

LEIGHTON PARK SCHOOL, READING

PROPOSED CAR PARK

ECOLOGICAL APPRAISAL REPORT

02 March 2017



soltysbrewster
E C O L O G Y

4 Stangate House,
Stanwell Road,
Penarth,
Vale of Glamorgan,
United Kingdom.
CF64 2AA

Telephone:- 029 2040 8476

e-mail:- enquiry@soltysbrewster.co.uk

Web Site:- www.soltysbrewster.com

LEIGHTON PARK SCHOOL, READING

PROPOSED CAR PARK

ECOLOGICAL APPRAISAL REPORT

Document Ref: E1565502/ Doc 01 – 02 March 2017

Issue	Revision	Stage	Date	Prepared by	Approved by	Signed
1	-	Draft	02 March 2017	Annabelle Phillips	Dr. M Watts (Director)	

CONTENTS

Summary

1.0 Introduction

2.0 Methodology

Desk study

Field survey

3.0 Results

Desk study

Extended Phase 1 Habitat Survey

Fauna

4.0 Legislation, Policies and Plans

5.0 Conclusions and Recommendations

References

Appendices

- Appendix I Local records map received from TVERC
- Appendix II Phase 1 Habitat Plan and Accompanying Target Notes
- Appendix III Advice sheet on the use of street lighting and bats

SUMMARY

Soltys Brewster Ecology were commissioned to undertake an ecological appraisal at Leighton Park School in Reading in order to inform a planning application for a proposed car park. The ecological baseline conditions at the site were established in February 2017 through a combination of desk study and Extended Phase 1 Habitat Survey.

Desk based consultation confirmed that the site does not hold any statutory or non-statutory nature conservation designation although a number of Local Wildlife Sites are located within the surrounding area including Whiteknights Park, Whitley Park Farm/ St Patrick's Hall Pond and The Cowsey. However due to the habitats present on the application site and the physical separation from the designated sites, none would be considered of particular relevance. Records received from Thames Valley Environmental Records Centre identified a number of protected or notable species associated with the surrounding area including a variety of birds, invertebrates, reptiles and bats.

The Phase 1 Habitat survey undertaken in February 2017 identified that the proposed car park site was dominated by amenity grassland, hard standing and mixed plantation woodland. The amenity grassland and hard standing were not considered of ecological value and represent the most suitable areas of the site to support development. The mixed plantation woodland, although of little intrinsic value due to its small size and the presence of non-native species¹, is considered likely to provide suitable foraging and shelter for a variety of bird and mammal species (including bats).

The proposals for the site are for the construction of an additional car parking area for the school. The site layout is yet to be finalised, however it is understood there would be some tree loss associated with the proposed works although trees around the site boundary and some within the interior of the site would be retained. This is considered unlikely to result in a significant adverse impact when considered against the retention of larger areas of woodland and trees within the wider school site. The retention of boundary trees would help to ensure ecological connectivity across the site is retained.

Three trees within the site were identified as supporting features suitable for use by roosting bats. Should these trees require felling or pruning as part of the proposed works, further survey to establish the presence/ absence of roosting bats would be required. The optimum season for bat activity surveys is May to August inclusive.

Other considerations would include the avoidance of the bird nesting season (March-August) for any vegetation clearance. Tree planting to replace those to be lost as part of the proposed scheme, the use of native species or species of known benefit to wildlife within any soft landscaping and the provision of bird or bat boxes (on retained trees) would also be recommended to provide localised enhancements at the site.

¹ Including a small stand of Rhododendron, which is listed as an invasive non-native species under Schedule 9 of the Wildlife & Countryside Act 1981 (as amended).

1.0 INTRODUCTION

- 1.1. Soltys Brewster Ecology were commissioned by Leighton Park School to undertake an ecological appraisal of a parcel of land at Leighton Park School in Reading. A new car park is proposed at the site and a survey to establish the ecological baseline and inform the proposed works is required in the first instance.
- 1.2. The area associated with the proposed car park (i.e. application site) is centred at grid reference SU 7306 7161 within the northwest corner of the school campus. The surrounding area is dominated by the school grounds including playing fields, trees and woodland, existing residential development and the University of Reading campus to the north.
- 1.3. The current report presents the findings of an ecological desk study and Extended Phase 1 Habitat survey undertaken at the site in February 2017. The report describes the existing ecological conditions as well as identifying any potential ecological constraints/ opportunities associated with the proposed development at the site.

2.0 METHODOLOGY

- 2.1. In order to establish the baseline ecological conditions on site and in the adjoining habitats, a combination of desk-based review of existing site information and an Extended Phase 1 Habitat survey were undertaken in February 2017.

Desk study

- 2.2. The desk study primarily involved a review of data supplied by the Thames Valley Environmental Records Centre (TVERC) to inform a planning application² c.150m south of the current site but within the school campus. The data was reviewed to identify any records of rare, protected or notable flora and fauna within the site boundary and surrounding 1km area. The search criteria also included information relating to the location and citation details (where available) for any sites designated for their nature conservation interest such as Sites of Special Scientific Interest (SSSIs) or Sites of Importance for Nature Conservation (SINCs).

² in 2015
Leighton Park School, Reading
Proposed Car Park
Ecological Appraisal Report
E1565502/ Doc 01

Extended Phase 1 Habitat Survey

- 2.3. The fieldwork was undertaken on 20th February 2017 by a suitably experienced ecologist³ and followed standard Phase 1 Habitat Survey protocol (JNCC, 1990) as amended by the Institute of Environmental Assessment (1995). All habitats within the site were classified and mapped as accurately as possible. Habitats considered to have potential to support rare, protected or otherwise notable species of flora and fauna were noted, as were any direct signs of these species (e.g. Eurasian Badger *Meles meles* setts and dung-pits). Incidental observations of birds on or flying over the site were also recorded as were any stands or individual plants of invasive non-native plant species listed under Schedule 9 of the Wildlife & Countryside Act 1981 (as amended).
- 2.4. A map of habitats was drawn up and target notes were used to identify features of ecological interest. Where possible, habitats were cross-referenced to any relevant UK or local priority habitats.
- 2.5. In addition any trees present were assessed for their potential to support roosting bats and were categorised in relation to the bat roosting features (BCT, 2016). The categories are as follows:
- **Known or confirmed roost**
 - **High** - A tree with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.
 - **Moderate** – A tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status.
 - **Low** - A tree of sufficient size & age to contain PRFs (Potential Roost Features) but with none seen from the ground or features seen with only very limited roosting potential.
 - **Negligible** – Negligible habitat features on site likely to be used by roosting bats.

