sunnyside Wood (SLW5)	S11	Semi-mature Coniferous Plantation with broadleaved trees at edges. Scots pine, Birch	Local	Medium	Local	Very small and isolated area of woodland. Foraging opportunities and breeding habitat are present within mature Scots pine plantation. Grey squirrels present. This woodland habitat does not currently support red squirrels but is regarded to be potentially suitable for the species and is considered to partially enrich the habitat resource within the local context. Therefore, red squirrels that may occur here are evaluated as being of local importance.
Greenloaning Plantation (SLW6)	S12	Immature – Semi-mature Semi-natural broad-leaved woodland. Birch, Willow	Local	Low	Less than Local	Isolated woodland with low value habitat for red squirrels due to poor foraging opportunities and lack of cover. Grey squirrels present. This woodland habitat does not currently support populations of red squirrels and so is considered to be of less than local importance.
Hill of Blairs (SLW7)	S15	Mature Coniferous Plantation Scots pine Semi-mature Broad-leaved Plantation Birch, Rowan	Regional	High	Regional	Optimal foraging and breeding habitat provided within mature Scots pine plantation. Contiguous to area of coniferous woodland > 150ha. Red squirrels present here (local resident personal communication.) and in neighbouring woodland (Craigingles Wood). Grey squirrels present (ongoing inter-specific competition). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland as there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the regional and UK BAP
Whitestone Wood (SLW8)	S15	Semi-mature - Mature Coniferous Plantation Scots Pine	Regional	High	County	Abundant foraging and breeding opportunities for red squirrels provided by presence of small-masted coniferous species. Well connected to area of coniferous woodland > 150ha at Cleanhill Wood and Hill of Blairs where red squirrels are present This woodland habitat does not currently support red squirrels but is regarded to be potentially suitable for the species and is considered to appreciably enrich the habitat resource within the local context.

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Wood Name (Wood Code)	Habitat Area (from A25.1 Terrestrial Habitat Report)	Age and Type of Woodland	Evaluation of Habitats (from A25.1 Terrestrial Habitat Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
						Therefore, red squirrels that may occur here are evaluated as being of county importance.
Section SL3						
Cleanhill Wood (SLW9)	S20	Mature Coniferous Plantation/ Broadleaved Woodland Scots pine, European Larch, Beech, Rowan	County	High	Regional	Optimal foraging habitat due to presence of small-masted coniferous species within and contiguous to area of coniferous and broadleaved woodland > 150ha. Red squirrel records here (hair-tube surveys and local resident pers comm) and in surrounding woodland (Craigingles Wood and Kingcausie). Grey squirrel present (ongoing inter-specific competition). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland as there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the regional and UK BAP.
Durris Forest (SLW11)	S18	Mature Coniferous Plantation Spruce, Scots pine, Lodgepole pine, European Larch	Local	High	Regional	Optimal foraging habitat due to mixture of small-masted coniferous species present. Within and contiguous to area of high value red squirrel habitat > 150ha. Grey squirrel present (ongoing inter-specific competition). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland as there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the regional and UK BAP.
Kingcausie (SLW10)	S24	Mature Mixed Coniferous/Broad- leaved Woodland Scots pine, European Larch, Beech, Rowan	County	High	Regional	Optimal foraging and breeding habitat (due to tree species present and age structure) within and adjacent to mature contiguous coniferous and broadleaved woodland >150 ha. Red squirrels present here and in adjoining woodland (Craigingles Wood and Cleanhill Wood). Grey squirrel present (ongoing inter-specific competition). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because it is considered there are regularly occurring, locally significant populations of this nationally important

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Wood Name (Wood Code)	Habitat Area (from A25.1 Terrestrial Habitat Report)	Age and Type of Woodland	Evaluation of Habitats (from A25.1 Terrestrial Habitat Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
						species, which occurs in the regional and UK BAP.
Section SL4						
Milltimber Wood (SLW12)	S35	Mature Coniferous Plantation Scots pine, Sitka spruce	Local	High	Regional	Abundance of foraging opportunities and breeding sites provided within this mature coniferous plantation. Red squirrels present here (hair-tube and visual surveys). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland as there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the regional and UK BAP.
Guttrie Hill Wood (SLW13)	S34	Semi-mature – Mature Coniferous Plantation Scots pine, Sitka spruce. Broad-leaved species at edges: sycamore, birch	County	High	Regional	Optimal foraging and breeding habitat (due to presence of small-masted coniferous species and age structure). Red squirrels present here (hair-tube and visual surveys). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland as there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the regional and UK BAP.
Beans Hill Wood (SLW14)	S39	Mature Coniferous Plantation Scots pine	County	Low	Less than Local	Small and highly isolated area of Scots Pine with poor connectivity to surrounding woodland. This woodland habitat does not currently support populations of red squirrels and so is considered to be of less than local importance.
Section SL5						
Gairnhill Wood (SLW15)	S43	Mature Coniferous Plantation Scots pine, Sitka spruce Areas of Broad-leaved Plantation Beech	County	High	Regional	High value red squirrel habitat providing optimal foraging and breeding opportunities. Contiguous to area of coniferous woodland > 150 ha. Red squirrels present here (hair-tube and visual surveys) and in the surrounding woodland (Kingshill Wood, Silverburn Wood). Grey squirrels present (ongoing inter-specific competition). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological

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Wood Name (Wood Code)	Habitat Area (from A25.1 Terrestrial Habitat Report)	Age and Type of Woodland	Evaluation of Habitats (from A25.1 Terrestrial Habitat Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
						value in this woodland as there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the regional and UK BAP.
Silverburn Wood (SLW16)	S41	Mature Coniferous Plantation Scots pine, European Larch	Local	High	Regional	Optimal foraging and breeding habitat within mature Scots pine plantation. High connectivity to nearby coniferous woodland. Red squirrels present here (hair-tube and visual surveys) and also in adjacent woodland (Gairnhill Wood). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland as there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the regional and UK BAP.
Moss of Auchlea (SLW17)	S45	Mature Broad-leaved semi-natural Woodland Willow, Alder	Regional	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.
Kingshill Wood (SLW18)	S43	Mature Coniferous Plantation Scots pine, Sitka spruce	County	High	Regional	Optimal foraging and breeding habitat due to presence of mixture of coniferous species within and contiguous to area of coniferous woodland > 150 ha. Red squirrels present here (2004 surveys and NESBReC records) and in adjacent woodland (Gairnhill Wood). Grey squirrels present (ongoing inter-specific competition). This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland as there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the regional and UK BAP.
Section SL6						
Hillhead of Derbeth (SLW19)	N6, N7	Mature Coniferous/Broad-leaved mixed plantation Broad-leaved semi-natural woodland	County	Medium	County	Isolated woodland containing mixture of conifers and large and small-masted broad-leaved species. Providing foraging and breeding potential. Incidental sighting of red squirrel approximately 0.5Km away in adjoining woodland strip (see paragraph 3.2.2). It may therefore

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Wood Name (Wood Code)	Habitat Area (from A25.1 Terrestrial Habitat Report)	Age and Type of Woodland	Evaluation of Habitats (from A25.1 Terrestrial Habitat Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
						<p>also be possible that red squirrels are also utilising Hillhead of Derbeth. Taking the precautionary approach this woodland habitat is therefore considered to support populations of red squirrels. However, due to the isolated nature of the woodland it is considered unlikely to support a locally significant red squirrel population thus red squirrels that occur here are evaluated as being of county importance.</p>

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Section SL1

- 4.1.3 Blue Hill Plantation and Drumth Whacket showed no evidence of red squirrel presence and are considered to be of local and less than local importance, respectively. The habitat in this area mainly consists of semi-mature Sitka spruce, which is not a favoured woodland type for red squirrels. Only mature Sitka spruce produces mast (> 30 years old) (Philippa Murphy, Forestry Commission, pers comm.) and so it is highly unlikely that any of the trees in these woodland areas will have reached mast producing age. Stands of mature Scots Pine (approximately 5%) are present within Blue Hill Plantation (see Appendix 25.1: Terrestrial Habitats) however, this would have to increase to at least 20% of the forest cover to promote heavy coning and thus provide year round foraging opportunities for red squirrels (Pepper and Paterson, 1998). Records of red squirrels exist for nearby woodland Duff's Hill (see paragraph 4.1.4) however, recent tree felling has resulted in the isolation of these woodland areas from each other.
- 4.1.4 Duff's Hill Plantation comprises lodgepole pine (approximately 50%) and Sitka spruce (approximately 50%). Lodgepole pine confers direct value for red squirrels as a food resource and so this woodland area is considered to have potential for supporting red squirrel populations. 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). Anecdotal records of red squirrel indicate that they exist here (local resident personal communication) (see Figure A25.8a). It must be noted however, that these observations were made prior to the felling of the northern section of Duff's Hill which is no longer connected to Blue Hill Plantation to the north. The hair-tube surveys also revealed the presence of grey squirrels, leading to an assumption of ongoing inter-specific competition between the two species. This area is assessed as being of county importance to red squirrels, as even though red squirrel records exist, it is unlikely that this woodland can support a locally significant red squirrel population due to its isolated nature and sub-optimal tree species composition.

