

ROBERT HITCHINS



ECOLOGYSOLUTIONS

Part of the ES Group

LAND AT OAKLEY FARM,
BATTLEDOWN,
CHELTENHAM

**Landscape and Ecology
Management Plan**

March 2021
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1. INTRODUCTION

- 1.1 Ecology Solutions has been appointed by Robert Hitchins Ltd to prepare the working method statement for ecological management (and enhancement of the habitats and species) for the Land at Oakley Farm, Battledown, Cheltenham, hereafter referred to as the 'site'. This has been set out in the form of a Landscape and Ecology Management Plan (LEMP) which sets out the protection of features of ecological interest and management of those due to be retained and created within the development site.
- 1.2 This LEMP has been written in accordance with the mitigation and enhancements set out in Chapter 7 (by Ecology Solutions) within the Environmental Statement dated January 2020.
- 1.3 Ecology Solutions or another appropriately qualified ecologist should be appointed to advise and ensure that ecological mitigation works are carried out as detailed within the LEMP.
- 1.4 This LEMP also provides a template for safeguarding wildlife post-development and future enhancements and guidelines for future management regimes.
- 1.5 The plan is intended to be an iterative process that is subject to annual review by the management company and will be maintained in perpetuity. Any future amendments to the plan will be dependent on prevailing conditions and the opinion and judgement of land managers on the ground. Nevertheless, the spirit of the plan and its ultimate goal is to provide effective ecological enhancement, to benefit local wildlife interests and work towards national and local species / habitats of Principal Importance (Priority Species / Habitats) targets.
- 1.6 This LEMP has been written with reference to published guidance from the Chartered Institute of Ecology and Environmental Management (CIEEM) and in accordance with Natural England guidelines for protected species.
- 1.7 The document is set out as follows:
 - Ecological baseline and evaluation of important features within the development site;
 - Objectives of the LEMP in order to maximise the ecological potential of features due to be retained within the site;
 - Management prescriptions in order to achieve objectives. These include any monitoring requirements; and
 - The adaptive work program for the first 10 years.
- 1.8 A copy of this report and the management plan should be provided to all interested parties as necessary to ensure compliance with its prescriptions and the protection and enhancement of the biodiversity interest.

2. ECOLOGICAL BASELINE AND EVALUATION

- 2.1 Habitat surveys were based upon an extended Phase 1 survey technique. The habitats and dominant plant species were recorded, together with conspicuous faunal activity and evidence of the presence, or potential presence, of protected species. Results from these habitat and faunal surveys are summarised below and further detail can be seen in Chapter 7 of the Environmental Statement (dated January 2020).
- 2.2 During the surveys undertaken, all obvious faunal activity such as birds or mammals observed visually or by call, was also recorded. Specific attention was paid to any potential use of the site by protected species, Priority Species, or other notable species.
- 2.3 In addition, specific surveys were carried out for the presence of bats, Badgers *Meles meles*, Breeding Birds and Reptiles.

Ecological Features

- 2.4 The following main habitat / vegetation types were identified within the site:
- Amenity Grassland and Amenity Planting;
 - Semi-Improved Grassland;
 - Hedgerows and Trees;
 - Dry Depression, Ruderal Vegetation and Ruderal-dominated Grassland;
 - Scattered Scrub, Bramble Scrub and Cleared Bramble Scrub;
 - Buildings and Hardstanding; and
 - Cleared Ground.
- 2.5 Full descriptions of these habitats can be seen in Chapter 7 of the Environmental Statement (ES) (dated January 2020).

Wildlife Use of the Site

- 2.6 General observations were made during the surveys of any faunal use of the site, with specific attention paid to the potential presence of any protected or notable species. Specific surveys were undertaken with regard to bats, Badgers, Breeding Birds and Reptiles.
- 2.7 A summary of the findings are set out below, and full details of the results can be seen within Chapter 7 of the Environmental Statement (dated January 2020). The existing ecological features within the site can be seen on Plan ECO1.

Bats

- 2.8 Overall, the vast majority of bat activity was recorded from Common Pipistrelle, with less activity recorded from *Myotis* sp., Lesser Horseshoe *Rhinolophus hipposideros* bats, Soprano Pipistrelle *Pipistrellus*

pygmaeus, *Nyctalus* sp., Brown Long-eared *Plecotus auritus*, Nathusius' Pipistrelle *Pipistrellus nathusii* and Barbastelle *Barbastella barbastellus*. Only occasional and low levels of activity was recorded from Serotine *Eptesicus serotinus*.

- 2.9 In general, bats use most of the hedgerows within the site to varying degrees throughout the year with areas of greater registrations at the crossing point of hedgerows H3 and H1 along hedgerows and trees associated with the demolished farm building B1, along H7-H11, along the northern section of H9 (just before crossing point of H9 and H12), at the crossing point of H2 and H2a. Lower numbers of bat registrations were recorded along H1, H2a, H5, H6 and along the north-western (H2a and H3), north-eastern and eastern boundary of the site (see Plan ECO1 and Figures 7.4-7.11 within the ES dated January 2020).
- 2.10 In addition, there is one mature Oak tree with an occasionally used summer day roost used by a single Noctule *Nyctalus noctula* bat in the north of the site (see Figure 7.3 within the ES dated 2020).

Badgers

- 2.11 During the surveys undertaken, no evidence of Badgers was recorded within the site, although it is considered the habitats present offer some suitable opportunities for foraging Badgers.

Breeding Birds

- 2.12 It is considered that the site supports an unremarkable ornithological assemblage, with low numbers of notable breeding bird species, including House Sparrow *Passer domesticus*, Willow Tit *Poecile montanus*, Dunnock *Prunella modularis* and Bullfinch *Pyrrhula pyrrhula*.