³ Full Member of the Chartered Institute of Ecology and Environmental Management.
 Leighton Park School, Reading
Proposed Car Park
 Ecological Appraisal Report
 E1565502/ Doc 01

3.0 RESULTS

Desk Study

- 3.1 The data provided by TVERC confirmed that the site does not contain any statutory or non-statutory nature conservation designations. A number of Local Wildlife Sites (LWS) are located within the surrounding area including Whiteknights Park, Whitley Park Farm/ St Patrick's Hall Pond and The Cowsey. Whiteknights Park is designated due to the Parkland and Wood Pasture habitats and associated species it supports. Whitley Park Farm/ St Patrick's Hall LWS is designated due to the lowland mixed deciduous woodland habitats and associated bird assemblage including Bullfinch *Pyrrhula pyrrhula*, Linnet *Carduelis cannabina*, Lesser Spotted Woodpecker *Dendrocopos minor*, Spotted Flycatcher *Muscicapa striata* and Song Thrush *Turdus philomelos*. The Cowsey LWS is designated due to the lowland mixed deciduous woodland it supports.
- 3.2 Based on the physical separation from the Leighton Park School site these sites were not considered of particular ecological relevance to the current proposals. Maps indicating the location of Local Wildlife Sites in the surrounding area are displayed in Appendix I.
- 3.3 The TVERC data species data confirmed the presence of a number of protected or notable species within the surrounding 1km area including Heath Cudweed *Gnaphalium sylvaticum*, Stag Beetle *Lucanus cervus*, Smooth Newt *Lissotriton vulgaris*, Green Woodpecker *Picus viridis*, Song Thrush, Starling *Sturnus vulgaris*, Bullfinch, Slow-Worm *Anguis fragilis*, West European Hedgehog *Erinaceus europaeus*, Common Pipistrelle *Pipistrellus pipistrellus* and other unidentified Myotis bat species *Myotis sp.*
- 3.4 These records were associated with habitats in areas other than the site and were not considered of particular relevance to the Leighton Park School site based on the known habitat preferences of the species listed above, the physical separation from the site and the site conditions. Mobile species such as birds and bats in the surrounding area are considered of relevance to the site, and in particular the trees and woodland associated which is likely to provide nesting habitat for birds and foraging/ commuting habitat for bats locally.
- 3.5 Bat surveys undertaken c.150m southeast of the current site in May and June 2016 to inform the felling of a tree identified no evidence of roosting bats (SBE, 2016). A limited range of species were recorded during the 2016 surveys including Common Pipistrelle, Soprano Pipistrelle *Pipistrellus pygmaeus* and Noctule *Nyctalus noctula* bats with low levels of bat activity associated with the site.

Extended Phase 1 Habitat Survey

- 3.6 The distribution and extent of habitats within and adjacent to the site are illustrated in the Phase 1 Habitat plan and accompanying target notes in Appendix II. The site is dominated by amenity grassland, mixed plantation woodland and areas of hard standing with smaller areas of ornamental shrub planting, scrub and short sections of ornamental hedgerow also associated with the site.

Amenity grassland

- 3.7 The southwest of the site is dominated by an area of regularly mown amenity grassland (Plate 1). The grassland was of limited species diversity with species present including Perennial Rye-grass *Lolium perenne*, Annual Meadow-grass *Poa annua*, Daisy *Bellis perennis* and Dandelion *Taraxacum officinale*.

Mixed plantation woodland

- 3.8 The majority of the site consisted of a small area of mixed plantation woodland dominated by Beech *Fagus sylvatica* and Yew *Taxus baccata* with dense Cherry Laurel *Prunus laurocerasus* in the shrub layer. Other species present include Oak *Quercus robur*, Holly *Ilex aquifolium*, Silver Birch *Betula pendula*, Sycamore *Acer pseudoplatanus* and Hazel *Corylus avellana*. The dense Cherry Laurel limited light reaching the woodland floor and ground flora was dominated by Ivy *Hedera helix* with a number of non-native species such as Wilson's Honeysuckle *Lonicera nitida* and Variegated Periwinkle *Vinca major* 'Variegata' also present.

Hedgerows and scrub

- 3.9 Short sections of ornamental Beech and Yew hedgerow were found in the southeast of the site surrounding the area of amenity grassland. These hedgerows were regularly trimmed and small in size, being approximately 1m W x 1.5m H.
- 3.10 An area of dense scrub was also found in the southwest of the site. This was dominated by Bramble *Rubus fruticosus*, Buddleia *Buddleja davidii* and Willow *Salix* sp. saplings colonising over the foundations of a former building.

Invasive non-native plant species

- 3.11 A small stand of Rhododendron was found to be present within the woodland (Target Note 8). This species is considered to be invasive and is listed under Schedule 9, Section 14 of the Wildlife and Countryside Act 1981 (as amended) and it is an offence "to plant or otherwise encourage" its growth in the wild. This could include cutting the plant or roots and disturbing surrounding soil if not correctly managed.

Plate 1. Amenity grassland



Plate 2. Woodland with Cherry Laurel dominant in the shrub layer (Target Note 6)



Plate 3. Ornamental Beech Hedgerow (Target Note 1)



Fauna

3.12 In the course of the survey, a search of field signs for protected or notable species was undertaken and the potential of the habitats to support these species considered. In the context of this report, these species meet any of the following criteria:

- Species protected by British or international law;
- Species listed on Section 41 of the NERC Act;
- Nationally rare or nationally scarce species;
- Species of Conservation Concern (e.g. JNCC Red List, RSPB/BTO Red or Amber Lists);

Bats

3.13 The majority of trees within the site were assessed as being of negligible/ low potential to support roosting bats. However three trees supported potential roost features (PRFs) such as upward facing cavities, rot holes and woodpecker holes and were assessed as being of moderate potential to support roosting bats (Plate 4, Target Notes 2, 4 & 5).

