



ENVIRONMENTAL CONSULTANTS

Unit 4, Langham Stables, Langham Lane, Lodsworth, Petworth, West Sussex, GU28 9BU

Mitigation Statement

Land South of Burndell Road, Yapton, West Sussex

Author: Jess Burkitt BSc (Hons), GradCIEEM

Reviewed by: Dan Bennett BSc (Hons) MCIEEM

13th August 2018

Project No: 2699

The Ecology Co-operation Ltd
Registered Office: Greens Court, West Street, Midhurst, West Sussex, GU29 9NQ
Company number: 8905527



Report Summary

1. The Ecology Co-op was commissioned by Crayfern Homes Ltd to outline necessary mitigation for land proposed for development at Land south of Burndell Road in Yapton, where previous surveys have shown that the site supports a medium population of slow worms and a low population of common lizards.
2. Pre-construction work includes the preparation of a 'receptor site' containing suitable reptile habitat, followed by the fencing, trapping of common reptiles at the development site and translocation to this receptor site.
3. Enhancement measures are proposed to encourage biodiversity at the development site, including the creation of new species rich native hedgerows and wildflower meadow habitat that will be beneficial for a variety of invertebrates and in turn provide value for foraging birds and bats. Roosting features for bats have been incorporated into the scheme along with bird boxes for nesting birds.
4. Site staff must be briefed prior to the commencement of construction on the importance of protecting the reptile fencing and contacting an ecologist in the event that any reptiles or other wildlife are identified within the construction zone.
5. Post construction management is detailed in Section 4. This includes condition checks for bat roosting features, bird boxes and an appropriate cutting method for management of proposed wildflower meadow habitats.

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1 INTRODUCTION

1.1 Purpose of the Report

This document has been produced to demonstrate how a residential development involving construction of 43 residential dwellings at Land south of Burndell Road, Yapton West Sussex, will minimise its impact upon protected species, wider biodiversity and provide targeted enhancement measures for nesting birds and bats. It outlines all mitigation and compensation measures that are designed to ensure that valuable habitats are either protected, replaced or enhanced, together with the measures put in place to prevent harm to legally protected species and comply with wildlife legislation. .

All of the prescribed mitigation measures described within this document will be issued to relevant works contractors to ensure that they are carried out in full. Implementation of this will be overseen by a suitable ecological consultancy, and the works contractor will be given contact details for an ecologist so that any issues can be resolved promptly.

This report was commissioned and produced at the request of Crayfern Homes Ltd.

1.2 Background

The Ecology Co-op was commissioned to undertake a preliminary ecological appraisal of the site in March 2018, followed by protected species at the site in spring-summer 2018. These surveys revealed that the site supports a 'medium' population of slow worms *Anguis fragilis* and a 'low' population of common lizard *Zootoca vivipara*. The site also supports suitable habitat for nesting birds.

The site comprises a single large field of unmanaged dense, tussocky improved grassland bordered by species-poor hedgerows, scattered trees and a wet ditch running along the southern and western boundaries. There are some patches of scattered scrub along the boundaries of the site.





1.3 Relevant Legislation

Reptiles

Slow Worms, Adder, Grass Snakes and Common Lizards are protected against intentional killing or injuring and trade under part of subsection 9(1) and all of subsection 9(5) of the Wildlife and Countryside Act 1981. Destruction of known habitats whilst reptiles are present may therefore lead to an offence.

Birds

All species of bird are protected under Section 1 of the Wildlife and Countryside Act 1981 (as amended). Protection was extended by the Countryside and Rights of Way (CROW) Act 2000. Under the above legislation it is an offence to intentionally:

- kill, injure or take any wild bird;
- take, damage or destroy the nest of any wild bird while that nest is in use or being built; or
- take or destroy an egg of any wild bird.

Certain species are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) and receive protection under Sections 1(4) and 1(5). The protection was extended by the Countryside and Rights of Way (CROW) Act 2000. There are special penalties where the offences listed above are committed for any Schedule 1 species and it is also an offence to intentionally or recklessly:

- disturb any such bird when it is building its nest or while it is in or near a nest containing dependent young; or
- disturb the dependent young of any such birds

2 PRE-CONSTRUCTION MITIGATION MEASURES

2.1 Reptile Mitigation - rationale

Suitable reptile habitat occupies a large proportion of the development site. There is therefore insufficient space within the development site to accommodate the reptile population on-site and the only option in this case is the capture and translocation to a pre-prepared off-site receptor site capable of supporting the translocated animals.

The receptor site selected for this purpose is located at Littlehampton Golf Course (see Section 2.2), where there are substantial areas of suitable habitat for reptiles. To ensure that translocation of reptiles does not result in 'overcrowding' of an existing population, the receptor sites are subject to a presence absence survey in advance and some habitat enhancements to increase carrying capacity at the site. In this case, the addition of several reptile purpose-built hibernacula to the grassland would be a significant enhancement to improve the availability of hibernation sites as the receptor site currently lacks suitable natural features.

Once the receptor site is confirmed, trapping and translocation can start. This involves fencing the site to prevent reptiles from entering the site from connected habitat outside the development boundary (see Section 2.3). This is followed by a set period of trapping out (see Section 2.4) in accordance with current best practice guidance.