Reptiles

- 2.13 During the surveys undertaken, no reptiles were recorded within the site. It is considered that the regular cutting management of the grassland fields may not lend itself to the presence of reptiles.

Invertebrates

- 2.14 Given the habitats present it is likely an assemblage of common invertebrate species would be present within the site.

Other Species

- 2.15 It is considered the Application Site offers potentially suitable habitats / opportunities for the Priority Species Hedgehog *Erinaceus europaeus*.

3. MANAGEMENT OBJECTIVES

- 3.1 The aims and objectives of the LEMP are to maintain and enhance features of ecological interest retained within the development, in addition to conserving populations of protected species on site, whilst providing for biodiversity enhancements within the proposed development.
- 3.2 Management represents an important component in these areas.
- 3.3 The following objectives have been identified:
- Objective 1: Maintain, safeguard and enhance retained and newly created habitats within the development site;
 - Objective 2: Maintain and safeguard populations of protected species identified within the development site area at a favourable conservation status; and
 - Objective 3: Increase biodiversity by maximising opportunities for flora and fauna.

4. MANAGEMENT MEASURES

- 4.1 The management measures for each habitat are set out below.
- 4.2 Management prescriptions and monitoring requirements have been described below in relation to each of the three objectives.
- 4.3 The proposals include new landscape planting throughout the site, including enhanced and new meadow grassland within areas of open space, new native hedgerow and tree / block planting as well as a new attenuation feature within the north-eastern corner of the site (see Plan ECO2).

Objective 1: Maintain, Safeguard and Enhance Retained and Created Habitats

Management of Habitat

Amenity Grassland

- 4.4 The proposals include the creation of new areas of gardens and public open space, which will be sown / oversown using a native species-rich grassland seed mixture (such as Emorsgate's Flowering Lawn Mixture EL1 or Standard General Purpose Meadow Mixture EM2).
- 4.5 The areas of amenity grassland will be sown in the first autumn or spring prior to completion of development.
- 4.6 The areas of amenity grassland will be cut on a regular basis. Checks will be made monthly, and the grass will be cut when it reaches **100mm** long, back to a length of **35mm**. Mowing will be required more frequently during the spring / summer seasons.

Semi-improved Grassland

- 4.7 The proposals include the creation of new areas of species-rich, meadow grassland.
- 4.8 These areas will be sown / oversown using green hay spread from existing areas of high botanical interest or by use of an appropriate native species-rich grassland seed mixture (such as Emorsgate's Standard General Purpose Meadow Mixture EM2 or Emorsgate's Special General Purpose Meadow Mixture EM3).
- 4.9 The grassland will be managed with a more intensive mowing regime in the first year to aid the initial establishment of the wildflower species. The grassland will then only be cut to **150mm and only half will be mown rotationally every year** to allow the grassland to maintain a long nature. This grassland will be cut between **August and September**. Cuttings will be left in discrete habitat piles.
- 4.10 Any areas of failed grassland (a loss of more than 5% in grassland cover) will be reseeded with a seed mix of similar species content.

Hedgerows and Trees

- 4.11 The majority of the hedgerows and existing trees are to be retained with only minor losses. The retained hedgerows will be bolstered through new native species planting. This will serve to thicken the hedgerow and provide enhanced habitats for a range of species.
- 4.12 New native hedgerow and new native trees / block planting are to be planted throughout the site.
- 4.13 Appropriate management of the new and existing hedgerows will be undertaken in order to enhance their ecological value, and this will include trimming being only undertaken during **winter months** when berries are no longer present to maximise foraging opportunities for birds in autumn.
- 4.14 Existing and new native hedgerows will be trimmed **every three years, or alternate sides of the hedgerow cut once every two years**, and the hedgerow maintained at a height of at **least 3-4m**. The hedgerows will be managed with a thick structure, and should the hedgerows become gappy or with sparse growth at their bases, the hedgerows will be subject to coppicing / laying to improve their structure. Should significant gaps be present within the hedgerows, additional native species planting will be undertaken to fill the gaps.
- 4.15 Hedgerows will be cut back in **January / February** in order to maintain healthy growth and a good structure and to also avoid the main bird-nesting season, March-August (inclusive).
- 4.16 For the first five years after planting, regular health checks of the hedgerows will be undertaken especially during periods of dry weather, to ensure that the hedgerows are not affected by drought. Any failed sections of existing hedgerows will be replaced with similar species content and size to that within the site.
- 4.17 All retained trees and new native trees / block planting within the site will be subject to appropriate arboriculture maintenance where necessary, to help prolong their life and ensure they are safe. The condition of the mature trees within the site will be monitored during the first five years following completion of the development, to ensure a favourable condition is maintained.
- 4.18 Any arboricultural management e.g. pruning / lopping will be carried outside the bird nesting season (**March-August inclusive**) to avoid any potential offence, or after a suitably qualified ecologist has undertaken checks to ensure no nesting birds are present. Where possible any dead wood produced will be retained as an ecological feature, either as standing deadwood or as log piles / hibernacula, offering new habitat for small mammals and saproxylic invertebrates.
- 4.19 Planting of new trees / block planting will be undertaken during the **autumn, winter or spring**. For the first five years after planting, regular health checks of the trees will be undertaken to ensure successful establishment especially during periods of dry weather, to ensure that they are not affected by drought and to identify any potential gaps where plants have not survived. Any failed new tree planting will be replaced

with native species of local provenance and of similar species content to that within the site.