Section SL2

- 4.1.5 Clochandighter and Sunnyside Wood (< 2ha) are both isolated areas of woodland. Only grey squirrels were recorded in these woodland areas. However, the diverse mix of small-masted coniferous species present provides abundant foraging opportunities for red squirrels and both woodlands are considered to have some potential for supporting red squirrel populations. Clochandighter and Sunnyside Wood are therefore deemed to be of local importance to red squirrels.
- 4.1.6 Greenloaning Plantation is considered to be of less than local importance for red squirrel populations. No red squirrels were recorded in this isolated woodland and a dearth of foraging opportunities and lack suitable cover means this woodland habitat is of low value.
- 4.1.7 Hill of Blairs and Whitestone Wood are both considered to be of high habitat value to red squirrels as they are dominated by Scots Pine, providing optimal breeding and foraging opportunities. Red squirrels are present in Hill of Blairs (local resident personal communication) and this woodland area is considered to be of regional importance. Whitestone Wood is considered to be of county importance for red squirrels. Although the hair-tube and visual surveys yielded negative results for Whitestone Wood, it is highly likely that red squirrels are also utilising this area given its high connectivity to Hill of Blairs. The road that separates Hill of Blairs and Whitestone Wood from Cleanhill Wood and Craingles Wood, where red squirrels are also present, (see paragraph 4.1.8) is narrow and unlikely to pose a real barrier to the movement of red squirrels thus these woodland areas may be seen in the context of contiguous cover (Reynolds and Bentley, 2004) (see Figure A25.8c).

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Section SL3

- 4.1.8 The red squirrels recorded within Kingcausie and Cleanhill Wood are likely to be utilising this entire woodland area as the age structure and mixture of tree species present provide high quality foraging and breeding habitat for red squirrels. Red squirrel records exist in Craingles Wood (NO 875993), which although outside the survey corridor, is contiguous to both Cleanhill Wood and Kingcausie. Grey squirrels have also been observed in these woodland areas. In spite of the probable resultant ongoing inter-specific competition, these woodland areas are considered to be of regional importance for red squirrels.
- 4.1.9 Red squirrel records also exist for Durriss Forest. This woodland is considered to provide high quality red squirrel habitat given the favourable assemblage of coniferous species present and its high connectivity to Kingcausie where red squirrels are also present. Therefore, Durriss Forest is considered to be of regional importance despite the likelihood of ongoing inter-specific competition with grey squirrels.

Section SL4

- 4.1.10 Red squirrels are present in both Milltimber Wood and Guttrie Hill Wood. Dreys were also recorded by Jacobs ecologists in both woodlands. This in conjunction with the apparent absence of grey squirrels means it is highly likely that red squirrels are breeding here however, we cannot be certain of this without observational evidence. Coniferous trees are the most suitable trees for building dreys and they provide high energy food nearly all year round (Corbett and Southern, 1977; Waulters and Dhondt, 1987, in Verboom and van Apeldoorn, 1990). These woodlands are therefore considered to be of regional importance to red squirrels.
- 4.1.11 As mentioned previously, Verbeylen et al. (2003) have shown that a minimum of 3.5ha of woodland is required to support a viable population of red squirrels, providing that the squirrels are able to disperse to other nearby woodland areas. As connectivity is high between Milltimber Wood and Guttrie Hill Wood (see Figure A25.8e) and given the small size of these woodlands (approximately 6.5ha and 4.5ha respectively), it is likely that the squirrels are commuting between the two woodlands.
- 4.1.12 Despite containing Scots pine, Beans Hill Wood provides low value habitat for red squirrels due to its high degree of isolation and small size (approximately 2ha). No red squirrels were recorded, therefore this woodland is considered to be of less than local importance. Culter House Wood was not subject to survey as its tree species mix renders it to be of unfavourable habitat for red squirrels. Hence, Culter House Wood is considered to be of less than local importance.

Section SL5

- 4.1.13 Gairnhill Wood, Silverburn Wood and Kingshill Wood provide optimal red squirrel habitat with an ideal assemblage of tree species and varied age structure presenting excellent foraging and breeding opportunities. Red squirrels were recorded in all three woodland areas and it is likely that squirrels are inter-dispersing between these woodland areas as there is a high degree of connectivity between them (see Figure A25.8f). Grey squirrels were also recorded in Gairnhill Wood and Kingshill Wood thus there is the potential for inter-specific competition between the two species. Nevertheless, this is considered a key area for red squirrel conservation and is deemed to be of regional importance.
- 4.1.14 Moss of Auchlea is an area of wet woodland predominantly comprised of small-masted broadleaved species such as goat willow. It is highly isolated from surrounding woodland areas, separated from Gairnhill Wood and Kingshill Wood to the east by open pasture fields (see Figure A25.8f). This high degree of isolation combined with a lack of suitable refuge sites and limited foraging opportunities, results in this woodland being evaluated as less than local importance for red squirrels.

Section SL6

- 4.1.15 Hillhead of Derbeth Woodland is an isolated area of mature mixed woodland of medium quality habitat. No red squirrels were recorded within the woodland however, an incidental sighting of a red squirrel was made in an adjoining woodland strip, southeast of the woodland (see paragraph 3.2.2). It is therefore possible that red squirrels are utilising Hillhead of Derbeth, but were undetected by the hair-tube surveys. Taking a precautionary approach, and assuming that red squirrels are present, this area is therefore considered to be of county importance.
- 4.1.16 West Hatton Woods (grid ref. NJ855070) were not surveyed as the isolated nature and species mixture of this broadleaved woodland meant that it is considered to be of less than local importance to red squirrels.

5 Potential Impacts

5.1 Introduction

- 5.1.1 This section describes the types of impacts on red squirrels 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 the red squirrel in the Highways Agency network ecological information. An Advice Note on the red squirrel in the DMRB was targeted for publication in 2006 however, a date has yet to be finalised.
- 5.1.3 According to the Scottish Strategy for Red Squirrel Conservation (SSG, 2004), the precise reasons for the decline of the red squirrel are unknown, but the following have been identified as likely factors:
- 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.

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- 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 proposed scheme are considered to be permanent. Temporary impacts, which are only apparent while the proposed scheme is being built, are discussed in association with the construction phase.

Direct Mortality

Construction

- 5.2.3 Direct mortality due to construction of the proposed scheme could 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. If there is a drey present, it is an offence under the Wildlife and Countryside Act (1981) (as amended) and the Nature Conservation (Scotland) Act 2004 (see paragraph 1.2.11) to undertake the tree clearance phase of the construction works, if this leads to the death (either directly or indirectly) of a red squirrel.

Operation

- 5.2.4 Direct mortality during the operational phase could occur 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 may attempt to cross the carriageway during the operational phase of the proposed scheme and therefore be at increased risk of mortality resulting from traffic. Mortality could 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).

Habitat Loss

Operation

- 5.2.5 Habitat loss could arise 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 loss of woodland habitat due to the proposed scheme may represent a substantial loss of red squirrel breeding and foraging habitat and affect the long-term viability of woodland areas to support red squirrels. Red squirrels can be prone to starvation and any reduction in habitat could 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

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the loss of any one of these tree species may lead to a gap in foraging opportunities for red squirrel.

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

5.2.7 The total amount of landtake required in order to construct the Southern Leg of the proposed scheme is estimated at approximately 2.77km² / 277ha. Table 11 shows the estimated total pre-construction and post-construction areas of Phase 1 Habitats present within the proposed landtake. The post-construction figures take account of both anticipated habitat loss to construction and habitat created or changed as a result of mitigation.