3.14 The trees, woodland and scrub within the site and the wider school grounds are likely to offer foraging and commuting habitats for bats in the local area.

Birds

- 3.15 During the survey a number of bird species were noted on or flying over the site including Blackbird *Turdus merula*, Wood Pigeon *Columba palumbus*, Carrion Crow *Corvus corone*, Long-tailed Tit *Aegithalos caudatus* and Robin *Erithacus rubecula*. The species present at the time of survey would not be considered representative of the full range of species that the site could potentially support (i.e. during the breeding season/ passage) but the assemblage recorded was considered largely representative of that likely to breed on and in the vicinity of site.
- 3.16 The woodland scrub within the site and the surrounding area were considered suitable to suitable to support a variety of breeding birds as well as offering shelter and foraging opportunities.

Other species

- 3.17 No standing water was found within the site boundary and as such the site was considered unsuitable to support breeding amphibians. Similarly the habitats within the site were not considered suitable to support reptiles, with dense woodland offering no basking opportunities and grassland being regularly mown resulting in a short sward. No evidence of use of the site by Badger was found during the current survey.

Plate 4. Tree of moderate potential to support roosting bats with deadwood and woodpecker holes (Target Note 2)



4.0 LEGISLATION, POLICIES AND PLANS

- 4.1 The following legislation and planning policy relating to nature conservation and biodiversity are considered of at least some relevance to the area surveyed and to any the proposed future development of the site.

Legislation Pertaining to the Protection of Bats

- 4.2 Under Annex II of the *Council Directive 92/43/EEC 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora* (EC Habitats Directive) some bat species are listed as of Community Interest, the conservation of which requires designation of Special Areas of Conservation (SACs); Under Annex IV of the EC Habitats Directive all bat species are listed as of Community Interest, in need of strict protection. In England and Wales, the EC Habitats Directive has been transposed into law in 1994 and, following recent amendments is set out in the *Conservation of Habitats & Species Regulation 2010* to give bats, their breeding sites and resting places a high level of strict protection making it an offence (subject to certain specific exceptions) to deliberately capture or kill/injure a bat, to damage or destroy a place used for shelter or protection or to deliberately disturb a bat in such a place.
- 4.3 Bats are also afforded protection within England and Wales under the Wildlife and Countryside Act 1981 (as amended); Countryside and Rights of Way Act 2000; Natural Environment and Rural Communities Act 2006.

Legislation Pertaining to Birds

- 4.4 Under the Wildlife & Countryside Act 1981 (as amended) all wild birds are protected against killing or injury and their nests against damage or destruction whilst they are being built or contain eggs/dependent young.

Natural Environment and Rural Communities Act 2006

- 4.5 Section 40 of the Natural Environment and Rural Communities Act 2006 (the NERC Act) places a duty ('the biodiversity duty') on every public authority - including a local authority and a local planning authority – to have regard to the purpose of conserving biodiversity (which also includes restoring or enhancing a population or habitat). Of the key principles, the most relevant to this site are those directed at maintaining and promoting biodiversity, as well as preventing harm to biodiversity.

National Planning Policy Framework (2012)

4.6 This document set out the Government's planning policies for England and how these are expected to be applied. Chapter 11 deals with Conserving and Enhancing the Natural Environment and states:

The planning system should contribute to and enhance the natural and local environment by:

- protecting and enhancing valued landscapes, geological conservation interests and soils;
- recognising the wider benefits of ecosystem services;
- minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;
- preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and
- remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

Reading Borough Local Development Framework - Core Strategy

4.7 The Reading Borough Local Development Framework Core Strategy was adopted in January 2008. This document will guide how the city will grow socially, economically and environmentally and sets out the authorities planning policies. Policies within the Core Strategy considered of relevance to the current site include:

CS36: Biodiversity and Geology

a) Development should retain, protect and incorporate features of biodiversity or geological interest (including protected species and their habitats) found within the application site into their schemes.

On sites with recognised biodiversity or geological value, development will not be permitted where there would be a direct or indirect adverse impact on the site, unless it can be clearly demonstrated that: -

- i. The need for development clearly outweighs the need to protect the value of the site; and*
- ii. Appropriate compensation, impact minimisation, mitigation and compensation are provided.*

b) Local Nature Reserves and Wildlife Heritage Sites will be safeguarded and where possible, enhanced. Permission will not be granted for any development that would adversely affect a designated nature reserve or Wildlife Heritage Site.

c) Any development that would sever or threaten the integrity of an established wildlife link, as indicated on an adopted proposals map, will not be permitted. Where applicable, developments should be designed to protect,

consolidate, extend and enhance the network of wildlife links and corridors in and adjoining the Borough, working with neighbouring authorities where appropriate.

CS38: Trees, Hedges and Woodlands

Individual trees, groups of trees, hedges and woodlands will be protected from damage or removal, and the Borough's vegetation cover will be extended.