Attenuation Feature

- 4.20 The proposals include a new attenuation feature located within the north-western corner of the site.
- 4.21 A seasonal Wetlands mixture (such as Emorsgate's Meadow Mixture for Wetlands EM8) will be sown around the attenuation area prior to the completion of the development during either the **autumn or spring** to ensure best results.
- 4.22 The grassland will be managed with a more intensive mowing regime in the first year to aid the initial establishment of the wildflower species. The grassland will then only be cut to **150mm every year**. This grassland will be cut between **August and September**.
- 4.23 Aquatic vegetation (if present) will be removed if the attenuation feature becomes overgrown. This vegetation will be removed in the **autumn** and left adjacent to the ponds for 48 hours to ensure no amphibians or invertebrates are present within the vegetation before the vegetation is removed.
- 4.24 The attenuation feature will be monitored on a yearly basis to ensure no invasive species colonise the ponds. Should invasive species be noted, these will be treated appropriately and with due consideration to the wildlife present within the pond.

Attenuation Marginal Vegetation

- 4.25 Marginal vegetation (pond edge mix) will be managed if it becomes overgrown. This vegetation will be cut in the **autumn** and left adjacent to the pond for 48 hours to ensure amphibians and invertebrates have left the vegetation before the vegetation is removed.

Objective 2: Maintain Populations of Protected Species at a Favourable Conservation Status

Bats

- 4.26 The scheme has been designed to provide bats continued navigational and foraging corridors throughout the site. The majority of hedgerows within the site are to be retained and enhanced with the planting of native species which will maintain and enhance existing foraging and navigational opportunities for bats.
- 4.27 The enhancement and creation of new areas of wildflower meadow grassland, new native hedgerow planting, new native tree / block planting and the creation of a new attenuation feature, will provide new and enhanced foraging and navigational opportunities for bats.
- 4.28 Dark corridors for foraging and commuting bats will be maintained through green corridors along retained and enhanced hedgerows and trees and new native tree / block and hedgerow planting. Key routes

located along the southern and northern boundary of the site as well as along existing hedgerows and trees located within the eastern part of the site are maintained and will continue to provide connected foraging and commuting routes to off-site habitat as well as a north to south foraging route across the site itself. These dark corridors will continue to benefit the particularly light adverse bat species such as Lesser Horseshoe bats, Barbastelle, Brown Long-eared bats and *Myotis* sp. These key routes are shown on Plan ECO3 and additional dark areas are to be included throughout the site in particular within the southern open space.

- 4.29 The Oak tree located within the north of the site and supporting an occasionally used summer roost of a Noctule bat will be buffered from the proposed development and placed within a dark corridor (see Plan ECO3). All trees with potential features to support roosting bats will be retained and are connected through the retained dark corridors.
- 4.30 The levels of illuminance from the proposed lighting within the site onto dark corridors will be limited to <0.5 lux or no greater than the existing levels of illuminance. Additional mitigation measures as described within the Lighting Strategy by Illume Design (see Appendix 2) will minimise light spillage into ecologically sensitive areas. The proposed lighting strategy minimises light spillage into the key areas through integral backshields and positioning streetlights as far as possible from street crossing points, as well as tree planting on either side of the road or footpath at bat crossing points that fall within the dark corridors. To minimise further light spill onto dark corridors, screening will be provided in the form of vegetation such as newly planted trees and hedgerows as well as bolster planting and enhancement of existing hedgerows particularly within the edges of dark corridors which will provide enhanced connectivity throughout the site. Temporary fencing may be installed around newly planted trees / hedgerows in these areas to allow vegetation to mature to a minimum of 2m in height. In addition, a dimming regime will reduce further impacts between midnight and 5:30 am.
- 4.31 New roosting opportunities will be created with the installation of 10 bat boxes on suitable semi-mature / mature trees within the site (see Plan ECO4). This measure will provide enhanced roosting opportunities within the site.
- 4.32 Bat boxes will be checked **annually** to ensure they are in place and in the unlikely event that a bat boxes needs to be replaced or repaired; it will be first checked by a licences bat worker.
- 4.33 Any arboricultural management will have regard for the potential presence of roosting bats. Any trees with features suitable to support roosting bats that are due to be lopped / felled will be subject to tree-climbing surveys to determine whether bats are present. The retention of standing and fallen dead wood will provide potentially suitable roosting opportunities for bats.

Badgers

- 4.34 The enhanced and new areas meadow grassland as well as new native tree / block planting will offer good potential foraging resources for Badgers through encouraging different varieties of invertebrates. The

retention of vast majority of trees within site would be unlikely to result in significant adverse effects on any Badgers using the site. The inclusion of new native where berry / fruit bearing species (seasonal foraging resources) within the planting scheme will provide further cover and foraging opportunities for Badgers.

Birds

- 4.35 The development proposals will retain many of the existing foraging and nesting opportunities for birds. The native hedgerow and new native tree / block planting throughout the site, will provide new nesting and foraging opportunities for birds.
- 4.36 The creation of a new attenuation feature will also provide new foraging opportunities for birds.
- 4.37 Management of habitats will be undertaken with due consideration for potential use by birds. Cutting of vegetation, particularly those features that provide important nesting habitats (including hedgerows and trees) will be undertaken during the winter months. Should the above timing constraints conflict with any timetabled works, it is recommended that works commence only after a suitably qualified ecologist has undertaken checks to ensure no nesting birds are present. If nesting birds are found to be present during checks then clearance would need to be delayed until young have fledged.
- 4.38 New nesting opportunities will be created with the installation of 10 bird boxes on suitable retained trees within retained areas of open space within the site (see Plan ECO3). Bird boxes will be checked **annually** to ensure they are in place and will be replaced and repaired if damaged.