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. Consideration will need to be given so as to avoid the inappropriate siting of construction compounds and storage facilities. This may 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 either fragments or isolates woodland, there is the potential for impacts on the long-term genetic diversity of the local red squirrel population. This barrier may cut off populations by restricting movement of red squirrels during either 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 impacts of further development activities on red squirrel populations isolated on the eastern side of the road (refer to Cumulative Impact Assessment, Part E: Cumulative Assessment, of the ES).

Disturbance

Construction

5.2.10 Disturbance due to construction operations is predicted to represent an 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 could all have adverse effects. Impacts would 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 could prompt squirrels to move away from the carriageway to forage and/or breed. As a result, this may 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.

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Table 11 – Phase 1 Habitat Areas Pre and Post Construction

Phase 1 Habitat Description	Phase 1 Habitat Categories within scheme land-take	
	Pre-construction (ha)	Post-construction (ha)
Woodland mixed plantation	2.43	27.86
Woodland broadleaved plantation (Including standard trees)	2.78	7.43
Woodland broadleaved semi-natural	2.90	1.25
Woodland coniferous plantation	15.41	8.59
Scattered scrub	3.55	6.78
Dense continuous scrub	3.58	7.73
Riparian woodland	0	3.03
Acid grassland semi-improved	4.84	3.40
Acid grassland unimproved	0.09	0.06
Amenity grassland	0.01	0.01
Improved grassland	122.66	66.29
Marshy grassland	4.66	3.63
Neutral grassland semi-improved	3.59	1.85
Neutral grassland unimproved	1.57	0.79
Poor semi-improved grassland	23.45	12.77
Disturbed amenity grassland	0.08	0.06
Arable	43.92	18.70*
Built up areas (buildings)	2.51	3.03
Open water	0.36	0.57
Parkland mixed	3.22	4.35
Fen	0.39	0.60
Heath - acid grassland dry mosaic	0.08	0.13
Recently felled coniferous	0.34	0.58
Wet bog	0.52	0.63
Bare ground	1.58	1.80
Herb and fern tall ruderal	0.18	0.36
Total	244.70	182.29

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

Pollution and Other Indirect Impacts

Construction and Operation

5.2.13 Any accidental spillage, polluted runoff, airborne or light pollution may 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 are more likely to be affected by indirect impacts such as pollution of food sources or food caches.

5.3 Specific Impacts

- 5.3.1 The potential impacts associated with the construction and operation of the proposed scheme on local red squirrel populations at specific locations within Sections SL1 - SL6 of the Southern Leg are provided in Table 11. The significance of the impact is derived from the impact assessment process described in Section 2.4. For details on habitat loss refer to the terrestrial habitats report in Appendix A25.1.

Section SL1

- 5.3.2 No red squirrels were recorded in either Blue Hill Plantation or Drumth Whacket, which is located over 200m from the proposed scheme. No potential impacts on red squirrels have been identified in these woodlands.
- 5.3.3 Disturbance of red squirrels in Duff's Hill may occur during construction and operation due to the close proximity of the proposed scheme. Such impacts are considered to be of low negative magnitude and Minor significance. Recent felling activities have isolated Duff's Hill and Blue Hill from each other. The scheme would exacerbate this habitat fragmentation, further preventing the dispersal of red squirrels from Duff's Hill to other woodland areas. Due to the existing habitat isolation at this location, the potential impact is considered to be a low negative impact of Minor significance.

Section SL2

- 5.3.4 No potential impacts on red squirrels are predicted in this section due to the distance of the woodland areas from the proposed route and/or because no evidence was found that they currently support populations of red squirrels.

Section SL3

- 5.3.5 Both Cleanhill Wood and Kingcausie are considered to be of regional importance for red squirrels. The risk of red squirrel direct mortality occurring during construction due to habitat clearance in these woodland areas is considered to represent a high negative impact of Major significance.
- 5.3.6 Disturbance through increased noise levels and human presence during construction may force red squirrels that are in close proximity to construction works to retreat deeper into the woodland. Impacts from disturbance during construction in both Cleanhill Wood and Kingcausie are regarded as medium negative magnitude and Moderate significance.
- 5.3.7 The proposed scheme would sever habitat in Cleanhill Wood and Kingcausie from contiguous woodland areas to the west (Durris Forest). This would prevent red squirrels from moving between woodland areas on opposite sides of the carriageway and as such, habitat fragmentation is considered a high negative impact of Major significance.
- 5.3.8 The proposed scheme would result in the loss of high value red squirrel habitat, comprising mature mixed broadleaved and coniferous woodland. Approximately 5.75ha would be lost from Cleanhill Wood and approximately 2ha of Kingcausie woodland would be felled, reducing red squirrel foraging and/or breeding habitat. Habitat loss in Cleanhill Wood is therefore predicted to constitute a medium negative impact of Moderate significance, whereas in Kingcausie, it is regarded as a low negative impact of Minor significance.
- 5.3.9 The risk of direct mortality of red squirrels during operation of the scheme is regarded as a high negative impact of Major significance in Cleanhill Wood and Kingcausie, as squirrels may attempt to cross the carriageway to disperse to woodland areas west of the scheme. Increased disturbance through noise and/or traffic pollution are assessed as being low negative magnitude and Minor

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significance as these impacts would be likely to cause red squirrels in close proximity to the carriageway to retreat eastwards into the wood, away from the road.

- 5.3.10 Durriss Forest is located over 200m from the proposed scheme. Due to its distance from the scheme, potential impacts in this woodland area are regarded as being of Negligible significance for red squirrels.

Section SL4

- 5.3.11 Guttrie Hill Wood is considered regionally important for red squirrels and the risk of direct mortality occurring during habitat clearance for construction represents a high negative impact of Major significance.
- 5.3.12 Disturbance to red squirrels in this woodland during construction is predicted to be a medium negative impact of Moderate significance. Increased noise levels and human presence in construction areas would likely render these areas less attractive to red squirrels, causing them to retreat into the woodland. Disturbance of red squirrels in regionally important Milltimber Wood is considered to be a low negative impact of Minor significance as this woodland is located over 100m to the east of the proposed scheme.
- 5.3.13 The proposed carriageway would sever Milltimber Wood and Guttrie Hill Wood, restricting dispersal of red squirrels between the two areas. This is predicted to be a high negative impact of Major significance as isolation of these woodland areas could lead to a loss of genetic diversity and ultimately local extinction.
- 5.3.14 The increased risk of red squirrel mortality from road traffic accidents (RTAs) is regarded as a high negative impact of Major significance, as red squirrels may attempt to cross the carriageway to access woodland areas on the opposite side of the scheme.
- 5.3.15 The loss of approximately 0.25ha of high quality red squirrel foraging and/or breeding habitat at Guttrie Hill Wood is considered a low negative impact of Minor significance as this represents only around 5% of the entire woodland area.
- 5.3.16 Disturbance from noise and/or traffic pollution during operation of the scheme is predicted to result in impacts of Minor and Moderate magnitude in Milltimber and Guttrie Hill Woods, respectively.
- 5.3.17 Beans Hill Wood is considered to provide low value habitat for red squirrels and is assessed as being of less than local importance. No red squirrels were recorded and thus no potential impacts on red squirrels are predicted in this woodland area.

Section SL5

- 5.3.18 Silverburn Wood and Garinhill Wood are both assessed as being regionally important for red squirrels. The risk of direct mortality during woodland clearance for construction is considered to be an impact of high negative magnitude and Major significance. Medium negative impacts of Moderate significance are also predicted in these woodlands as a result of increased disturbance from increased noise levels and human presence during the construction phase.
- 5.3.19 A small area of woodland (approximately 05.ha) would be lost from Gairnhill Wood as a result of the proposed scheme. This is regarded as a low negative impact of Minor significance given the overall size of Gairnhill Wood. However, part of the woodland area to be felled is likely to serve as a red squirrel commuting corridor between Silverburn Wood and Gairnhill Wood and this fragmentation is predicted to have severe impacts. The proposed scheme would isolate Silverburn Wood from adjacent Gairnhill Wood, leaving approximately 7ha to the west of the carriageway and >150ha of contiguous woodland to the east. This fragmentation is regarded as a high negative impact of Major significance for Silverburn Wood due to its small size. Isolation of Silverburn Wood could potentially lead to local extinction of the red squirrel population within the woodland. In

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comparison, Gairnhill Wood is a much larger area of woodland and habitat fragmentation here is regarded as being of Moderate impact significance.