5.0 CONCLUSIONS AND RECOMMENDATIONS

- 5.1 The combination of desk study and field surveys undertaken at the site identified a limited range of habitat types dominated by amenity grassland, hard standing and mixed plantation woodland. The amenity grassland and hard standing were considered of low intrinsic ecological value and represent the most suitable areas of the site to support development. The mixed plantation woodland, although of little intrinsic value due to its small size and the presence of non-native species, is considered likely to provide suitable foraging and shelter for a variety of bird and mammal species (including bats).
- 5.2 The proposals for the site are for the construction of an additional car parking area for the school. The site layout is yet to be finalised, however it is understood there would be some tree loss associated with the proposed works although trees around the site boundary and some within the interior of the site would be retained. This is considered unlikely to result in a significant adverse impact when considered against the retention of larger areas of woodland and trees within the wider school site. The retention of boundary trees would help to ensure ecological connectivity across the site is retained.
- 5.3 Three trees within the site were identified as supporting features suitable for use by roosting bats (moderate bat potential). Should any of these trees require felling or pruning as part of the proposed works further survey to establish the presence/absence of roosting bats would be required. The optimum season for bat activity surveys is May to August inclusive. If evidence of roosting bats was found, specific mitigation and a European Protected Species (EPS) licence would be required to permit works to the tree. To minimise impacts on bats and other species foraging/ commuting over the site it is also recommended that development seeks to minimise impacts on any retained habitats such as trees and woodland through sensitive design of site lighting (see Appendix III).
- 5.4 Given the high likelihood of a number of birds nesting on site clearance of trees and scrub vegetation associated with any future development should be undertaken outside of the bird nesting season (i.e. clearance possible between September and February inclusive) or preceded by a thorough check for the presence of nesting birds. All wild birds are protected against killing and injury under the Wildlife and Countryside Act 1981 (as amended) and their nests against damage or destruction whilst in use or being built.
- 5.5 A programme of treatment/ eradication for invasive plant species (Rhododendron) would also be recommended as part of the proposed works.

- 5.6 Further recommendations include the use of native species or species of known benefit to wildlife within any soft landscaping scheme associated with future development of the site. Replacement tree planting would also be recommended to mitigate for those to be lost as part of the proposed scheme. The incorporation of bird and bat boxes on retained trees would provide localised enhancement for these species.

REFERENCES

Bat Conservation Trust (2016) *Bat Surveys for Professional Ecologists – Good Practice Guidelines*. Bat Conservation Trust, London.

Eaton MA, Aebischer NJ, Brown AF, Hearn RD, Lock L, Musgrove AJ, Noble DG, Stroud DA and Gregory RD (2015) *Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man*. British Birds 108, 708–746.

Institute for Environmental Assessment (1995) *Guidelines for Baseline Ecological Assessment*. E & FN Spon, Hong Kong.

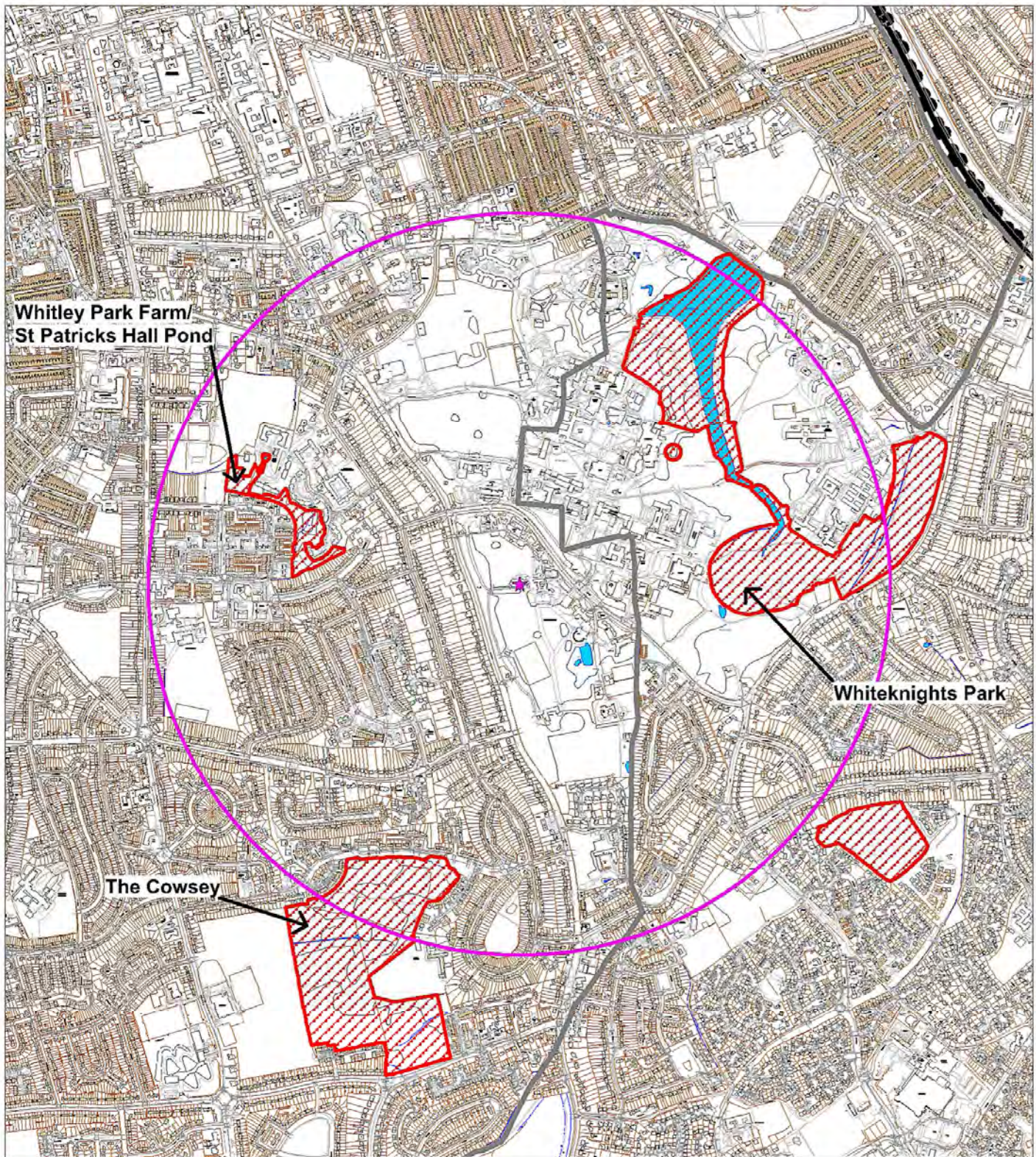
Joint Nature Conservation Committee (JNCC) (1990) *Handbook for Phase I Habitat Survey. A technique for environmental audit*. JNCC, Peterborough.