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It is essential that the designated receptor sites are maintained suitable for reptiles in perpetuity. Aftercare of the receptor site includes maintenance is set out in Section 4.

2.2 Off-site Reptile Receptor Area

A reptile receptor site, Littlehampton Golf Course, has been located within 3 miles of the development site. Littlehampton Golf Course and comprises an 18-hole golf course with numerous areas of rough grassland, sand dune habitat) and large areas of scrub habitat. Part of the site bordering the coastline is designated as a Site of Special Scientific Interest (SSSI).

The proposed reptile receptor site has been surveyed to determine whether an existing population of reptiles is present. The survey was carried out following accepted best practice guidance for presence/absence surveys. A total of 20 roofing felt sheets were placed across the site. Reptiles are attracted to these refugia to warm up in the mornings and late afternoon to regulate their temperature and a suitably qualified surveyor can count the number and in some cases sex each of the species present.



Figure 3. The location of Littlehampton Golf Club, with the proposed receptor area outlined in red.

The refugia were placed out on the 16th July and left for a week to 'bed in' before the commencement of the survey process. A total of seven survey visits were undertaken. The weather conditions, dates and times together with the findings are provided in Table 1 below. Please note that survey timing was restricted as the golf course management requested that surveys were completed before 8am.



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Table 1: Results of reptile survey undertaken at Littlehampton Golf Course. SW – Slow worm, GS – Grass snake, CL – Common Lizard, Juv – Juvenile, SA – Sub adult, F- Female, M – Male.

Date	Start Time	Air Temp/ Refugia Temp (°C)	Weather Notes, cc = Cloud cover, BF=wind strength based on Balfour Scale	Survey findings
25/07/2018	07:00	18/19	3% moisture, 7mph winds, no cloud cover	0
27/07/2018	06:00	19/16	10% moisture, no cloud cover, rapidly warming up	Mat 16 – 3 juv CL Mat 15 – 1 juv CL
01/08/2018	07:00	15/14	3% moisture, 5mph winds, no cloud cover	Mat 15 – 1 adult CL
03/08/2018	06:30	18/17	6mph winds, 2% moisture, no cloud cover	0
06/08/2018	07:00	18/17	5mph winds, little cloud cover, 3% moisture, Rapidly warming up	0
08/08/2018	07:00	18/30	12mph winds, 3% moisture	0
10/08/2018	07:00	17/28	21% moisture, scattered showers, 60% cloud cove	Mat 15 – 1 juv CL

2.2.1 Receptor Site Habitat Enhancements

A minimum of 6no. new reptile and amphibian hibernacula will be created within the receptor site to increase its carrying capacity to accommodate translocated reptiles. These are constructed using logs and branches, piled on top of each other, with grass cuttings, earth and turf laid over the top to provide insulation (See Figure 4). These features also provide benefits for other species including solitary bees, wasps and other insects.