- 5.3.20 The risk of direct mortality through RTAs during operation of the scheme is considered to be a high negative impact of Major significance as red squirrels may attempt to cross the carriageway in order to commute between the two woodland areas. Disturbance through noise and/or traffic pollution during operation is expected to constitute a low negative impact of Minor significance in Gairnhill Wood. Disturbance impacts are regarded as being of Moderate significance in Silverburn Wood given the small size of the woodland and thus the vulnerability of the resident red squirrel population.
- 5.3.21 Kingshill Wood is also assessed as being regionally important for red squirrels. However, this woodland area is located approximately 100m away from the proposed scheme and impacts of Negligible significance are predicted. Negligible impacts are also predicted for Moss of Auchlea as this area of woodland habitat is of less than local importance to red squirrels and would be approximately 150m away from the scheme.

Section SL6

- 5.3.22 Hillhead of Derbeth Woodland is assessed as being of county importance for red squirrels. Potential high negative impacts of Moderate significance are predicted due to the risk of red squirrel mortality and increased disturbance during habitat clearance in the construction phase.
- 5.3.23 The operational scheme would sever Hillhead of Derbeth Woodland, fragmenting it from woodland areas north of Fairley Home Farm (where a red squirrel was recorded – refer to baseline section). The proposed carriageway would exacerbate the existing isolated nature of the woodland, which is regarded as a medium negative impact of Moderate significance. The risk of red squirrel mortality through RTAs is likely to result in a high negative impact of Moderate significance if squirrels attempt to cross the carriageway to disperse to other woodland areas.
- 5.3.24 Approximately 0.25ha of medium value red squirrel habitat would be lost due to the proposed scheme. This minor habitat loss and the low risk of disturbance to red squirrels during operation of the scheme are both regarded as low negative impacts of Minor significance.

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Table 12 - Potential Impacts

Habitat Area	Woodland Name (Code) and Evaluation	Phase of scheme	Description of Impact	Impact Magnitude/ Significance
Section SL1				
S6	Blue Hill Plantation (SLW1) Local	Construction and Operation	No significant impacts are predicted as this woodland is not considered to currently support populations of red squirrels.	Negligible/Negligible
S6/S9	Drumth Whacket (SLW2) Local	Construction and Operation	Woodland is situated >200m from the proposed scheme therefore no significant impacts are predicted.	Negligible/Negligible
S7	Duff's Hill Plantation (SLW3) County	Construction	Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works to retreat deeper into the woodland	Low negative/Minor
		Operation	Operational scheme would exacerbate habitat fragmentation issues between the southern section of Duff's Hill and Blue Hill Plantation.	Low negative/Minor
			Risk of increased disturbance through noise and/or traffic pollution during the operational scheme. Likely to cause red squirrels in close proximity to the carriageway to retreat into the wood away from the road.	Low negative/Minor
Section SL2				
S14	Clochdighter (SLW4) Local	Construction and Operation	No significant impacts are predicted as this woodland is not considered to currently support populations of red squirrels.	Negligible/Negligible
S11	Sunnyside Wood (SLW5) Local	Construction and Operation	No significant impacts are predicted since this woodland is not considered to currently support populations of red squirrels.	Negligible/Negligible
S12	Greenloaning Plantation (SLW6) Less than Local	Construction and Operation	No significant impacts are predicted as woodland is over 200m from the proposed scheme and the habitat is considered to be of low value to red squirrels.	Negligible/Negligible
S15	Hill of Blairs (SLW7) Regional	Construction and Operation	Woodland is approximately 150m from the proposed route and therefore no significant impacts are predicted.	Negligible/Negligible
S15	Whitestone Wood (SLW8) County	Construction and Operation	No significant impacts are predicted as woodland is situated over 50m from the proposed scheme.	Negligible/Negligible
Section SL3				
S20	Cleanhill Wood (SLW9) Regional	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Major

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Habitat Area	Woodland Name (Code) and Evaluation	Phase of scheme	Description of Impact	Impact Magnitude/ Significance	
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works to retreat deeper into the woodland.	Medium negative/Moderate	
			Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas.	High negative/Major
				Loss of approximately 5.75ha of high value habitat comprising mature mixed broadleaved and coniferous woodland, which is likely to constitute red squirrels foraging and/or breeding habitat.	Medium negative/Moderate
				Proposed scheme severs Cleanhill Wood leaning approximately 77ha of woodland to the east of the carriageway and 11.25ha to the west. The resultant habitat fragmentation would prevent dispersal of red squirrels between these woodland areas and inhibit their movement into the neighbouring contiguous woodland (Durris Forest to the west and Craingles Wood to the east).	High negative/Major
				Risk of increased disturbance through noise and/or traffic pollution during the operational scheme. Likely to cause red squirrels in close proximity to the carriageway to retreat into the wood away from the road.	Low negative/Minor
S18	Durris Forest (SLW11) Regional	Construction and Operation	Woodland is situated over 200m from the proposed scheme therefore no significant impacts are predicted.	Negligible/Negligible	
S24	Kingcausie (SLW10) Regional	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Major	
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works to retreat deeper into the woodland.	Medium negative/Moderate	
		Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas.	High negative/Major	
			Loss of approximately 2ha of high value habitat comprising mature mixed broadleaved and coniferous woodland, which is likely to constitute red squirrel foraging and/or breeding habitat.	Low negative/Minor	
			Proposed scheme isolates Kingcausie woodland from the woodland bordering Crynoch Burn thus severing red squirrel dispersal between the two woodland areas and beyond.	High negative/Major	
Risk of increased disturbance through noise and/or traffic pollution during the operational scheme. Likely to cause red squirrels in close proximity to the carriageway to retreat into the wood away from the road.	Low negative/Minor				

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Habitat Area	Woodland Name (Code) and Evaluation	Phase of scheme	Description of Impact	Impact Magnitude/ Significance
Section SL4				
S35	Milltimber Wood (SLW12) Regional	Construction	Risk of disturbance through increased noise levels and human presence during the construction phase of the proposed scheme. Woodland areas in close proximity to construction works are likely to become less attractive to red squirrels causing them to retreat to the eastern reaches of the wood.	Low negative/Minor
		Operation	Risk of direct mortality through RTAs if squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas, such as nearby Guttrie Hill Wood.	High negative/Major
			Proposed scheme would isolate Milltimber Wood from nearby Guttrie Hill Wood, thus severing red squirrel dispersal between the two woodlands. This could lead to a loss of genetic diversity and ultimately local extinction.	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational scheme. Likely to cause red squirrels in close proximity to the carriageway to retreat eastwards into the wood away from the road.	Low negative/Minor
S34	Guttrie Hill Wood (SLW13) Regional	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Major
			Risk of disturbance through increased noise levels and human presence during the construction phase of the proposed scheme. Woodland areas in close proximity to construction works are likely to become less attractive to red squirrels causing them to retreat westwards into the wood.	Medium negative/Moderate
		Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas such as nearby Milltimber Wood.	High negative/Major
			Loss of approximately 0.25ha of high quality red squirrel habitat comprising mature and semi-mature coniferous species which is likely to constitute foraging and/or breeding habitat.	Low negative/Minor
			Proposed scheme runs alongside eastern edge of woodland and would isolate Guttrie Hill Wood from nearby Milltimber Wood, thus severing red squirrel dispersal between the two woodlands. This could lead to a loss of genetic diversity and ultimately local extinction.	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational scheme. Likely to cause red squirrels in close proximity to the carriageway to retreat westwards into the wood away from the road.	Medium negative/Moderate
S39	Beans Hill Wood (SLW14) Less than Local	Construction and Operation	Woodland habitat is of low value to red squirrels therefore no significant impacts are predicted.	Negligible/Negligible