Mitchell-Jones, A.J. (2004) *Bat mitigation guidelines; January 2004*. English Nature. Peterborough.

Soltys Brewster Ecology (2016) Leighton Park School – Bat Survey Report. E1565501/Doc 02 - 13 June 2016.

APPENDIX I DESK-STUDY INFORMATION RECEIVED FROM TVERC

Leighton Park School, Reading Designated Wildlife Sites Map



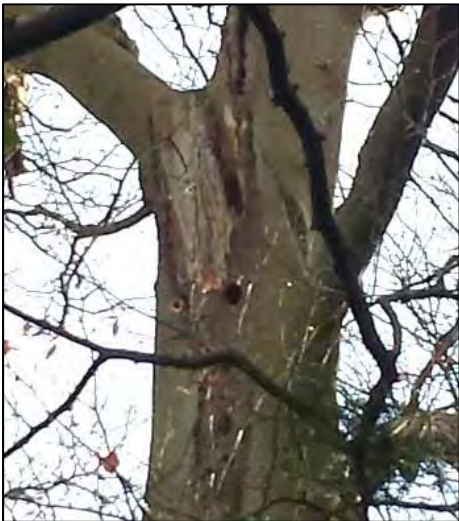
★ Site central grid reference

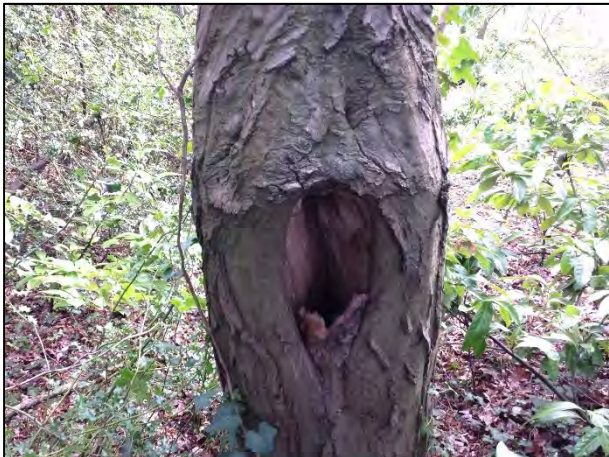
Scale: 1:15,000

Search Area

Local Wildlife Site

APPENDIX II PHASE 1 HABITAT SURVEY MAP AND TARGET NOTES

Target Note	Description/Comment
<i>Birds seen/ heard:</i> Long-tailed Tit, Great Tit, Blackbird, Robin, Carrion Crow, Blue Tit, Wood Pigeon.	
1	Regularly trimmed ornamental Beech hedgerow c.1m wide x 1.5m high. Ornamental Yew hedgerow also present to east. 
2	Mature Beech tree with deadwood and woodpecker holes. Moderate potential to support roosting bats. 
3	Number of semi-mature trees with dense cover of Ivy leaf but only small/ light cover of Ivy stem. No other features suitable for use by roosting bats noted. Trees of Low bat potential.

4	Sweet Chestnut tree. Crown reduction undertaken in the past with rot holes present at limb scars. Moderate potential to support roosting bats. 
5	Hornbeam with upward facing cavity in trunk c.1m above ground level. Cavity quickly narrows but does appear to extend some distance through trunk. Tree of moderate potential to support roosting bats. 
6	Mixed plantation woodland dominated by Beech and Yew with Cherry Laurel dominant in shrub layer. Other species present include Oak, Holly, Silver Birch, Hazel Sycamore and conifers. Woodland dominated by young/ semi-mature trees with some mature trees also present. Limited ground flora observed and non-native species such as Wilson's Honeysuckle and Variegated Periwinkle present.
7	Scrub colonising over foundations of former buildings. Species present include Bramble, Broom, Willow saplings and Buddleia. 
8	Small stand of Rhododendron.

APPENDIX III ADVICE NOTE ON BATS & LIGHTING (2014)

The following advice in relation to Bats and lighting provides a summary of the review of available evidence compiled by the Bats and Lighting Research Project at the University of Bristol. The full report should be reviewed for further information on any of the summary points identified below. The citation for the full report is:

Stone, E.L. (2013) *Bats and lighting: Overview of current evidence and mitigation guidance. Lighting Research Project, University of Bristol.*

Introduction

Urbanisation and development affect bat habitats, either through direct loss or disturbance from light and noise pollution or human activities. Changes in habitat affect the quantity, quality and connectivity of foraging, drinking and roosting resources available to bats. Linear landscape features such as hedgerows, river banks and canals are important for bats, often being used for foraging and commuting (Limpens & Kapteyn 1991; Verboom *et al.* 1999).

Bat habitats and roosts are under increasing pressure and disturbance from suburban development and its associated artificial lighting. Connectivity of habitat and foraging areas to roosts is fundamental to the survival of many bat populations (Verboom & Huitema 1997). Lighting schemes can damage bat foraging habitat directly through loss of land and spatial exclusion of bats due to high illuminance, or indirectly by severing commuting routes from roosts, through light spillage polluting hedgerows, tree lines and watercourses (Racey 2006). Lighting around roosts has also been shown to delay emergence, causing bats to miss the peak in insect prey abundance (Downs *et al.* 2003).

Legislation pertaining to lighting in Britain

There is no legal duty for a lighting authority to illuminate roads in Britain and lighting is installed because the perceived benefits outweigh the negatives. Recent research by The Highways Agency (in England) found that the safety benefits of motorway lighting were 1/3 lower than previously thought. Additional field trials to switch-off lights on motorways have found lower numbers of accidents when lights were off than when illuminated (<http://www.highways.gov.uk/knowledge/30236.aspx>). A number of authorities have been trialling part night lighting solutions and even complete removal. The results have been mixed but a significantly large number of projects have shown no detriment from implementation of these changes.

Street lighting (A roads, B roads, pedestrian lighting)

There are over 7.5million street lights in the UK (Anon. 2009). Common light types used for external applications in the UK.

Common types of street light used in the Britain.