Invertebrates

- 4.39 The proposed new attenuation feature, enhanced and new meadow grassland, new native hedgerow and tree / block planting will offer new opportunities for invertebrates. A variety of plant species will be used as part of the landscape scheme which will increase the attractiveness of the site for a range of different invertebrate species.
- 4.40 In addition, the retention of standing and falling dead wood and the creation of new log piles from any arboricultural works, will provide new shelter opportunities for invertebrates including saproxylic species

Objective 3: Increase Biodiversity by Maximising Opportunities for Flora and Fauna

- 4.41 The creation of new and enhanced areas of species-rich meadow grassland, new native hedgerow and new native tree / block planting will offer enhanced and new opportunities for will provide enhanced and new foraging and navigational resources for bats, enhanced and new terrestrial habitats for Badgers and Hedgehogs and foraging and enhanced and new nesting resources for birds.
- 4.42 The new tree / block planting and new hedgerow planting throughout the site is based around native species and those of benefit to wildlife, which

will provide new foraging and nesting resources for birds and foraging and navigational resources for bats. The provision of berry-bearing and fruiting species will also provide suitable seasonal resources for birds and other wildlife.

- 4.43 The creation of an attenuation feature within the north-western corner of the site, to be planted with native aquatic and marginal species will provide new opportunities for invertebrates, which in turn will offer foraging resources for bats, birds and small mammals.
- 4.44 The provision of bat and bird boxes on buildings will provide new roosting and nesting opportunities for bats and birds over the existing situation.

PLANS AND APPENDICES

PLANS

PLAN ECO1

Ecological Features



KEY:

- SITE BOUNDARY
- SEMI-IMPROVED GRASSLAND
- AMENITY GRASSLAND
- RUDERAL-DOMINATED GRASSLAND
- RUDERAL VEGETATION
- DRY DEPRESSION
- BRAMBLE SCRUB
- CLEARED BRAMBLE SCRUB
- SCATTERED SCRUB
- HEDGEROW POTENTIALLY QUALIFYING AS 'IMPORTANT'
- SPECIES-RICH HEDGEROW
- SPECIES-POOR HEDGEROW
- TREE
- OAK WITH OCCASIONAL SUMMER DAY ROOST USED BY NOCTULE BAT
- TREE WITH FEATURES SUITABLE TO SUPPORT ROOSTING BATS
- AREA OF HIGHER SPECIES DIVERSITY - WITH HIGHER DENSITY OF INDICATOR SPECIES FOR PRIORITY HABITAT G06
- DRY DITCH
- BUILDING
- DEMOLISHED BUILDING / CLEARED GROUND
- DIRT TRACK
- HARDSTANDING
- GATE



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PLAN ECO1:
ECOLOGICAL FEATURES

Rev: A
Feb 21

PLAN ECO3

Proposed Dark Corridors Plan

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KEY:

- SITE BOUNDARY
- PROPOSED DARK CORRIDORS (0.5 LUX MAX)
- BAT ROAD CROSSINGS

NOTE: BAT ROAD CROSSING POINTS WILL BE DESIGNED IN DETAIL TO MINIMISE ILLUMINATION AND REDUCE LIGHT SPILL INTO DARK CORRIDORS WHICH WILL ALLOW BATS TO CROSS THESE AREAS SAFELY.





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**7807: LAND AT OAKLEY FARM,
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**PLAN ECO3:
PROPOSED DARK CORRIDORS**

Rev: B
Feb 21

PLAN ECO4

Landscape and Ecology Management Plan



- KEY:**
- SITE BOUNDARY
 - RETAINED OAK TREE WITH OCCASIONAL SUMMER DAY ROOST USED BY NOCTULE BAT
 - RETAINED TREE WITH FEATURES SUITABLE TO SUPPORT ROOSTING BATS
 - INDICATIVE LOCATION OF BIRD BOX
 - INDICATIVE LOCATION OF BAT BOX



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PLAN ECO4:
LANDSCAPE & ECOLOGY
MANAGEMENT PLAN

Rev: A
Feb 21

APPENDICES

APPENDIX 1

Illustrative Masterplan



- Key:**
- Existing Public Right of Way
 - Principal Access
 - Pedestrian Access
 - Possible Emergency Access
 - Existing Trees Retained
 - Existing Hedgerow Retained
 - Proposed Trees
 - Proposed New Native Hedgerows
 - Residential
 - Garages
 - Proposed Indicative Landscaped Drainage Pond
 - Primary Street (with road narrowing to avoid Root protection Zones)
 - Re-graded land with new tree planting
 - Proposed Bound Gravel footpaths should be designed to minimise the section of hedgerow to be removed.
 - Proposed 3m cycle link to Prior's Road
 - Root Protection Areas

APPENDIX 2

Lighting Strategy
by Illume Design (February 2021)



Oakley Farm

Lighting Strategy

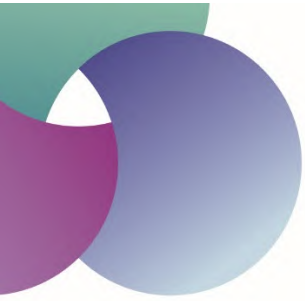
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PREPARED FOR:

Robert Hitchins Limited





Oakley Farm

Lighting Strategy

PROJECT: 4218

CURRENT REVISION: 0.2

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PREPARED BY: Bonnie Brooks MSc CEng MSL MCIBSE MILP

Rev	Date	Details
0.1	26.02.21	First Issue
0.2	03.03.21	Updated Dark Corridors Plan



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APPENDIX B: Baseline Lighting Survey Location Plan

APPENDIX C: Proposed Dark Corridors Plan and Site Illustrative Masterplan

APPENDIX D: Street Lighting Strategy



1 Introduction

1.1 General

This Lighting Strategy is provided by Illume Design Ltd, a specialist lighting design consultancy with experience and knowledge in lighting impact assessments, mitigation and lighting design in relation to light sensitive ecological receptors.