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Habitat Area	Woodland Name (Code) and Evaluation	Phase of scheme	Description of Impact	Impact Magnitude/ Significance
Section SL5				
S43	Gairnhill Wood (SLW15) Regional	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Major
			Risk of disturbance through increased noise levels and human presence during the construction phase of the proposed scheme. Woodland areas in close proximity to construction works are likely to become less attractive to red squirrels causing them to retreat to the eastern reaches of the wood.	Medium negative/Moderate
		Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas such as nearby Silverburn Wood.	High negative/Major
			Loss of approximately 0.5ha of high value red squirrel habitat, part of which is likely to serve as a commuting corridor between Silverburn Wood and Gairnhill Wood, as well as constituting red squirrel foraging and/or breeding habitat.	Low negative/Minor
			Proposed scheme would isolate Gairnhill Wood from adjacent Silverburn Wood by fragmenting the potential commuting corridor and thus severing dispersal between the two woodlands.	Medium negative/Moderate
			Risk of increased disturbance through noise and/or traffic pollution during the operational scheme. Likely to cause red squirrels in close proximity to the carriageway to retreat eastwards into the wood away from the road.	Low negative/Minor
S41	Silverburn Wood (SLW16) Regional	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Major
			Risk of disturbance through increased noise levels and human presence during the construction phase of the proposed scheme. Woodland areas in close proximity to construction works are likely to become less attractive to red squirrels causing them to retreat to the western reaches of the wood.	Medium negative/Moderate
		Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas, such as nearby Gairnhill Wood.	High negative/Major
			Proposed scheme would isolate Silverburn Wood (approximately 7ha) from Gairnhill Wood (>150ha of contiguous woodland). Severance of the commuting corridor would prevent dispersal between the two woodlands. This could lead to a loss of genetic diversity and ultimately local extinction.	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational scheme. Likely to cause red squirrels in close proximity to the carriageway to retreat westwards into the wood away from the road.	Medium negative/Moderate

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Habitat Area	Woodland Name (Code) and Evaluation	Phase of scheme	Description of Impact	Impact Magnitude/ Significance
S45	Moss of Auchlea (SLW17) Less than Local	Construction and Operation	Woodland is of low value to red squirrels and is located approximately 150m away from the proposed scheme. Therefore no significant impacts are predicted.	Negligible/Negligible
S43	Kingshill Wood (SLW18) Regional	Construction and Operation	The proposed scheme is situated approximately 100m from the woodland therefore no significant impacts are predicted.	Negligible/Negligible
Section SL6				
N6/N7	Hillhead of Derbeth (SLW19) County	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Moderate
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works to retreat deeper into the woodland.	Medium negative/Moderate
		Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas.	High negative/Moderate
			Loss of approximately 0.25ha of medium value habitat comprising a mixture of conifers and large and small-masted broadleaved species.	Low negative/Minor
		Fragmentation of this woodland area would exacerbate the existing isolated nature of the woodland.	Medium negative/Moderate	
		Risk of increased disturbance through noise and/or traffic pollution during the operational scheme. Likely to cause red squirrels in close proximity to the carriageway to retreat into the wood away from the road.	Low negative/Minor	

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).

Avoidance and Reduction of Impacts at the Project Planning Stage

- 6.1.2 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 to the EU Council Directive (97/11/EC of 3 March 1997).
- 6.1.3 The alignment of the Southern Leg section of the AWPR was determined in part by the need to avoid environmentally sensitive areas and features.

6.2 General

Direct Mortality

Advanced Works

- 6.2.1 To offset the effect of direct mortality, habitat (shrub and scrub) planting in appropriate areas surrounding green bridges must be undertaken before green bridges are constructed. By the time the proposed carriageway is operational, the habitat leading up to green bridges would be at a level where it would aid the passage of mammals across these.

Construction

- 6.2.2 Preconstruction surveys must be undertaken in order to ensure that previous data are 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.
- 6.2.3 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. All tree clearance works are to be undertaken outwith 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.
- 6.2.4 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.

Operation

- 6.2.5 Mitigation measures to ameliorate the direct mortality of red squirrels during operation of the proposed scheme involve controlling grey squirrel numbers by either culling them or removing large-masted tree species. This is likely to reduce both inter-specific competition and the probability

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of diseases such as squirrel poxvirus being transmitted to red squirrels. Mitigation designed to offset habitat loss will also help to ameliorate the impacts of direct mortality. The construction of green bridges to enable wildlife crossing will also reduce the potential for RTAs and squirrels once the proposed scheme is in operation (see paragraph 6.2.16). The mitigation proposed for habitat loss would also indirectly mitigate for direct mortality of red squirrels, as the provision of suitable habitat may result in red squirrels being less likely to attempt to cross the carriageway to access areas on the opposite side of the road.

Habitat Loss

Advanced Works

- 6.2.6 To off-set the effects of habitat loss, habitat (tree and scrub) planting in appropriate areas must be undertaken before existing habitats are cleared for road construction. Many coniferous species take more than 15 years to reach cone bearing age and pre-planting on this time scale will not be possible. However, red squirrels will be able to derive benefits from immature trees through the provision of shelter and food such as berries, shoots, fungi etc. Moreover, this will increase the age structural diversity of the woodland, which is beneficial to red squirrels (Pepper and Patterson, 1998). The importance of planting a number of different tree species in the same area cannot be understated. It is vital that when planting trees there is a variation of tree species that will create a year-round food source for red squirrels to account for good/bad seed years in different tree species (see paragraph 6.2.11). The presence of a varied food source will discourage red squirrels from attempting to cross the carriageway in order to forage in woodland areas on the opposite site of the road.

Construction

- 6.2.7 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 red squirrel dreys are not destroyed.
- 6.2.8 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.
- 6.2.9 In advance of any work starting, contractors will provide a Method Statement outlining how tree-felling will be undertaken. 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 (ECoW) will be informed at least one week in advance of any works proposed in ecologically sensitive areas.
- 6.2.10 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.

Operation

- 6.2.11 Mitigation for the loss of red squirrel habitat will include the planting of suitable tree species of value to red squirrels in appropriate areas within a kilometre of the proposed scheme. These species include Scot's Pine *Pinus sylvestris*; European larch *Larix decidua*; Norway spruce *Picea abies*; Lodgepole pine *Pinus contorta*; Douglas fir *Pseudotsuga menziesii*; yew *Taxus baccata* and hawthorn *Crataegus monogyna*. Other species that can be planted which have a general conservation value and do not encourage grey squirrels are birch *Betula pendula*; rowan *Sorbus aucuparia*; ash *Fraxinus excelsior*; willow *Salix sp.*; aspen *Populus tremula* and alder *Alnus*

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glutinosa. Large masted tree species such as oak *Quercus sp.*, beech *Fagus sylvatica*, chestnuts *Aesculus sp.* and hazel *Corylus avellana* must not be planted within a kilometre of the proposed scheme, where this does not conflict with existing conservation management plans.

- 6.2.12 The impacts of habitat loss may also be alleviated by ensuring that management procedures in existing woodland areas are complementary to red squirrel conservation. Provision of high quality red squirrel habitat means these areas can serve as refuge sites, limiting stress caused by resource competition with grey squirrels.
- 6.2.13 Suitable management strategies for red squirrels include:
- maintaining a favourable species mixture (refer to Section 6.2.11);
 - providing a mixed age structure of trees (refer to Section 6.2.6); and
 - adopting practices that promote heavy coning (such as delay felling of crowned trees and planting tree species favourable to red squirrels along south facing rides).

Habitat Fragmentation and Isolation

- 6.2.14 Two suggested ways to offset the effects of habitat fragmentation and isolation on red squirrel populations are translocation and re-introduction, however these involve complex procedures that carry a high risk of failure if not fully observed. Generally, translocation and reintroduction will be a lower priority than sustaining existing populations (Pepper and Patterson, 1998). Translocation of red squirrels is not a viable option as this species becomes stressed when trapped. In addition to this, if they are released in to other red squirrel territories they will be subjected to competition for the territory, food and resources that will lead to added stress. It is considered less stressful to leave fragmented populations completely alone.

Advanced Works

- 6.2.15 To offset the impacts of habitat fragmentation and isolation, tree and scrub planting in appropriate areas must be undertaken before existing habitats are cleared for road construction.

Construction and Operation

- 6.2.16 The impacts of habitat fragmentation and isolation during the operational phase would be lessened reduced by creating new areas of habitat. Planting suitable tree species that have direct value for red squirrels (such as Scot's Pine, larch, Norway spruce, Lodgepole pine, Douglas fir, yew and hawthorn) in open areas, will encourage the movement of red squirrels between previously isolated or fragmented woodland. Woodland management sympathetic to red squirrel conservation will also help to indirectly ameliorate habitat fragmentation impacts (as detailed in paragraphs 6.2.12 and 6.2.132). Using alternative management methods to clear felling of contiguous woodland blocks will help avoid further fragmentation.
- 6.2.17 Wildlife overpasses or green bridges and passages adapted to allow climbing animals to cross the carriageway above the traffic would reduce fragmentation impacts on red squirrels as well as for a number of other species. Observations of red squirrels using fauna passages are rare, however, there are documented cases of red squirrels using suitably designed overbridges in Europe (COST 341, 2002; van der Grift and van der Sluis, 2003).
- 6.2.18 Due to the width of the proposed carriageway (approximately 30m wide plus embankment or cutting), it is unfeasible that red squirrels will use tree-top overpasses. Red squirrels are shy and do not tend to go into exposed/open areas. Treetop rope and/or plank overpasses may however be a viable mitigation option on narrower access roads.
- 6.2.19 The proposed mitigation will reduce the local effects of habitat fragmentation and isolation resulting from the construction and operation of the proposed scheme. However, it is considered that additional measures may be required in the context of wider impacts of the proposed scheme.