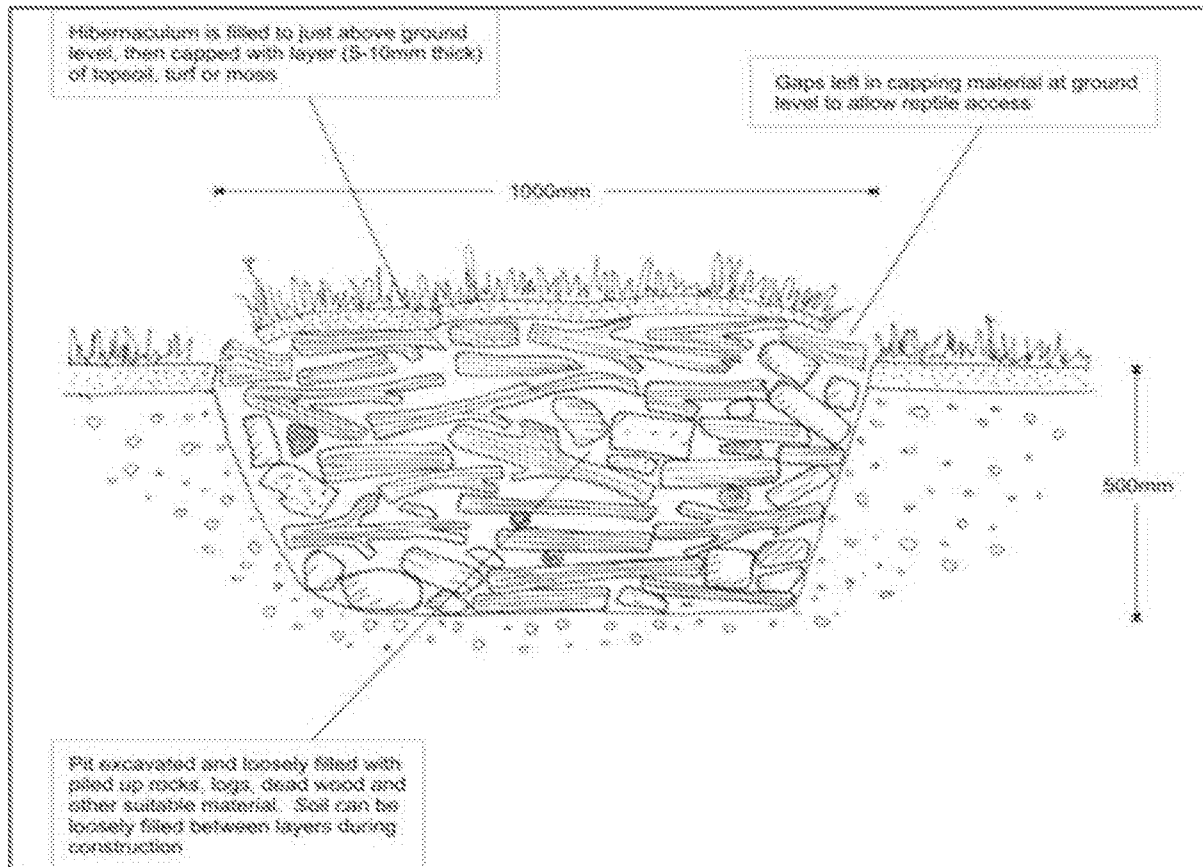


Figure 4. Illustration on how to build a reptile hibernaculum. Image taken from the 'Reptile Habitat Management Guidelines' by Herefordshire Amphibian and Reptile Team and the Herefordshire Nature Trust.

2.2.2 Photographs of receptor site



Figure 5. Suitable reptile habitat along the southern boundary of the golf course.



Figure 6. The rough grassland located along the boundaries of the golf course.



Figure 7. Rough grassland and scrub habitat to the east of the site.

2.3 Reptile-proof fencing

The proposed construction zone, to include the working footprint of the site, additional landscaping areas, any material storage areas and areas to be tracked over by machines, will be fenced with semi-permanent, amphibian and reptile proof fencing. A semi-permanent polypropylene material that is tough and stabilised against ultraviolet light should be installed to a depth of not less than 20cm below ground and supported by stakes every 2 metres fixed with clout nails and washers (See Figure 8). The fencing should be backfilled with earth and tightly compacted to make sure that it acts as an impassable barrier. The advantage of the semi-permanent fence is that it is less susceptible to damage by dogs, deer, foxes and other animals as well as any accidental damage by construction staff and is suitable for developments where fencing may need to remain in-situ over a long period of time.



Figure 8. An example of the semi-permanent fencing material that will be used.

The fencing separates the construction site from all adjacent green habitats, from which reptiles and amphibians might otherwise migrate onto the construction zone. The fencing remains in-situ until all construction work deemed a risk to reptiles and amphibians has been completed. To minimise the risk of killing or injury during installation, the fence should be installed outside of the newt and reptile hibernation period (generally October to late February dependent of weather conditions) and the vegetation along the fencing alignment and all access routes should first be cut to a height of 15cm prior to use of vehicles or machines across reptile habitat.

Installation method should follow the following steps:

1. At least 24 hours prior to the construction, the fence alignment and all access routes across reptile suitable habitat shall be hand searched by a suitably qualified ecologist and vegetation strimmed (using brush- cutters where necessary), with all cuttings raked off and removed. This will ensure that reptiles are discouraged from the fencing construction zone. The strimming process should be completed in two passes, with the grass cut to a height of 10- 15cm on the first pass, to reduce the risk of harming reptiles and allow them to escape, followed by a second pass to 5cm height, to remove all remaining cover and discourage reptiles from entering the work zone. This stage should be mindful of the potential for nesting birds (see Section 2.6).
2. A mini excavator or trenching machine not larger than 1.5 tonnes is then used to excavate a 20cm wide 20cm deep trench. Excavated earth will be piled on the outside edge of the trench so that it is easily backfilled once the fence has been installed.
3. Fence stakes are positioned every 2 metres and driven into the ground to a depth of at least 30cm to ensure they are secure.
4. The fencing material (supplied in 100kg rolls) will be rolled out along the outside edges of the trench and will be lifted into place when each full roll has been unravelled or cut into manageable sections.

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5. The fencing sheet will be attached to the stakes using 2 clout nails and plastic washers at the top and 15cm from the bottom of each stake.
6. Once fixed the excavated earth will be backfilled along the trench and trodden in to ensure that it is lightly compacted to prevent animals from burrowing beneath it.
7. After establishment, maintenance checks would be undertaken every week to repair any damage to the fence. Once construction has commenced, the fence checks and maintenance will become the responsibility of the works contractor.
8. Site staff must be briefed prior to the commencement of construction on the importance of protecting the reptile fencing and to contact an ecologist in the event that any reptiles or other wildlife is found during the construction process.
9. In order to reduce the risk of reptiles accessing the construction zone at the entrances to the site, the fence will have 'cut backs' on each of its ends (see Figure 10). At these locations, the fence loops back on itself, so that any animals travelling along the edge of the fence are guided back away from the site entrance.
10. All vegetation around the edge of the fencing must be kept short to deter reptiles away from the site.