The author of this report is a fully qualified Lighting Designer and Chartered Electrical Engineer, with full membership of the Institute of Lighting Professionals, Society of Light and Lighting, and Chartered Institute of Building Services Engineers.

Illume Design Ltd have been commissioned by Robert Hitchins Limited to undertake a Lighting Strategy including a Baseline Lighting Survey for the site on Land at Oakley Farm, Battledown, Cheltenham.

1.2 Scope of the Report

This lighting strategy covers the lighting proposals for the outline planning application that has been prepared for the residential development on Land at Oakley Farm, Battledown, Cheltenham. The Proposed Development comprising up to 250 residential dwellings, associated infrastructure, ancillary facilities, open space and landscaping; demolition of existing buildings; and creation of new vehicular access from Harp Hill. Refer to the Illustrative Masterplan prepared for the site.

Due to the ecological sensitivity of the site, with light sensitive bat species utilising the site for foraging and commuting, there is a requirement to ensure that dark corridors and zones are retained.

The aim of the Lighting Strategy is to outline relevant policy and guidance, the intended parameters for the proposed lighting within the site, and mitigation measures proposed to reduce the impacts in terms of ecological receptors.

This lighting strategy does not specifically address lighting impacts in relation to obtrusive light, however it is expected that the lighting proposals will meet the criteria for the relevant environmental zone, with these parameters included in the report.

1.3 Structure of the Report

This report has been broken down into the following sections:

Section 2 – Outlines the relevant legislation, planning policy and guidance

Section 3 – Summarises the guidance for environmental zone classification and limiting parameters

Section 4 – Details the baseline survey method and results for the site

Section 5 – Outlines the proposed lighting strategy and mitigation measures for the proposed development



Section 6 – Concludes / Summarises the Lighting Strategy

1.4 Site Location

The site is situated to the north east of Cheltenham town centre on the lower slopes of the Cotswold Scarp at Oakley and is within the Cotswolds Area of Outstanding Natural Beauty (AONB).

The Site comprises 15.29 hectares of predominantly agricultural land and includes buildings associated with Oakley Farm.

To the south, the Site is bound by Harp Hill with residential properties situated along this road. To the west and north the Site is bound by residential development. To the east the site is bound by residential development and the underground Hewlett's Reservoir.

The Site currently comprises six semi-improved grassland fields that are bounded by hedgerows and trees, as well as smaller areas of scrub, brambles, ruderal vegetation/ grassland, amenity grassland, hardstanding and farm buildings. The former farmstead of Oakley Farm is located towards the northern boundary of the Site and is accessed by a single track from the west.

Various areas within the site have been identified as being ecologically sensitive, with light sensitive Lesser Horseshoe bats present on site. Areas and corridors to remain dark have been identified on the on the Proposed Dark Corridors Plan in Appendix C. Levels of illuminance are required to be <0.5 lux, or no greater than the existing levels of illuminance, within the identified dark zones. At locations where the dark corridors cross the roads light spill is to be minimised as far as possible.

For further information refer to the Ecological Reports by Ecology Solutions.



2 Legislation, Planning and Policy Guidance

2.1 Legislative Background

Light pollution was introduced within the Clean Neighbourhoods and Environment Act (2005) as a form of statutory nuisance under the Environmental Protection Act (the 'EPA', 1990), which was amended in 2006 to include the following nuisance definition:

“(fb) artificial light emitted from premises so as to be prejudicial to health or nuisance.”

Although light was described as having the potential to cause statutory nuisance, no prescriptive limits or rules were set for impact assessment purposes. Guidance Notes for the Reduction of Obtrusive Light produced by the Institute of Lighting Professionals (ILP) has, therefore, been referred to for the purposes of this assessment.

Guidance produced by Defra, Statutory Nuisance from Insects & Artificial Light (2006) on s101 to s103 of the Clean Neighbourhoods and Environment Act (2005) has also been referred to which places a duty on local authorities to ensure that their areas are checked periodically for existing and potential sources of statutory nuisances - including nuisances arising from artificial lighting. Local authorities must take reasonable steps to investigate complaints of such nuisances from artificial light. Once satisfied that a statutory nuisance exists or may occur or recur, local authorities must issue an abatement notice (in accordance with s80(2) of the EPA 1990), requiring that the nuisance cease or be abated within a set timescale.

2.2 Planning Policy Context

The National Planning Policy Framework (NPPF) 2019 states that the purpose of the planning system is to contribute to the achievement of sustainable development and constitute the Government's view on what sustainable development in England means in practice for the planning system. Paragraph 180 states that with regard to artificial lighting, planning policies and decisions should:

“limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.”

2.3 International Guidance

Commission Internationale De L'Eclairage (CIE) 150: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations (the 'CIE 150', 2017)

The purpose of CIE 150 is to aid in formulating guidelines for assessing the environmental effects of exterior lighting and to provide limits for relevant lighting parameters to control the obtrusive effects of exterior lighting to tolerable levels. CIE 150 also refers to the potentially adverse effects of exterior lighting on both natural and man-made environments.



CIE 126: Guidelines for Minimising Sky Glow (1997)

This document gives general guidance for lighting designers and policy makers on the reduction of sky glow. The report gives recommendations about maximum permissible values for exterior lighting installations. These values are regarded as limiting values. Lighting designers should strive to meet the lowest criteria for the design. Practical implementation of the general guidance is left to national regulations.

2.4 National Guidance

Institute of Lighting Professionals (ILP) (2011) Guidance Notes for the Reduction of Obtrusive Light (the 'ILP Guidance Notes')

The ILP has proposed lighting guidance and criteria for local authorities with a recommendation that these are incorporated at the local plan level. The ILP Guidance Notes define various forms of light pollution and describe a series of environmental zones. The ILP Guidance Notes provide suitable criteria against which the effects of artificial lighting can be assessed. This assessment has been based upon these criteria.