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Although not incorporated into this impact assessment, a number of red squirrel conservation projects and/or grey squirrel control schemes have been evaluated for their suitability to provide additional offset mitigation. This will aid in maintaining and enhancing red squirrel populations in the Aberdeen area in line with the red squirrel LBAP and the Scottish Red Squirrel Action Plan 2006-2011. Further details of the approach to identifying appropriate offset mitigation are provided in Part E of the Environmental Statement, Chapter 56 Mitigation.

Disturbance

Construction

- 6.2.20 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.
- 6.2.21 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 consist of a stout fence 2m high erected prior to the start of any works including site clearance (see above – mitigation for habitat loss).

Operation

- 6.2.22 In the short-term, it will be impossible to avoid disturbance to red squirrels during the operational phase of the proposed 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. Implementation of woodland management practices referred to in paragraphs 6.2.12 and 6.2.13, in appropriate areas, will indirectly help to alleviate impacts of disturbance.

6.3 Specific Mitigation

- 6.3.1 Mitigation measures to prevent, reduce and offset the negative impacts associated with the construction and operational phases of the proposed AWPR Southern Leg are summarised in Table 13. Areas of planting adjacent to the scheme are indicated on Figures 26.5a - 26.5p Landscape and Ecological Mitigation. Offset mitigation is in the process of being developed and specific location details are unable to be provided at the time of writing this report. Wider mitigation elements are discussed further in Chapter 56 (Mitigation).

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Table 13 - Specific Mitigation Measures for Red Squirrel Predicted Impacts

Direct Mortality	Habitat Loss	Habitat Fragmentation	Disturbance
Section SL1			
The risk of direct mortality is not considered to constitute a significant impact in this section so no specific mitigation is proposed.	Habitat loss is not considered to constitute a significant impact in this section so no specific mitigation is proposed.	Operation Generic mitigation as prescribed in paragraphs 6.2.15-6.2.19 including: Creation of woodland habitat (see Terrestrial Habitats report appendix A25.1) by replanting northern section of Duff's Hill (HA S7) with favourable tree species for red squirrel will benefit the species (see Figure 26.5c); Sympathetic woodland management for red squirrels of Duff's Hill, Blue Hill Plantation and Drumth Whacket to provide red squirrel refuge habitat.	Construction Generic mitigation as prescribed in paragraphs 6.2.20 and 6.2.21. Operation Generic mitigation as prescribed in paragraph 6.2.22.
Section SL2			
The risk of direct mortality is not considered to constitute a significant impact in this section so no specific mitigation is proposed.	Habitat loss is not considered to constitute a significant impact in this section so no specific mitigation is proposed.	Habitat fragmentation is not considered to constitute a significant impact in this section so no specific mitigation is proposed.	Disturbance is not considered to constitute a significant impact in this section so no specific mitigation is proposed.
Section SL3			
Construction Generic mitigation as prescribed in paragraphs 6.2.1-6.2.4. Operation Generic mitigation as prescribed in paragraph 6.2.5. See also specific mitigation for habitat fragmentation.	Construction Generic mitigation as prescribed in paragraphs 6.2.6-6.2.10. Operation Generic mitigation as prescribed in paragraphs 6.2.11-6.2.13 including: Planting of scrub and woodland (see Terrestrial Habitats report appendix A25.1) in HA 20, HA 23 and HA 24 between ch100200-100780 and ch100970-101160 (Figure 26.5g). Sympathetic woodland management for red squirrels of Cleanhill Wood, Kingcausie and Durris Forest.	Construction and Operation Generic mitigation measures as prescribed in paragraphs 6.2.15-6.2.19 including: Wildlife bridge at ch100600 with vegetation planted along the bridge to encourage use by red squirrels. Habitats on both sides of proposed carriageway to be linked up to bridge by planting/maintaining existing vegetation (see Figure 26.5g). See also specific mitigation for habitat loss.	Construction Generic mitigation as prescribed in paragraphs 6.2.20 and 6.2.21. Operation Generic mitigation as prescribed in paragraph 6.2.22. See also specific mitigation for habitat loss.

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Direct Mortality	Habitat Loss	Habitat Fragmentation	Disturbance
Section SL4			
<p>Construction Generic mitigation as prescribed in paragraphs 6.2.1-6.2.4.</p> <p>Operation Generic mitigation as prescribed in paragraph 6.2.5. See also mitigation for habitat fragmentation.</p>	<p>Construction Generic mitigation as prescribed in paragraphs 6.2.6-6.2.10.</p> <p>Operation Generic mitigation as prescribed in paragraphs 6.2.11-6.2.13 including: Planting of mixed woodland and coniferous woodland (see Terrestrial Habitats report appendix A25.1) in HA S34 between ch103800-104310 (Figure 26.5j). Replanting of western section of Milltimber Wood (see Terrestrial Habitats report appendix A25.1) in HA S35 (Figure 26.5j). Sympathetic woodland management for red squirrels of Guttrie Hill Wood and Milltimber Wood to provide refuge habitat. See also specific mitigation for habitat fragmentation.</p>	<p>Construction and Operation Generic mitigation measures as prescribed in paragraphs 6.2.15-6.2.19: See also specific mitigation for habitat loss.</p>	<p>Construction Generic mitigation as prescribed in paragraphs 6.2.20 and 6.2.21.</p> <p>Operation Generic mitigation as prescribed in paragraph 6.2.22. See also specific mitigation for habitat loss and fragmentation.</p>
Section SL5			
<p>Construction Generic mitigation as prescribed in paragraphs 6.2.1-6.2.4.</p> <p>Operation Generic mitigation as prescribed in paragraph 6.2.5. See also specific mitigation for habitat loss.</p>	<p>Construction Generic mitigation as prescribed in paragraphs 6.2.7-6.2.10.</p> <p>Operation Generic mitigation as prescribed in paragraphs 6.2.11-6.2.13 including: Planting of (see Terrestrial Habitats report appendix A25.1) mixed woodland alongside proposed carriageway in HA S43 between ch106025-107090 (Figure 26.5l). Sympathetic woodland management for red squirrels of Silverburn Wood, Gairnhill Wood and Kingshill Wood to provide refuge habitat. See also specific mitigation for habitat fragmentation.</p>	<p>Construction and Operation Generic mitigation as prescribed in paragraphs 6.2.15-6.2.19 See also specific mitigation for habitat loss</p>	<p>Construction Generic mitigation as prescribed in paragraphs 6.2.20 and 6.2.21.</p> <p>Operation Generic mitigation as prescribed in paragraph 6.2.22. See also specific mitigation for habitat loss and fragmentation.</p>

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Direct Mortality	Habitat Loss	Habitat Fragmentation	Disturbance
Section SL6			
<p>Construction Generic mitigation as prescribed in paragraphs 6.2.1-6.2.4.</p> <p>Operation Generic mitigation as prescribed in paragraph 6.2.5. See also specific mitigation for habitat loss.</p>	<p>Construction Generic mitigation as prescribed in paragraphs 6.2.7-6.2.10.</p> <p>Operation Generic mitigation as prescribed in paragraphs 6.2.11-6.2.13 including: Planting of mixed woodland (see Terrestrial Habitats report appendix A25.1) in HA N4 and HA N7 between ch109300-109500m (Figure 26.5o). Sympathetic woodland management for red squirrels of Hillhead of Derbeth to provide refuge habitat.</p>	<p>Construction and Operation Generic mitigation as prescribed in paragraphs 6.2.15-6.2.19 including: Wildlife overbridge at ch109515 with vegetation planted along the bridge to encourage use by red squirrels. Habitats on both sides of proposed carriageway to be linked up to bridge by planting/maintaining existing vegetation (see Figure 26.5o).</p>	<p>Construction Generic mitigation as prescribed in paragraphs 6.2.20 and 6.2.21.</p> <p>Operation Generic mitigation as prescribed in paragraph 6.2.22. See also specific mitigation for habitat loss and fragmentation.</p>