Figure 9. The proposed fencing route at Land South of Burndell Road, Yapton, to enclose the entire construction and landscaping zone of the site is shown in blue. The site boundary is shown in red. Images produced courtesy of Google maps (Map data ©2018 Google)

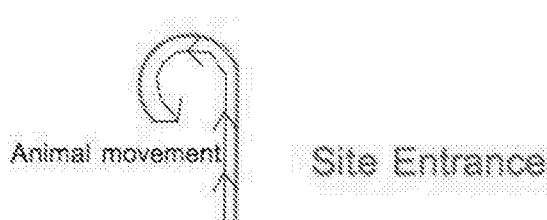


Figure 5. Cut backs' used to guide animals away from the site entrance.

2.4 Reptile Trapping and Translocation

The reptile trapping methodology proposed is based on currently accepted best practice guidelines outlined by the Amphibian and Reptile Group UK (ARGUK). A minimum total of 60 trapping visits will be made between mid-March and October, using 'reptile mats' (bitumen roofing felt 1mx0.5m sections) and 'reptile tins' (corrugated metal sheets) placed at a density of not less than 100 per hectare across all suitable reptile habitat on the development site and enclosed within reptile proof fencing.

Trapping and translocation visits will be undertaken every working day where possible as long as the air temperature is between 9 degrees and 18 degrees in the morning or mid-afternoon in the absence of wet or very windy weather. All captured reptiles will be placed into a large smooth-sided bucket with some green hay at the bottom and transported immediately to the proposed receptor site. All capture details would be recorded for submission to the LPA if requested, as evidence of the work undertaken.

Trapping and translocation should continue beyond 60 visits if reptiles continue to be caught or observed. The construction zone will be declared free of reptiles once 60 trapping visits have been completed and following 5 days with no capture or observation of reptiles in the construction zone. In exceptional circumstances, reptile trapping may be curtailed by weather conditions or no captures before 60 trapping visits have been completed. In these circumstances, the alternative approaches put in place to prevent harm to reptiles will first be agreed with all relevant stakeholders.

'Habitat manipulation' will be used in conjunction with trapping to help focus effort following the first 20 trapping visits. This involves carefully cutting back vegetation in selected areas to concentrate remaining reptiles in to progressively smaller areas of habitat. The vegetation is cut using a hand-held strimmer, on a day when the temperature is above 9°C and reptiles are active, in two passes. The first pass will be to a height of approximately 10-15cm, which removes the bulk of material without any risk of harm to reptiles and encourages them to move out of the area. The second pass is then made immediately afterwards to take the grass height down to below 5cm to discourage reptiles from returning.

2.5 Great crested newts

The PEA identified one pond within 250m of the development site located adjacent to the north-east corner of the site. This pond was assessed as having 'below average' suitability for great crested newts. Permission to access this pond for presence/absence surveys for great crested newts was denied by the land owners. The local context and absence of other ponds in the local landscape, combined with the low suitability of this pond, makes the presence of great crested newts unlikely. However, as no



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survey was possible they cannot be completely disregarded. In the unlikely event that a great crested newt is found during the reptile mitigation work, all activity will cease immediately, and the mitigation strategy reviewed. It may be necessary to apply to Natural England for an EPS licence to continue, with the introduction of pitfall trapping and a suitable designated receptor site for great crested newts.

2.6 Nesting Birds

Any scrub, trees or hedgerows within the construction zone must be removed outside of the nesting bird season (1st March to 31st August). Where this is not possible, small areas of scrub or individual trees may be removed if preceded by a 'nesting bird check' by a suitably qualified ecologist and no evidence of nests or breeding bird activity found. If an active nest is discovered, a 20m exclusion zone should be established around the site and works postponed until the chicks have fledged.

3 CONSTRUCTION PHASE MITIGATION MEASURES

3.1 Wildflower Meadow Creation

It is recommended that a wildflower meadow is established in the public open space areas at the southern extremity and along the boundaries of the site. This will increase the value of this area as foraging habitat for bats, birds, reptiles and amphibians as well as pollinating insects. To establish this as a wildflower area a process of light rotavating and seeding should be employed with good ground preparation essential to the success of the wildflower meadow. The sowing process is best undertaken between late August and the end of September during mild and wet weather best suited to seedling establishment or during mid-March to mid-May when the ground has sufficient moisture and there is very little risk of frosts. The rotavating process is designed to create an area of largely bare ground to allow the wildflower seed mix to establish. Immediately following rotavating, a suitable seed mixture containing not less than 20 wildflower and grass species should be sown across the ground at a density of four grams per square metre. The species mix included must all be of native British origin. A recommended seed mixture is EM5 – Meadow mixture for loamy soils, which is available from Emorsgate seeds (www.wildseed.co.uk). Table 2 details the composition of this mixture.

As part of on-going management, the sward should be cut and gathered to a height of approximately 5cm at least three times in its first year of establishment to control the flush of annual weeds which will grow during the first growing season. Thereafter the sward should be cut (with all cuttings removed and composted) between mid-August and late September every year. Cutting in the spring (March/April) should be included if the sward grows too vigorously.



Table 2 – Composition of EM5 – Meadow mixture for loamy soils to be sown along the boundaries of the site.