Institute of Lighting Professionals (ILP) (2013) PLG 04 Guidance on Undertaking Environmental Lighting Impact Assessments

The aim of this guidance is to outline good practice in lighting design and provide practical guidance on the production and assessment of lighting impacts within new developments.

Guidance Note 08/ 18 Bats and artificial lighting in the UK – Bats and the Built Environment series

This guidance document was jointly published in 2018 by the ILP and BCT. It is intended to raise awareness of the impacts of artificial lighting on bats, and mitigation is suggested for various scenarios.



3 Environmental Zone Classification and Parameters

All standards consulted in section 2 are nationally recognised documents, (some internationally, also) which deal with all design issues associated with external lighting.

3.1 Environmental Zoning

The CIE Standards, the CIBSE and the Society of Light & Lighting guidance documents all apply a common Environmental Zoning system, which is summarised in Table 3.1 below.

TABLE 3.1: ENVIRONMENTAL ZONES			
Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Intrinsically dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO Starlight Reserves, IDA Dark Sky Parks/ Places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhibited rural areas. National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low District brightness (SQM 15 to 20)	Sparsely inhabited rural areas. Village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural or urban settlements. Small town centres or suburban locations
E4	Urban	High district brightness	Town/City centres and other commercial areas with high levels of night-time activity

3.2 Obtrusive Light Limitation for Exterior Lighting Installations

The ILP Guidance Notes for the Reduction of Obtrusive Light provide guidelines and threshold values applicable to each Environmental Zone, which are reproduced in tables 3.2 – 3.7 with associated notes.

Table 3.2 aims to address light intrusion by providing maximum values of vertical illuminance on properties. Limits apply to nearby dwellings, or potential dwellings, more specifically to their relevant surfaces or parts of surfaces, especially where windows are located. This parameter can also be considered for the management of spill light.

Table 3.3 aims to limit the luminous intensity of bright luminaires. It shows the maximum values for the luminous intensity of luminaires in designated directions where views of bright surfaces of luminaires are likely to be a nuisance to occupants of premises or from positions where such views are likely to be maintained, that is, not momentary or short-term.

Table 3.4 aims to limit the effects on transport systems, applying limits where users of road networks are subject to a reduction in the ability to see essential information.

Tables 3.5 and 3.6 aim to limit the effects of sky glow. The limits in table 3.5 represent the traditional method to limit sky glow, and have been widely used to assess sky glow prior to the guidance update in January 2020. The limits in table 3.5 are now intended to be applied to installations with up to three luminaires, or to compare single luminaires. The limits in table 3.6 are suggested to be applied to installations with four or more luminaires. However, there are likely to be a number of scenarios and installations where table 3.6 cannot be reasonably applied, as the types of installations listed are limited. In these instances, table 3.5 will be applied to the whole installation to limit and assess impacts in terms of sky glow.

Table 3.7 aims to limit the effect of over-lit building facades and signs. For illuminated advertising signs the aim should be to achieve the limits advised in PLG05.

TABLE 3.2: Maximum values of vertical illuminance on properties

Light technical parameter	Application conditions	Environmental Zones				
		E0	E1	E2	E3	E4
Illuminance in vertical plane (E_v)	Pre-curfew	n/a	2 lx	5 lx	10 lx	25 lx
	Post-curfew	n/a	<0.1 lx*	1 lx	2 lx	5 lx
Note: * If the installation is for public (road) lighting then this may be up to 1 lx.						

TABLE 3.3: Limits of the luminous intensity of luminaires in designated directions

Light technical parameter	Application conditions	Luminaire group (projected area A_P in m^2)					
		$0 < A_P \leq 0.002$	$0.002 < A_P \leq 0.01$	$0.01 < A_P \leq 0.03$	$0.03 < A_P \leq 0.13$	$0.13 < A_P \leq 0.50$	$A_P > 0.5$
Maximum luminous intensity emitted by luminaire (I in cd)	E0						
	Pre-curfew	0	0	0	0	0	0
	Post-curfew	0	0	0	0	0	0
	E1						
	Pre-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	2,500
	Post-curfew	0	0	0	0	0	0
	E2						
	Pre-curfew	0.57 d	1.3 d	2.5 d	5.0 d	10 d	7,500
	Post-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	500
	E3						
	Pre-curfew	0.86 d	1.9 d	3.8 d	7.5 d	15 d	10,000
	Post-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	1,000
	E4						
	Pre-curfew	1.4 d	3.1 d	6.3 d	13 d	26 d	25,000
	Post-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	2,500
Aid to gauging A_P		2 to 5cm	5 to 10cm	10 to 20cm	20 to 40cm	40 to 80cm	>80cm
Geometric mean of diameter (cm)		3.2	7.1	14.1	26.3	56.6	>80
Corresponding A_P representative area (m^2)		0.0008	0.004	0.016	0.063	0.251	>0.5

Notes:

1. d is the distance between the observer and the glare source in metres;
2. A luminous intensity of 0 cd can only be realised by a luminaire with a complete cutoff in the designated directions;
3. A_P is the apparent surface of the light source seen from the observer position
4. For further information refer to Annex C of CIE 150
5. Upper limits for each zone shall be taken as those with column $A_P > 0.5$

TABLE 3.4: Maximum values of threshold increment and viewing direction in the path of travel

Light technical parameter	Road classification*			
	No road lighting	M6/M5	M4/M3	M2/M1
Veiling luminance [†] (L_v)	0.037 cd/m ²	0.23 cd/m ²	0.40 cd/m ²	0.84 cd/m ²
Threshold increment	15% based on adaption luminance of 0.1 cd/m ²	15% based on adaption luminance of 1.0 cd/m ²	15% based on adaption luminance of 2.0 cd/m ²	15% based on adaption luminance of 5 cd/m ²

Notes:

* Road classifications as given in CIE 115:2010

† The veiling luminance values specified in this table are based upon on a permissible TI value of 15%

Definitions:

TI The measure of disability glare (the reduction in visibility caused by intense light sources in the field of view) expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare.