6.4 Mitigation Overview

- 6.4.1 Habitat loss and fragmentation will be addressed through re-planting, connecting woodland areas and the creation of additional habitat. Implementing woodland management practices complementary to red squirrel conservation will also be of benefit. This planting and woodland habitat management may also indirectly mitigate for direct mortality of red squirrels, as the provision of appropriate habitat may result in red squirrels being less likely to attempt to cross the carriageway to forage and/or breed in areas on the opposite side of the road.
- 6.4.2 It is important that planting recommended as mitigation be in place prior to construction commencing. Time is needed to allow planting to be of sufficient size to be of benefit to red squirrels. It may take time for red squirrels to become habituated to the operational road and additional habitat must be available for them to move into before the proposed scheme becomes operational. Mitigation through the management of grey squirrels will include fragmenting existing beech avenues, where this does not conflict with existing conservation management plans, to dissuade the dispersal of this species.
- 6.4.3 In order to ensure compliance with the legislation regarding disturbance or destruction of a red squirrel drey, a method statement is being developed in liaison with SNH (refer to paragraph 6.2.4). It is essential to ensure that all personnel working on site are aware of the protocols to be followed and legal obligations.
- 6.4.4 Controlling grey squirrel numbers in woodlands north of the River Dee is a primary objective for the Forestry Commission and it is expected that management of grey squirrel numbers in these areas will be of benefit to red squirrels. A long-term management plan to manage woodlands that have been fragmented by the proposed scheme for red squirrel conservation purposes is a mitigation option under consideration by the Scottish Executive. This will include on-going monitoring of red squirrels once the road is operational, as well as on-going monitoring of grey squirrels once control measures have been put in place.
- 6.4.5 As part of the development of the Environmental Management Plan, a Red Squirrel Management Plan will be developed to ensure that the mitigation for red squirrels as proposed in this ES and the Mitigation Vision Statement are translated into a deliverable commitment. This will help to maintain and enhance red squirrel populations in the Aberdeen area in line with the red squirrel LBAP and the Scottish Red Squirrel Action Plan 2006-2011.

7 Residual Impacts

- 7.1.1 The long-term residual impacts predicted once the mitigation outlined above has been successfully implemented are shown in Table 14. Section SL2 has been omitted from the table as it is anticipated that there would be no major impacts as a result of the proposed scheme. Therefore, the residual impacts in this section are considered to be of Negligible significance.
- 7.1.2 The specific mitigation proposed may not completely ameliorate for all predicted impacts. Indeed, impacts on red squirrels of Moderate or greater significance remain for Milltimber Wood, Guttrie Hill Wood, Silverburn Wood and Gairnhill Wood (refer to Table 13). However, these residual impacts will be ameliorated through successful implementation of offset mitigation that will help reduce the cumulative impacts associated with the proposed scheme (Part E of the Environmental Statement).

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Table 14 - Specific Residual Impacts on Red Squirrels Following Mitigation

Woodland (Woodland Number and Habitat Area)	Phase of Scheme	Description of Impact (Before Mitigation)	Impact Magnitude/ Significance	Description of Residual Impact (Following Mitigation)	Residual Impact Magnitude/ Significance
Section SL1					
Duff's Hill Plantation (SLW3, HA S7)	Construction	Risk of red squirrel disturbance due to construction activities. Likely to force red squirrels to retreat deeper into the wood.	Low negative/ Minor	Generic mitigation measures include erection of temporary fencing to define exclusion zones around active dreys, as per method statement, will minimise disturbance. Any disturbance will be temporary.	Negligible/Negligible
	Operation	Risk of increased disturbance to red squirrels during the operational scheme.	Low negative/ Minor	Appropriate woodland management for red squirrels will ameliorate impacts of disturbance by providing red squirrel refuge habitat.	Negligible/Negligible
		Scheme would exacerbate habitat fragmentation issues between southern section of Duff's Hill and Blue Hill Plantation to the north.	Low negative/ Minor	Habitat creation through replanting northern section of Duff's Hill, appropriate management of this and the surrounding woodlands for red squirrels will benefit the species. However, the remaining habitat fragmentation is still considered to be a Minor significant impact.	Low negative/ Minor
Section SL3					
Cleanhill Wood (SLW9, HA S20)	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/ Major	Method statement (see paragraph 6.2.4) will be followed including: phased tree clearance and implementation of exclusion zones around active dreys to avoid felling drey trees.	Negligible/Negligible
		Risk of red squirrel disturbance due to construction activities. Likely to force red squirrels to retreat deeper into the wood.	Medium negative/ Moderate	Generic mitigation measures include erection of temporary fencing to define exclusion zones around active dreys, as per method statement, will minimise disturbance. Any disturbance will be temporary.	Low negative/ Minor
	Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway.	High negative/ Major	Installation of wildlife bridge will help reduce the risk of direct mortality by providing a safe crossing point. However, it may take some time for red squirrels to become accustomed to using the overbridge. See also mitigation for habitat loss.	Low negative/ Minor
		Permanent loss of red squirrel woodland habitat.	Medium negative/ Moderate	Woodland and scrub habitat creation together with sympathetic management of surrounding woodland areas for red squirrel conservation will help ameliorate habitat loss impacts. However, it may take some time for planted areas of woodland habitat to mature.	Low negative/ Minor
		Proposed scheme would fragment Cleanhill Wood from Durriss Forest.	High negative/ Major	Installation of wildlife bridge will help mitigate for habitat fragmentation although it may take some time for red squirrels to become accustomed to using the overbridge. See also mitigation for habitat	Low negative/ Minor

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Woodland (Woodland Number and Habitat Area)	Phase of Scheme	Description of Impact (Before Mitigation)	Impact Magnitude/ Significance	Description of Residual Impact (Following Mitigation)	Residual Impact Magnitude/ Significance
				loss.	
		Risk of increased disturbance to red squirrels during the operational scheme.	Low negative/ Minor	Appropriate woodland management for red squirrels along with habitat creation will ameliorate impacts of disturbance by providing red squirrel refuge habitat.	Negligible/Negligible
Kingcausie (SLW10, HA S24)	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/ Major	Method statement (see paragraph 6.2.4) will be followed including: phased tree clearance and implementation of exclusion zones around active dreys to avoid felling drey trees.	Negligible/Negligible
		Increased risk of disturbance to red squirrels due to construction activities. Likely to force red squirrels to retreat deeper into the wood.	Medium negative/ Moderate	Generic mitigation measures include erection of temporary fencing to define exclusion zones around active dreys, as per method statement, will minimise disturbance. Any disturbance will be temporary.	Low negative/ Minor
	Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway.	High negative/ Major	Installation of wildlife bridge at Cleanhill Wood will help reduce the risk of direct mortality by providing a safe crossing point. However, it may take some time for red squirrels to become accustomed to using the overbridge. See also mitigation for habitat loss.	Low negative/ Minor
		Permanent loss of red squirrel woodland habitat.	Low negative/ Minor	Woodland and scrub habitat creation together with sympathetic management of surrounding woodland areas for red squirrel conservation will help ameliorate habitat loss impacts. However, it may take some time for planted areas of woodland habitat to mature.	Negligible/Negligible
		Proposed scheme would isolate Kingcausie woodland from the woodland bordering Crynoch Burn, thus severing red squirrel dispersal between these two woodland areas and beyond.	High negative/ Major	Installation of wildlife bridge at Cleanhill Wood will help mitigate for habitat fragmentation although it may take some time for red squirrels to become accustomed to using the overbridge. See also mitigation for habitat loss.	Low negative/ Minor
		Risk of increased disturbance to red squirrels during the operational scheme.	Low negative/ Minor	Appropriate woodland management for red squirrels along with habitat creation will ameliorate impacts of disturbance by providing red squirrel refuge habitat.	Negligible/Negligible
Section SL4					
Milltimber Wood (SLW12, HA S35)	Construction	Risk of red squirrel disturbance due to construction activities.	Low negative/ Minor	Generic mitigation measures include erection of temporary fencing to maintain prescribed working area will ensure minimal disturbance. Any disturbance will be temporary.	Negligible/Negligible