	Colour	% UV	Correlated colour temperature (k) ⁴	Approx % of UK Lighting stock
Low pressure sodium (LPS / SOX)	Yellow/orange	0.0	1807	44%
High pressure sodium (HPS / SON)	Pinkish / off white	0.3	2005-2108	41%
Compact fluorescent	Warm white	0.5-1.0	2766-5193	15%
Metal Halide (e.g. Philips CosmoPolis)	Blue-white	2.0-7.0	2720-4160 CosmoPolis 2720	N/A
Light emitting diode (LED)	White/warm - white	0.0	2800-7000	N/A

Predicting the impacts of lighting on bats

There are many aspects of ecological light pollution which are yet to be investigated, and so a precautionary approach is important. It is important to consider the following when predicting the impacts of lighting on bats:

i. Impacts may be cumulative

Lighting is one of many anthropogenic impacts on bats and so it is important to consider impacts of lighting in the context of the site and other conditions affecting the species or colony. For example even a small amount of lighting may have a disproportionate impact on bats at sites where there are already high levels of disturbance, therefore impacts must be assessed in the context of other disturbances on the colony/roost in question.

ii. Impacts will vary according to site, species and behaviour

The impacts of lighting on bats is species specific and varies according to the specific behaviour being affected. Impacts on a site by site basis can be based on knowledge of the species involved and the type of behaviour affected.

iii. Impacts may occur over different temporal scales

Some impacts may occur over very short time frames making them more obvious (e.g. spatial avoidance) and therefore more likely to be recorded. However, lighting may impact behaviours over longer time scales (e.g. reduced breeding success) and may be harder to record and therefore underestimated.

iv. Impacts may occur at both the individual or population level

Lighting may impact on a few individuals in a colony or population, i.e. causing temporary avoidance of a commuting route used by a small percentage of bats occupying a roost. However, there may be effects at the population level, e.g. reduced juvenile growth rates due to reduced foraging or delayed emergence caused by lighting (e.g. see Boldogh et al. 2007).

v. Impacts may be indirect occurring at the ecosystem or community level

⁴ refers to the colour appearance of the light emitted by a light source and is measured in degrees Kelvin (K). The CCT of a light source is calculated by relating the colour of the lamp to the light colour of a reference source when heated to a particular temperature. CCT gives a general measure of the “coolness” or “warmth” of the light source: CCT ratings below 3200K are considered warm whereas ratings above 4000K are considered cool. CCT gives an indication of the general appearance of the light, but not its spectral power distribution, and so two lamps that appear the same may have different colour rendering properties.

Lighting can impact bats via changes at the ecosystem level. Lighting may lead to a competitive advantage for some species which benefit from the increased foraging opportunities provided by moths attracted to lights with high UV content. This may lead to competitive exclusion of those species unable to take advantage of new artificially illuminated areas (Arlettaz *et al.* 2000). Indirect effects include effects on bats' insect prey. Bats have a competitive advantage over moths at street lights (Svensson & Rydell 1998), which interferes with the relationship between predator and prey.

A summary of the key impacts per species according to behaviour types is provided in Table 5.1. These are based on current knowledge and may change as more evidence emerges, so are given as guidance only and specific levels of impact will vary on a site by site basis. Low impact does not mean there is no impact, but suggests that impact is likely to have a negligible impact on the population. Further research is required to have high confidence in many of these predictions and therefore they should be used as guidance only.

Table 5.1 Summary of predicted impacts of lighting according to bat behaviour.

Impact Behaviour	High	Medium	Low
Maternity roost	All species	-	-
Night roost	<i>Rhinolophus hipposideros</i> <i>Rhinolophus ferrumequinum</i> <i>Myotis</i> spp. <i>Plecotus</i> spp.	<i>Pipistrellus</i> spp. <i>Nyctalus</i> spp. <i>Eptesicus serotinus</i> <i>Barbastella barbastellus</i>	-
Emergence	All species	-	-
Foraging	<i>Rhinolophus hipposideros</i> <i>Rhinolophus ferrumequinum</i> <i>Myotis</i> spp. <i>Plecotus</i> spp.	-	<i>Pipistrellus</i> spp. <i>Nyctalus</i> spp. <i>Eptesicus serotinus</i> <i>Barbastella barbastellus</i>
Commuting	<i>Rhinolophus hipposideros</i> <i>Rhinolophus ferrumequinum</i> <i>Myotis</i> spp. <i>Plecotus</i> spp.	-	<i>Pipistrellus</i> spp. <i>Nyctalus</i> spp. <i>Eptesicus serotinus</i> <i>Barbastella barbastellus</i>
Swarming	All species	-	-
Hibernation	All species	-	-

Key messages and recommendations:

Emergence and roosting

- Current evidence demonstrates that external light disturbance at emergence and return will have negative impacts for bats (especially *Rhinolophus*, *Myotis*, and *Plecotus* spp.) and should be avoided.
- Internal illumination of roosts is likely to impact negatively on long-term population growth and survival and should be avoided for all species.
- Direct illumination of a roost exit/entrance may cause roost abandonment for all species (particularly for *Rhinolophus* and *Myotis* spp.) and should be avoided.

Commuting

- Light disturbance along commuting routes will cause avoidance behaviour for *R. hipposideros* and *Myotis* spp. and should be avoided.

Foraging

- Light disturbance can reduce the availability of foraging areas for some species.
- A precautionary approach must be taken and illumination of foraging areas avoided, particularly for light sensitive species.

Hibernation

- There is limited evidence of the impact of lighting on hibernating bats. However illumination of hibernation sites should be avoided during the hibernation period.

Swarming

- There is a lack of evidence regarding the impact of lighting on bat swarming behaviour and so illumination of known or potential swarming sites should be avoided under the precautionary principle.