L_v The luminance that would need to be superimposed on a scene in object space to reduce the scene's contrast by an amount equal to the added retinal illuminance from scattered light on the scene's retinal image. It is most commonly used to describe the contrast-reducing effect of a glare source in the field of view.

TABLE 3.5: Maximum values of upward light ratio (ULR) of luminaires

Light technical parameter	Environmental Zones				
	E0	E1	E2	E3	E4
Upward light ratio (ULR)/%	0	0	2.5	5	15

Note:

This does not take into account the effect of light reflected upwards from ground that also contributes to sky glow. This is the traditional method to limit sky glow and is suitable to compare different single luminaires.

TABLE 3.6: Maximum values of upward flux ratio of installation (of four or more luminaires).

Light technical parameter	Type of installation	Environmental Zones				
		E0	E1	E2	E3	E4
Upward flux ratio (UFR)/%	Road	n/a	2	5	8	12
	Amenity	n/a	n/a	6	12	35
	Sports	n/a	n/a	2	6	15

Notes:

- Table 3.6 allows the effect of both direct and reflected upward components of a whole installation to be taken into account. The factor being the upward flux ratio (UFR) and CIE 150 suggests that table 3.6 is used for all installations consisting of four or more luminaires.
- Clauses 6.4.2 and 6.4.3 of CIE 150:2017 describe the calculation methods for both ULP and UFR.
- Light emitted just above the horizontal in a zone between 90° and 110° is extra critical for sky glow in large open areas around observatories. An additional measure in these areas limits the luminous intensities ($I_{90} - I_{110}$) as follows:
 - between 90° and 100° $< 0.5 \text{ cd}/1000\text{lm}$;
 - between 100° and 110° 0 cd.

TABLE 3.7: Maximum permitted values of average surface luminance (cd/m^2)

Light technical parameter	Application conditions	Environmental Zones				
		E0	E1	E2	E3	E4
Building façade luminance (L_b)	Taken as the product of the design average illuminance and reflectance divided by π	< 0.1	< 0.1	5	10	25
Sign luminance (L_s)	Taken as the product of the design average illuminance and reflectance divided by π , or for self-luminous signs, its average luminance	< 0.1	50	400	800	1000

Note:

The values apply to both pre- and post-curfew, except that in zones 0 and 1 the values shall be zero post curfew. The values for signs do not apply to signs for traffic control purposes.



4 Baseline Survey

4.1 Scope

The purpose of the baseline survey is to record existing light levels within the site to inform the Ecological Assessment and the locations of the proposed dark zones for the development.

This section outlines the methodology and results from the baseline survey which included a desk-top survey and site visit.

4.2 Assessment of Existing Environmental Zone

The site has been assessed to be located within Environmental Lighting Zone E1, representative of a location within an AONB. The site is located at the edge of the Cotswolds AONB.

However, it should be noted that the majority of the site is bounded by lit roads and development with lighting conditions being more representative of an E2 Zone, with the developed areas that bound the site being representative of an E3 zone / suburban location. at the boundaries.

This zone assessment has been based on the ILP guidance (refer to table 3.1), and the results of the baseline lighting survey.

4.3 Methodology

A day and night-time site visit were undertaken on 15th January 2021 to ascertain the levels of illuminance at the sensitive ecological features within the site. A record was made of the types of lighting installations present within the Site, and immediate surrounding area.

The weather conditions were cloudy but dry during the day and evening. Night-time measurements were taken between 8pm - midnight.

An evening as close to the New Moon phase as possible was selected as 'natural' ambient light levels from the moon will be as low as possible, allowing any 'artificial' ambient lighting levels from surrounding lighting, light aura or sky glow etc. to be measured as accurately as possible. This provides a baseline upon which any new lighting effects will be additive. (The survey was conducted two nights after the New Moon phase. The moon phase was a 6% waxing crescent.)

Natural ambient light from moon light will have an additive effect to the lighting levels measured during the survey depending on the phase of the moon and sky conditions. The typical level of illuminance at ground level from a full moon on a clear night in the UK is 0.35 lux.

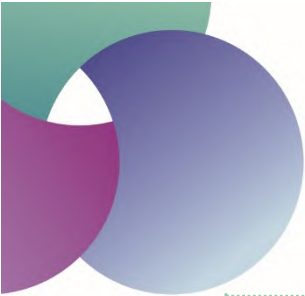
Survey locations were selected in measured intervals, and at identifiable peaks, along the hedgerow boundaries, and at selected locations within the site. Measurements of point illuminance were recorded at each of the survey locations. These were recorded horizontally on the ground, and at 1.5m in the vertical plane in the four compass directions, North, South,



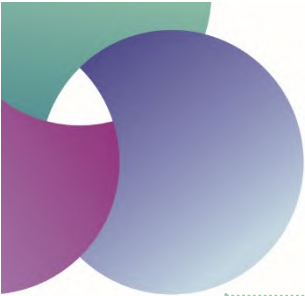
East and West at each location. Measurements were taken using a calibrated Konica Minolta T-10A Illuminance Meter (Serial no: 30018095/20016053).

GPS coordinates were recorded at each survey location and are listed in table 4.1. (NB: Measured GPS coordinates generally have an accuracy of within 3m.)