%	Wildflowers- Latin name	Common name
0.5	<i>Achillea millefolium</i>	Yarrow
3	<i>Centaurea nigra</i>	Common Knapweed
1	<i>Daucus carota</i>	Wild Carrot
2.5	<i>Galium verum</i>	Lady's Bedstraw
0.3	<i>Geranium pratense</i>	Meadow Cranesbill
1.2	<i>Knautia arvensis</i>	Field Scabious
0.5	<i>Lathyrus pratensis</i>	Meadow Vetchling
0.4	<i>Leontodon hispidus</i>	Rough Hawkbit
0.5	<i>Leucanthemum vulgare</i>	Oxeye Daisy
0.5	<i>Lotus corniculatus</i>	Birdsfoot Trefoil
1	<i>Malva moschata</i>	Musk Mallow
0.5	<i>Plantago lanceolata</i>	Ribwort Plantain
0.5	<i>Plantago media</i>	Hoary Plantain
1	<i>Primula veris</i>	Cowslip
1	<i>Prunella vulgaris</i>	Selfheal
2	<i>Ranunculus acris</i>	Meadow Buttercup
1	<i>Ranunculus bulbosus</i>	Bulbous Buttercup
1.5	<i>Rhinanthus minor</i>	Yellow Rattle
1	<i>Rumex acetosa</i>	Common Sorrel
0.1	<i>Trifolium pratense</i>	Wild Red Clover
20		

%	Grasses- Latin name	Common name
8	<i>Agrostis capillaris</i>	Common Bent
3	<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass (w)
3	<i>Briza media</i>	Quaking Grass (w)
32	<i>Cynosurus cristatus</i>	Crested Dogstail
10	<i>Festuca ovina</i>	Sheep's Fescue
20	<i>Festuca rubra</i>	Slender-creeping Red-fescue
3	<i>Phleum bertolonii</i>	Smaller Cat's-tail
1	<i>Trisetum flavescens</i>	Yellow Oat-grass (w)
80		

3.2 Tree and Hedgerow Planting

New species rich native hedgerows are to be planted along the southern and eastern and western boundaries to provide increased foraging and commuting habitat for bats as well as nesting areas for birds.

These new species rich hedgerows must use only native species from UK stock and include at least 50% hawthorn *Crataegus monogyna*. The remaining 50% should be made up of five of the following species: Blackthorn *Prunus spinosa*, spindle *Euonymus europaeus*, dogwood *Cornus sanguinea*, Wayfaring-tree *Viburnum lantana*, field or dog rose *Rosa arvensis/ Rosa canina*, guelder rose *Viburnum*

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opulus, field maple *Acer campestre*, wild privet *Ligustrum vulgare*, beech *Fagus sylvatica* and hazel *Corylus avellana*. It is also recommended that native honeysuckle *Lonicera periclymenum* is introduced along these lengths.

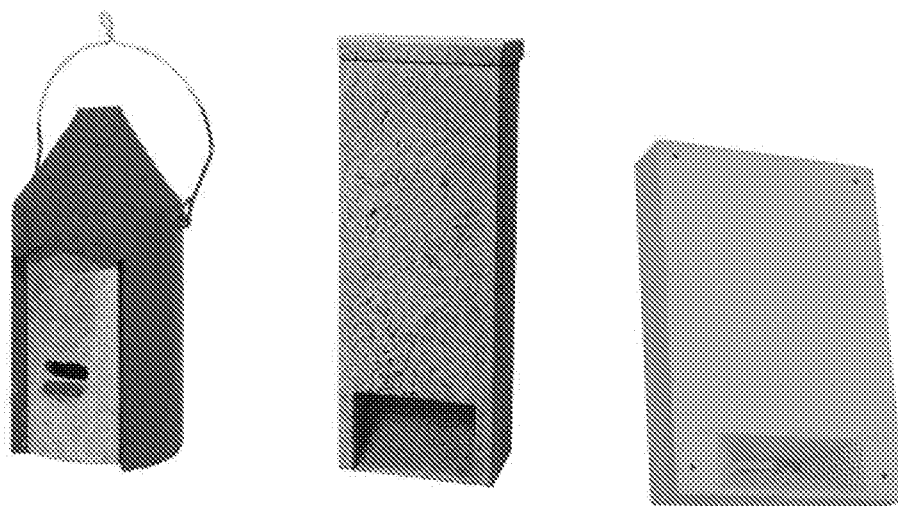
The landscaping plan will incorporate a variety of trees with only native trees sourced from UK stock to be used in all of the wider landscaping around the site boundaries (non-native trees and shrubs may still be used for landscaping the residential plots). This will create greater habitat for a variety of birds and invertebrates. Given the arrival of ash dieback, it is not recommended that any ash saplings are planted anywhere on the site.

3.3 Enhancements for Bats

As a measure to enhance roosting opportunities for bats throughout the development, bespoke roosting features will be incorporated into the fabric of the new residential buildings. This will include the following:

One 1FR Schwegler Bat Tube installed in 5 buildings and one 1WI Schwegler Summer and Winter Bat Box in each of the other buildings (see Figure 10). The 1WI bat box is designed for year-round occupation meaning it is suitable for hibernation of bats in winter as well as roosting and breeding in summer. Both are designed to be set within the fabric of an external wall, incorporated in the masonry and rendered flush with the surface so that only the entrance is visible externally. The boxes are designed to be maintenance free.