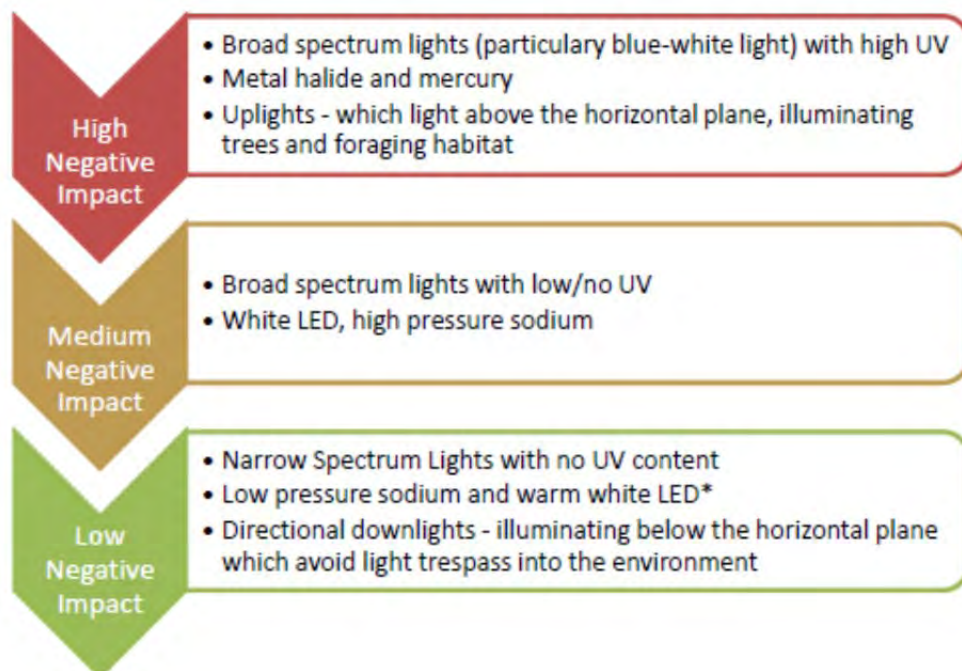
Summary of impacts of light types on bats

Light technology is rapidly developing and new light types are being installed and trialled across the UK. There is a general trend towards white light due to the increased colour rendering and increased perceived brightness for the human eye. Humans perceive white light as brighter than yellow light and so lower light intensities can be used to achieve the same perceived brightness. Commonly used emerging lamps include white LED (Philips Stela and DW Windsor Monaro), warm-white LED, and ceramic metal halide (e.g. Philips 5. CosmoPolis). Some companies are testing new light types to find a wildlife friendly lamp which has little or no impact on wildlife e.g. QL Philips Clearsky lamps which are said to prevent migrating birds from colliding with offshore platforms. To date no such product has been rigorously tested on bats. However, there is little evidence of the comparative impacts of different light types on different bat species and behaviours.

The figures overleaf provides a general summary of the **relative** impacts of light types on bats. However, there is a lack of evidence regarding the comparative impacts of different light types on bats and these summaries should be considered general rules of thumb until more detailed information is available.

Summary of the current evidence of the relative impacts of different light types on bats

Light type	Species	Impact	Evidence
White LED	<i>Rhinolophus hipposideros</i> and <i>Myotis</i> spp.	Reduced activity and spatial avoidance of commuting routes	Stone <i>et al.</i> , 2012
Warm white LED	Unknown at present	Unknown - though likely to have less impact on light sensitive species than white light types	
Low pressure sodium	<i>Nyctalus noctula</i>	Increased activity and foraging	Rydell & Baagoe 1996
	<i>Pipistrellus</i> spp.	No significant increase in activity compared to dark areas	Blake <i>et al.</i> , 1994
High pressure sodium	<i>Rhinolophus hipposideros</i> and <i>Myotis</i> spp.	Reduced activity and spatial avoidance of commuting routes; delayed commuting time	Stone <i>et al.</i> , 2009; 2011
	<i>Pipistrellus</i> spp., <i>Nyctalus noctula</i> , <i>Eptesicus serotinus</i>	Increased activity and foraging	Rydell & Baagoe 1996
Compact fluorescent	Unknown at present	Unknown - though likely to have a similar impact on light sensitive species as other white light types	
Mercury vapor lamps	<i>P. pipistrellus</i> and <i>Pipistrellus</i> spp. <i>Eptesicus</i> spp.	Increased activity (Rydell (1991) recorded increased activity of <i>Eptesicus nilssonii</i> (a species not present in the UK) at mercury vapor lamps in Sweden in spring April – May)	Haffner & Stutz 1985; Blake <i>et al.</i> 1994, Rydell & Racey 1995.



Approach to mitigation of artificial lighting

When mitigating the impacts of artificial lighting on bats it is important to ask the following key questions:

1. Do we need to light?
2. Where does the light need to be?
3. What is the light required for?
4. How much light is actually needed to perform the tasks required ?
5. When is the light required?

The following approach should be taken when developing a mitigation strategy:



Mitigation Strategies

Mitigation strategies will vary on a site by site basis according to the required level of lighting, use of the area, the surrounding habitat, the species of bat and specific behaviour affected.

No light

Where possible the ideal scenario would be to have no light at all at locations used by bats. This may be possible with good planning and involvement of lighting engineers at the survey and pre-planning stage. This may involve switching off existing units on site and ensuring areas used by bats have no new light units installed and will have no light trespass from nearby lights. If possible sites should contain light exclusion zones (dark areas) which are interconnected to allow bats to move freely from their roosts along commuting routes to their foraging grounds without being subject to artificial illumination.

Variable lighting regimes (VLR)

In many cases it is not feasible to have light exclusion zones in all in the areas occupied by bats at a site. In such cases new generation lighting controlled by CMS systems may be preferable to enable variable lighting regimes (VLR) to suit both human and wildlife use of the site. VLR involve switching off or dimming lights for periods of the night. Many county councils are adopting VLR using CMS controlled units, switching off/dimming lights when human activity is low (e.g. 12.30 – 5.30am). This technology could also be used to create a lighting regime that switches off lights during periods of high bat activity, such as commuting or emergence. Lights can also be dimmed (e.g. to 30% power) for periods of the night to reduce illumination and spill. The exact regime of lighting at a site will depend on the nature of public use and type and amount of bat activity, and will therefore vary between sites.