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Woodland (Woodland Number and Habitat Area)	Phase of Scheme	Description of Impact (Before Mitigation)	Impact Magnitude/ Significance	Description of Residual Impact (Following Mitigation)	Residual Impact Magnitude/ Significance
	Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway to disperse to other woodland areas, such as Guttrie Hill Wood.	High negative/ Major	Sympathetic woodland management for red squirrels and replanting western section of Milltimber Wood will provide refuge habitat. Squirrels would be less likely to attempt to cross road to forage and/or breed if they already have access to high quality habitat.	Medium negative/ Moderate
		Proposed scheme would isolate Milltimber Wood from nearby Guttrie Hill Wood.	High negative/ Major	Although sympathetic management woodland management of red squirrels will help alleviate fragmentation impacts to some extent, the small size of Milltimber Wood means it is probably too small to support a red squirrel population in isolation. Fragmentation could therefore lead to loss of genetic diversity and ultimately local extinction of red squirrels form the woodland.	High negative/ Major
		Risk of increased disturbance to red squirrels during the operational scheme.	Low negative/ Minor	Appropriate woodland management for red squirrels along with habitat creation will ameliorate impacts of disturbance by providing red squirrel refuge habitat.	Negligible/Negligible
Guttrie Hill Wood (SLW13, HA S34)	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/ Major	Method statement (see paragraph 6.2.4) will be followed including: phased tree clearance and implementation of exclusion zones around active dreys to avoid felling drey trees.	Negligible/Negligible
		Risk of red squirrel disturbance due to construction activities. Likely to force red squirrels to retreat deeper into the wood.	Medium negative/ Moderate	Generic mitigation measures include erection of temporary fencing to define exclusion zones around active dreys, as per method statement, will ensure minimal disturbance. Any disturbance will be temporary.	Low negative/ Minor
	Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway to disperse to other woodland areas, such as Milltimber Wood.	High negative/ Major	Sympathetic woodland management for red squirrels of Guttrie Hill Wood will provide refuge habitat Squirrels less likely to attempt to cross road to forage and/or breed if already have access to high quality habitat, however, the risk of mortality is still considered to be a Major adverse impact	High negative/ Major
		Permanent loss of red squirrel woodland habitat.	Low negative/ Minor	Sympathetic management of Guttrie Hill Wood and surrounding woodland areas for red squirrel will help ameliorate habitat loss impacts.	Negligible/Negligible
		Proposed scheme would isolate Guttrie Hill Wood from nearby Milltimber Wood.	High negative/ Major	Sympathetic woodland management for red squirrels (as per mitigation for habitat loss) will indirectly help alleviate fragmentation impacts to some extent and benefit the species however, habitat fragmentation is still considered to be a .Major significance impact, .	High negative/ Major
		Risk of increased disturbance to red squirrels during the	Low negative/ Minor	Appropriate woodland management for red squirrels will ameliorate impacts of disturbance by providing/improving access to red squirrel	Negligible/Negligible

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Woodland (Woodland Number and Habitat Area)	Phase of Scheme	Description of Impact (Before Mitigation)	Impact Magnitude/ Significance	Description of Residual Impact (Following Mitigation)	Residual Impact Magnitude/ Significance
		operational scheme.		refuge habitat.	
Section SL5					
Gairnhill Wood (SLW15, HA S43)	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/ Major	Method statement (see paragraph 6.2.4) will be followed including: phased tree clearance and implementation of exclusion zones around active dreys to avoid felling drey trees.	Negligible/Negligible
		Risk of red squirrel disturbance due to construction activities. Likely to force red squirrels to retreat deeper into the wood.	Medium negative/ Moderate	Generic mitigation measures include erection of temporary fencing to define exclusion zones around active dreys, as per method statement, will minimise disturbance. Any disturbance will be temporary.	Low negative/ Minor
	Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway.	High negative/ Major	Sympathetic woodland management for red squirrels of Gairnhill Wood and Kingshill Wood will provide refuge habitat. Squirrels less likely to attempt to cross road to forage and/or breed if already have access to high quality habitat.	Medium negative/ Moderate
		Permanent loss of red squirrel woodland habitat.	Low negative/ Minor	Woodland and scrub habitat creation together with sympathetic management of surrounding woodland areas for red squirrel conservation will help ameliorate habitat loss impacts. However, it may take some time for planted areas of woodland habitat to mature.	Negligible/Negligible
		Proposed scheme would fragment Gairnhill Wood from adjacent Silverburn Wood to the west.	Medium negative/ Moderate	Habitat creation and sympathetic woodland management of Gairnhill Wood and Kingshill Wood for red squirrels (as per specific mitigation for habitat loss) will help alleviate fragmentation impacts.	Low negative/ Minor
		Risk of increased disturbance to red squirrels during the operational scheme.	Low negative/ Minor	Appropriate woodland management for red squirrels along with habitat creation will ameliorate impacts of disturbance by providing red squirrel refuge habitat.	Negligible/Negligible
Silverburn Wood (SLW16, HA S41)	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/ Major	Method statement (see paragraph 6.2.4) will be followed including: phased tree clearance and implementation of exclusion zones around active dreys to avoid felling drey trees.	Negligible/Negligible
		Risk of red squirrel disturbance due to construction activities. Likely to force red squirrels to retreat deeper into the wood.	Medium negative/ Moderate	Generic mitigation measures include erection of temporary fencing to define exclusion zones around active dreys, as per method statement, will minimise disturbance. Any disturbance will be temporary.	Low negative/ Minor
	Operation	Risk of direct mortality through RTAs if red squirrels attempt to	High negative/ Major	Sympathetic woodland management for red squirrels of Silverburn Wood will provide refuge habitat. Squirrels less likely to attempt to	High negative/ Major

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Woodland (Woodland Number and Habitat Area)	Phase of Scheme	Description of Impact (Before Mitigation)	Impact Magnitude/ Significance	Description of Residual Impact (Following Mitigation)	Residual Impact Magnitude/ Significance
		cross the carriageway to disperse to other woodland areas, such as Gairnhill Wood.		cross road to forage and/or breed if already have access to high quality habitat, however, the risk of mortality is still considered to be a Major adverse impact.	
		Proposed scheme would isolate Silverburn Wood from adjacent Gairnhill Wood.	High negative/ Major	Sympathetic woodland management for red squirrels in Silverburn Wood will indirectly help alleviate fragmentation impacts to some extent and benefit the species, however, habitat fragmentation is still considered to be a Major significance impact.	High negative/ Major
		Risk of increased disturbance to red squirrels during the operational scheme.	Medium negative/ Moderate	Appropriate woodland management for red squirrels will help ameliorate impacts of disturbance by providing/improving access to red squirrel refuge habitat.	Low negative/ Minor
Section SL6					
Hillhead of Derbeth (SLW19, HA N6/N7)	Construction	Risk of red squirrel mortality during clearance of woodland for construction works.	High negative/ Major	Method statement (see paragraph 6.2.4) will be followed including: phased tree clearance and implementation of exclusion zones around active dreys to avoid felling drey trees.	Negligible/Negligible
		Risk of red squirrel disturbance due to construction activities.	Medium negative/ Moderate	Generic mitigation measures include erection of temporary fencing to define exclusion zones around active dreys, as per method statement, will minimise disturbance. Any disturbance will be temporary.	Low negative/ Minor
	Operation	Risk of direct mortality through RTAs if red squirrels attempt to cross the carriageway.	High negative/ Major	Installation of wildlife bridge will help reduce the risk of direct mortality by providing a safe crossing point. However, it may take some time for red squirrels to become accustomed to using the overbridge. See also mitigation for habitat loss.	Low negative/ Minor
		Permanent loss of red squirrel woodland habitat.	Low negative/ Minor	Woodland and scrub habitat creation together with sympathetic woodland management for red squirrel conservation will help ameliorate habitat loss impacts. However, it may take some time for planted areas of woodland habitat to mature.	Negligible/Negligible
		Proposed scheme would fragment this woodland area thus exacerbating the existing isolated nature of woodland.	Medium negative/ Moderate	Installation of wildlife bridge will help mitigate for habitat fragmentation although it may take some time for red squirrels to become accustomed to using the overbridge. See also mitigation for habitat loss.	Low negative/ Minor
		Risk of increased disturbance to red squirrels during the operational scheme.	Low negative/ Minor	Appropriate woodland management for red squirrels along with habitat creation will ameliorate impacts of disturbance by providing red squirrel refuge habitat.	Negligible/Negligible

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