Finally, two Schwegler woodcrete bat boxes (2F Schwegler bat boxes) would be hung on suitable mature trees upon the southern and eastern site boundaries. The boxes would be hung by a suitably qualified ecologist to ensure that this positioning is most suitable, but generally locations above 3.5 metres in the most south-easterly facing aspect of a tree is best.



2F Schwegler Bat Box

1FR Schwegler Bat Tube

1WI Schwegler Summer and Winter Bat Box

Figure 10. Images of bespoke roosting features for bats.



3.4 Mitigation for Bats

Bright external lighting can have a detrimental impact upon foraging and commuting bats, but importantly can also cause bats to be fooled into thinking that the light is from the sun, causing them to remain in their roosts for longer. As a result, the site boundaries must be protected from artificial lighting with no street lamps or outside lights to face towards these boundaries or new species rich hedgerows proposed to be planted. Guidelines issued by the Bat Conservation Trust should be incorporated into the lighting scheme and the following measures must be implemented into the site design:

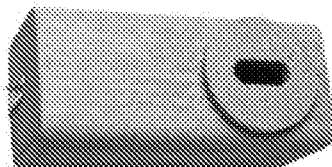
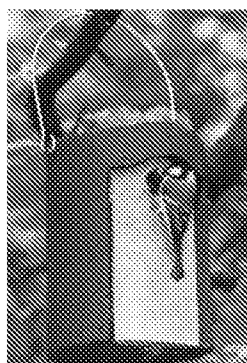
1. No 'upward pointing' or bare bulb lights will be installed anywhere on the development.
2. All external lights upon lamp-posts will not be more than 3.5 metres in height and will have shields installed to focus light towards footpaths and roads only (See figure 9). No light will be allowed to emit light past horizontal (90 degrees from the ground).
3. Any pedestrian ground lighting will not exceed 3 lux.
4. No external lights will be installed on new buildings above a height of 2 metres and all external lights will have shields to prevent light splash beyond horizontal.



Figure 8. An example of suitable downward shielded street lighting.

3.5 Enhancements for nesting birds

In order to enhance the site for nesting birds, some common nesting bird boxes will be put up across the site. Two 1B Schwegler nest boxes should be installed at least 3 metres high on mature trees along the southern and western boundaries. One No.17 Schwegler Swift nest box should be installed across five of the new residential dwellings and they should be installed at least six to seven metres above the ground, ensuring that there is no obstruction to access for the birds entering or exiting the nest box. The Swift nest box is best situated under the shelter of eaves or overhanging roofs.



Schwegler 1B nest box

No.17 Schwegler Swift Nest Box

Figure 11. Examples of bird nesting boxes.

4 POST CONSTRUCTION MANAGEMENT

4.1 *Monitoring translocated reptile population and maintenance of receptor site*

It is important to establish the success of the mitigation measures outlined within this report and if necessary to be able to prescribe further enhancements if it becomes evident that there is a decrease in the reptile population present. As such, two post-construction reptile surveys are proposed at the receptor site, with intervals of one year and three years following the translocation. A simple seven survey visit presence/absence survey carried out under best practice guidance would comprise each post-construction monitoring survey.

It is important for the receptor site to be managed for reptiles in perpetuity. This means leaving the designated areas of reptile habitat undisturbed during the active season, and safeguarding features suitable for hibernation, and crucially not disturbing them in winter. The grasslands should be allowed to grow tall and should not be frequently mown. If mowing is required, such as to prevent scrub establishment, then this should be done in the winter months and never below 10cm height. Machinery with a low ground pressure should always be used and no other vehicles should be allowed to enter suitable reptile habitat.

4.2 *Development site biodiversity features maintenance*

All planted hedgerows must only be cut outside the bird nesting season (1st March to 31st August) and where possible hedges shouldn't be cut until February, so that valuable winter food associated with fruiting hedge trees is retained for over-wintering birds.

Bat boxes on trees will be inspected each year to check that they had not become detached or damaged.

The wildflower meadow should be cut and gathered each year between mid-August and the end of September. This is important to ensure that species diversity of the area is maintained, and grass



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species do not become dominant. Where necessary, a second cut could be taken in March or early April each year if the sward is growing too coarsely. Grass cuttings should be removed and composted in designated heaps away from watercourses.

Should you need any further advice on the information provided above, please do not hesitate to contact The Ecology Co-op.



5 APPENDIX 1 - ARTIFICIAL LIGHTING AND WILDLIFE

Interim Guidance: Recommendations to help minimise the impact of artificial lighting - produced by The Bat Conservation Trust

Wherever human habitation spreads, so does artificial lighting. This increase in lighting has been shown to have an adverse effect on our native wildlife, particularly on those species that have evolved to be active during the hours of darkness. Consequently, development needs to carefully consider what lighting is necessary and reduce any unnecessary lighting, both temporally and spatially. When the impacts on different species groups are reviewed, the solutions proposed have commonalities that form the basis of good practice. These are outlined in the following document.