Habitat creation

- **Light barriers:** vegetation can be planted (e.g. hedgerows or trees) to reduce light spill so acts as a light barrier. Careful consideration should be given to the minimum size of the habitat required to restrict any light trespass when used as a light barrier. The size and depth of the corridor will vary according to the distance from the light source, light intensity, light spread and light type.

- **Dark corridors:** dark corridors can be created to encourage/guide bats away from lit areas or around lit obstacles (such as roads). Corridors should be placed with consideration for the use of the landscape as a whole in relation to key commuting routes, linking foraging sites and roosts. Corridors can be composed of man-made or natural materials (e.g. fences, brick walls, tree lines or hedges). Corridors with outgrown vegetation are preferable as they create dark fly ways sheltered from predators and the elements. Heavily clipped low hedges or tree-lines are less suitable. To increase their effectiveness dark corridors should be:
 - i. Well-connected within the bat landscape – linking to existing flight paths, roosts or foraging areas;
 - ii. Outgrown with mature vegetation providing shelter for bats from the weather and predators as they fly;
 - iii. Planted with native species to encourage insect populations, thereby allowing bats to forage along the corridors;
 - iv. Located away from roads to avoid traffic noise which will reduce the foraging efficiency of passive listening bats (Schaub 2008); and
 - v. Monitored/maintained long-term to ensure they remain functional, e.g. have not been removed or altered in a way that will reduce effectiveness.

Spacing and height of units

Increasing the spacing between light units can reduce the intensity and spread of the light to minimise the area illuminated and give bats an opportunity to fly in relatively dark areas between lights. Reducing the height of light units will keep the light as close to the ground as possible, reducing the volume of illuminated space. This will also give bats a chance to fly over the light units in the dark area above the light (as long as the light does not spill above the vertical plane). There are many low level lighting options for pedestrian and cycle path lighting which minimise spill and reduce overall illumination including: low level illuminated bollards, down-lights, handrail lighting or footpath lighting.

Reducing intensity

Reducing light intensity will reduce the overall amount and spread of illumination. For some bat and insect species this may be sufficient to minimise disturbance or the magnitude of any negative impacts. However, some species may require very low light levels to have little/no impact on bat behaviour. Stone *et al.*, (2012) found that levels as low as 3.6lux caused spatial avoidance of a preferred commuting route by *Rhinolophus hipposideros*. Average light levels recorded along preferred commuting routes of *Rhinolophus hipposideros* under natural unlit conditions were 0.04 lux across eight sites (Stone 2011). When mitigating the impacts of lighting for such species very low lux levels may not be suitable for human needs. In such cases reducing intensity may not be an option and alternative strategies may be preferable (e.g. dark corridors or light barriers). A “light threshold” below which there is little impact on bats may not exist for some species which may be light averse regardless of intensity (e.g. possibly *Rhinolophus hipposideros*). Light intensity can be reduced by:

- **Dimming:** CMS technology can be used to reduce the power of lights on request (e.g. by 80%) and can be used as part of a VLR for periods of high bat activity;
- **Changing the light source:** new technologies such as ceramic metal halide (e.g. Philips CosmoPolis, 45 watts) often have a lower wattage compared to old lamp types (e.g. HPS, 75 watts), and can be used to reduce light intensity. However, there is a trade-off between reduced intensity and the pattern of light distribution. Some older light types such as HPS, produce a heterogeneous light environment whereby light intensity declines steeply away from the light source. However some new technologies such as LEDs produce a uniform light distribution resulting in a loss of dark refuges between the lamps (Gaston *et al.* 2012). In such cases it may be preferable to increase the spacing between the units to create dark refuges. In addition when changing the light source it is important to consider the effects of the spectral content of the light; or

- *Creating light barriers:* light intensity can be reduced at a particular site by creating a light barrier which restricts the amount of light reaching the sensitive area. Barriers can be in the form of newly planted vegetation walls, fences or buildings.

Changing the light type

When selecting a light type it is important to consider the colour appearance and rendering of the lamps in relation to human and bat vision. Different light types are likely to have different effects on bats, and these effects will be species and behaviour specific. Choosing the light type (colour/spectral distribution) will inevitably be a compromise between the environmental and public requirements. Currently there is a lack of evidence of the comparative impacts of light types on bats. However, the following key principles can reduce potential negative impacts on bats and wildlife in general:

- *Avoid blue-white short wavelength lights:* these have a significant negative impact on the insect prey of bats. Use alternatives such as warm-white (long wavelength) lights as this will reduce the impact on insects and therefore bats
- *Avoid lights with high UV content:* (e.g. metal halide or mercury light sources), or reduce/completely remove the UV content of the light. UV has a high attractiveness to insects leading to direct insect mortality at street lights thereby reducing the availability of insect prey (Bruce-White & Shardlow 2011). Use UV filters or glass housings on lamps which filter out a lot of the UV content.

Reducing spill

Lighting should be directed only where it is needed to avoid trespass (spilling of light beyond the boundary of area being lit). Attention should be paid to avoid the upward spread of light near to and above the horizontal plane to minimise trespass and sky glow. Trespass can be minimised either prior to installation with careful lighting design and selection of appropriate lamp units, or post installation using a range of lamp modifications to restrict and direct light.

Prior to installation:

- Ensure a low beam angle of the lights (ideally less than 70° above the horizontal) (ILP, 2011)
- Install full horizontal cut off units (with no light more than 90° above the horizontal)
- Avoid the use of upward light (e.g. ground recessed luminaires or ground mounted floodlights up-lighting trees, buildings and vegetation)
- For security lighting use 'variable aim' luminaries which allow you to change the beam angle by moving the lamp
- LED lamps allow for directional lighting as individual/groups of LED bulbs can be switched off to direct light to specific angles and most luminaires are full cut off

Post installation:

- Install directional accessories on existing light units to direct light away from sensitive areas and minimise spill (e.g. baffles, hoods and louvres)
- Where possible change the angle of the lamp housing to reduce the angle of the beam below 70°