Overview of impacts

Invertebrates

Artificial light significantly disrupts natural patterns of light and dark, disturbing invertebrate feeding, breeding and movement, which may reduce and fragment populations. Some invertebrates, such as moths, are attracted to artificial lights at night. It is estimated that as many as a third of flying insects that are attracted to external lights will die as a result of their encounter.¹ Insects can become disoriented and exhausted making them more susceptible to predation. In addition, the polarisation of light by shiny surfaces attracts insects, particularly egg laying females away from water. Reflected light has the potential to attract pollinators and impact on their populations, predators and pollination rates. Many invertebrates natural rhythms depend upon day-night and seasonal and lunar changes which can be adversely affected by artificial lighting levels.

It is not always easy to disentangle the effects of lighting on moths from other impacts of urbanisation. However, it is known that UV and green and blue light, which have short wavelengths and high frequencies, are seen by most insects and are highly attractive to them. Where a light source has a UV component, male moths in particular will be drawn to it. Most light-induced changes in physiology and behaviour are likely to be detrimental. They discern it to be 'light', so they do not fly to feed or mate.²

Birds

There are several aspects of changes to bird behaviour to take into account. The phenomenon of robins and other birds singing by the light of a street light or other external lighting installations is well known, and research has shown that singing did not have a significant effect on the bird's body mass regulation. However, it was felt that the continual lack of sleep was likely to be detrimental to the birds' survival and could disrupt the long-term circadian rhythm that dictates the onset of the breeding season³. Many species of bird migrate at night and there are well-documented cases of the mass mortality of nocturnal migrating birds as they strike tall lit buildings. Other UK bird species that are particularly sensitive to artificial lighting are long-eared owls, black-tailed godwit and stone curlew.⁴

Mammals

A number of our British mammals are nocturnal and have adapted their lifestyle so that they are active in the dark in order to avoid predators. Artificial illumination of the areas in which these mammals are active and foraging is likely to be disturbing to their normal activities and their foraging areas could be

¹ Bruce-White C and Shardlow M (2011) A Review of the Impact of Artificial Light on Invertebrates - See more at: <http://www.buglife.org.uk/advice-and-publications/publications/campaigns-and-reports/review-impact-artificial-light#sthash.s7GPA1vL.dpuf>

² As above

³ Pollard A. (2009) Visual constraints on bird behaviour. University of Cardiff

⁴ Rodriguez A., Garcia A.M., Cervera F. and Palacios V. (2006) Landscape and anti-predation determinants of nest site selection, nest distribution and productivity in Mediterranean population of Long-eared Owls, *Asio otus*. *Ibis*, 148(1), pp.133-145



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lost in this way. It is thought that the most pronounced effect is likely to be on small mammals due to their need to avoid predators. However, this in itself has a knock-on effect on those predators.

The detrimental effect of artificial lighting is most clearly seen in bats. Our resident bat species have all suffered dramatic reductions in their numbers in the past century. Light falling on a bat roost exit point, regardless of species, will at least delay bats from emerging, which shortens the amount of time available to them for foraging. As the main peak of nocturnal insect abundance occurs at and soon after dusk, a delay in emergence means this vital time for feeding is missed. At worst, the bats may feel compelled to abandon the roost. Bats are faithful to their roosts over many years and disturbance of this sort can have a significant effect on the future of the colony. It is likely to be deemed a breach of the national and European legislation that protects British bats and their roosts.

In addition to causing disturbance to bats at the roost, artificial lighting can also affect the feeding behaviour of bats and their use of commuting routes. There are two aspects to this: one is the attraction that short wave length light (UV and blue light) has to a range of insects; the other is the presence of lit conditions.

As mentioned, many night-flying species of insect are attracted to lamps that emit short wavelength component. Studies have shown that, although noctules, serotines, pipistrelle and Leisler's bats, take advantage of the concentration of insects around white street lights as a source of prey, this behaviour is not true for all bat species. The slower flying, broad-winged species, such as long-eared bats, barbastelle, greater and lesser horseshoe bats and the *Myotis* species (which include Brandt's, whiskered, Daubenton's, Natterer's and Bechstein's bats) generally avoid external lights.

Lighting can be particularly harmful if it illuminates important foraging habitats such as river corridors, woodland edges and hedgerows used by bats. Studies have shown that continuous lighting along roads creates barriers which some bat species cannot cross⁵. It is also known that insects are attracted to lit areas from further afield. This could result in adjacent habitats supporting reduced numbers of insects, causing a further impact on the ability of light-avoiding bats to feed.

These are just a few examples of the effects of artificial lighting on British wildlife, with migratory fish, amphibians, some flowering plants, a number of bird species, glow worms and a range of other invertebrates all exhibiting changes in their behaviour as a result of this unnatural lighting.

Recommendations

Survey and Planning

The potential impacts of obtrusive light on wildlife should be a routine consideration in the Environmental Impact Assessment (EIA) process⁶. Risks should be eliminated or minimised wherever possible. Some locations are particularly sensitive to obtrusive light and lighting schemes in these areas should be carefully planned.

In August 2013, Planning Minister Nick Boles launched the new National Online Planning Guidance Resource aimed at providing clearer protection for our natural and historic environment. The guidance looks at when lighting pollution concerns should be considered and is covered within one of the on line planning practice guides⁷. The guide provides an overview for planners with links to documents that aim to give planners an overview of the subject through the following discussion points:

⁵ Stone E. L., Jones G and Harriss (2009) Street lighting disturbs commuting bats. *Current Biology*, 19, pp 1-5

⁶ See also: Institution of Lighting Professionals – Professional Lighting Guide (PLG 04) Guidance on undertaking lighting environmental impact assessments)



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1. When is obtrusive light / light pollution relevant to planning?
2. What factors should be considered when assessing whether a development proposal might have implications for obtrusive lighting / light pollution?
3. What factors are relevant when considering where light shines?
4. What factors are relevant when considering how much the light shines?
5. What factors are relevant when considering possible ecological impact?

This can help planners reach the right design through the setting of appropriate conditions relating to performance and mitigation measures at the planning stage.

The Institution of Lighting Professionals (ILP) recommends that Local Planning Authorities specify internationally recognised environmental zones for exterior lighting control within their Development Plans⁸. In instances lacking classification, it may be necessary to request a Baseline Lighting Assessment/Survey conducted by a Lighting Professional in order to inform the classification of areas, particularly for large-scale schemes and major infrastructure projects.

When assessing or commissioning projects that include the installation of lighting schemes, particularly those subject to the EIA process, the following should be considered and relayed to applicants:

Ecological consultants should confirm the presence of any sensitive fauna and flora, advising the lighting designers of bat routes and roosts and other areas of importance in order to ensure that reports correspond with each other.

Ecological consultants should consider the need for quantitative lighting measurements. In some instances it may be necessary for further lighting measurements to be taken. For example, outside an important bat roost. These should follow best practice guidance from the ILP and would ideally be conducted by a Lighting Professional.

Where appropriate, professional lighting designers should be consulted to design and model appropriate installations that achieve the task but mitigate the impacts. This should be done at the earliest opportunity. Early decisions can play a key role in mitigating the impact from lighting.

Reports submitted should outline the impacts of lighting in relation to ecology, making clear reference to the ecological findings, highlighting any sensitive areas and detail proposed mitigation. Consideration should also be given to internal lighting where appropriate.

Post –installation checks and sign off upon commissioning should be carried out by the lighting designer to ensure that the lighting installation has been installed in accordance with the design, that predictions were accurate and mitigation methods have been successful.

Principles and design considerations

Do not

provide excessive lighting. Use only the minimum amount of light needed for the task.

directly illuminate bat roosts or important areas for nesting birds

Avoid

installing lighting in ecologically sensitive areas such as: near ponds, lakes, rivers, areas of high conservation value; sites supporting particularly light-sensitive species of conservation significance (e.g. glow worms, rare moths, slow-flying bats) and habitat used by protected species.

using reflective surfaces under lights.

Do

consider employing a competent lighting designer who will apply the principals of providing the right light, in the right place, at the right time and controlled by the right system.

minimise the spread of light to at, or near horizontal and ensure that only the task area is lit.



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Flat cut-off lanterns or accessories should be used to shield or direct light to where it is required. **consider the height of lighting columns.** It should be noted that a lower mounting height is not always better. A lower mounting height can create more light spill or require more columns. Column height

consider no lighting solutions where possible such as white lining, good signage and LED cats eyes. These options can also be effective. For example, light only high-risk stretches of roads, such as crossings and junctions, allowing headlights to provide any necessary illumination at other times.

use temporary close-boarded fencing until vegetation matures, to shield sensitive areas from lighting.

limit the times that lights are on to provide some dark periods. The task being lit often varies, for example roads are less used after 23.00hrs and car parks are empty. A lighting designer can vary the lighting levels as the use of the area changes reducing lighting levels or perhaps even switching installations off after certain times. This use of adaptive lighting can tailor the installation to suit human health and safety as well as wildlife needs.

Technological specifications

Research from the Netherlands has shown that spectral composition does impact biodiversity.

Use narrow spectrum light sources to lower the range of species affected by lighting.

Use light sources that emit minimal ultra-violet light

Lights should peak higher than 550 nm

Avoid white and blue wavelengths of the light spectrum to reduce insect attraction and where white light sources are required in order to manage the blue short wave length content they should be of a warm / neutral colour temperature <4,200 kelvin.

Further guidance on the spectral composition of artificial lighting will be made available following the publication of research from the Netherlands.

Further reading:

A review of the impact of artificial light on invertebrates. Buglife. 2011

Royal Commission on Environmental Pollution. 2009. Artificial light in the environment. London, HMSO

The Ecological Consequences of Artificial Night Lighting" edited by Longcore and Rich

Shedding Light: A survey of local authority approaches to lighting in England. CPRE 2014

<http://planningguidance.planningportal.gov.uk/blog/guidance/light-pollution/when-is-light-pollution-relevant-to-planning/> <http://planningguidance.planningportal.gov.uk/blog/guidance/light-pollution/when-is-light-pollution-relevant-to-planning/>

⁸ Institution of Lighting Professionals (2011) Guidance Notes for the Reduction of Obtrusive Light GN01:201