TABLE 4.1: ECOLOGICAL RECEPTOR SURVEY LOCATIONS	
Survey Location Reference	Survey Location Description
E01	SO 96570 22608
E02	SO 96612 22590
E03	SO 96676 22565
E04	SO 96775 22529
E05	SO 96799 22526
E06	SO 96814 22527
E07	SO 96865 22524
E08	SO 96960 22521
E09	SO 97017 22518
E10	SO 97066 22521
E11	SO 97103 22532
E12	SO 97210 22523
E13	SO 97227 22504
E14	SO 97308 22497
E15	SO 97312 22435
E16	SO 97238 22411
E17	SO 97229 22457
E18	SO 97224 22456
E19	SO 97232 22412
E20	SO 97237 22401
E21	SO 97308 22422
E22	SO 97312 22316
E23	SO 97309 22142
E24	SO 97289 22165
E25	SO 97268 22187
E26	SO 97258 22194
E27	SO 97232 22209
E28	SO 97192 22230
E29	SO 97184 22271



E30	SO 97182 22309
E31	SO 97177 22350
E32	SO 97177 22386
E33	SO 97157 22361
E34	SO 97168 22338
E35	SO 97174 22298
E36	SO 97179 22258
E37	SO 97182 22230
E38	SO 97142 22241
E39	SO 97105 22244
E40	SO 97066 22251
E41	SO 97028 22251
E42	SO 96989 22256
E43	SO 96979 22300
E44	SO 96978 22337
E45	SO 96971 22377
E46	SO 97086 22341
E47	SO 96975 22416
E48	SO 96969 22455
E49	SO 96961 22494
E50	SO 96947 22519
E51	SO 96956 22479
E52	SO 96967 22443
E53	SO 96967 22404
E54	SO 96964 22366
E55	SO 96968 22329
E56	SO 96968 22287
E57	SO 96964 22263
E58	SO 96926 22257
E59	SO 96888 22261
E60	SO 96847 22273
E61	SO 96826 22304
E62	SO 96819 22341
E63	SO 96819 22381
E64	SO 96817 22422
E65	SO 96816 22460



E66	SO 96811 22499
E67	SO 96808 22520
E68	SO 96848 22520
E69	SO 96888 22519
E70	SO 96928 22520
E71	SO 97080 22517
E72	SO 97117 22510
E73	SO 97129 22442
E74	SO 97124 22361
E75	SO 97095 22350

Refer to the Baseline Lighting Survey Location Plan in Appendix B.

4.4 Baseline Conditions within the Site and Surrounding Area

The site is currently unlit. Although there are buildings associated with Oakley Farm, there is no operational lighting on site.

There is LED street lighting along Harp Hill immediately to the south of the site. A number of the street lights are located directly adjacent to the boundary hedgerow, and others are positioned on the opposite side of the road.

There is also high pressure sodium street lighting in Pillowell Close, and Brockweir Road. There is LED Street lighting to the various roads within the residential development to the north east of the site.

There is column mounted sodium lighting within the Sainsburys car park directly to the north of the lane.

The west of the site is immediately bounded by an unlit standalone footpath/ Public Right of Way. In addition to the site's boundary hedgerow, there is an additional hedgerow that is located to the west of the footpath, which both screen any light spill to the site from the residential properties in Wessex Drive.

To the eastern end of the northern site boundary, and the northern section of the eastern boundary, the back gardens of residential properties bound the site, with a boundary treatment that predominantly consists of close boarded fencing. A number of these properties have security style floodlighting, amenity lighting, and garden lighting.

The following images within this section of the report show the luminaire types within the immediate surrounding of the site.

Section 4.5 details the measurements of illuminance recorded at each survey location.

The measurements recorded show that the majority of the site is dark with the exception of the access lane, and areas along the northern and southern boundaries.



Considering the southern boundary, levels of illuminance of greater than 0.5 lux were recorded at 7 survey locations, and levels of illuminance greater than 0.2 lux were recorded at 2 locations. Light spill in excess of 0.5 lux was recorded up to 10m from the southern boundary. This is due to gaps and thinning in the southern hedgerow boundary, the hedgerow height, and the street lights along Harp Hill being located directly adjacent to this boundary in a number of places. Levels of illuminance recorded may potentially be higher than would be recorded in summer months, due to the survey being undertaken during the winter when the hedgerows were not in leaf.

The majority of the access lane is above 0.5 lux, with light spill from the Sainsbury's car park lighting, and from street lighting in the residential development to the north (Pillowell Close). Levels of illuminance were greater than 0.5 lux at survey location E11 along the northern boundary, where there is a break in the boundary vegetation, and light spill from street lights along Brockweir Road impact the site.

Levels of illuminance at survey location E14 in the north east corner of the site, were greater than 0.2 lux, which is caused by light spill from street lighting in Bream Court. Levels of illuminance to the northern and eastern boundaries of this small field in the north east corner of the site, and along the eastern boundary, have the potential to be higher than recorded as many of the residential properties adjacent to the boundary have amenity lighting and security floodlighting that was not switched on at the time of the survey.



Figures 4.1 and 4.2 – show the LED street lighting along the B4075 Priors Road, at the entrance to the current access lane to the site. The same type of street lighting is present along Harp Hill.



Figures 4.3 and 4.4 – show an example of the column mounted lighting in the Sainsbury's car park north of the site access lane.



Figures 4.5 and 4.6 – show an example of the high pressure sodium street lighting to Pillowell Close to the north of the site.



Figures 4.7 -4.10 – shows the high pressure sodium street lighting to Brockweir Road, and the gaps in the northern boundary vegetation.



Figures 4.11 and 4.12 – show an example of security floodlighting to residential properties along the eastern boundary.



Figures 4.13 – 4.16 – show examples of amenity lighting to residential properties along the eastern boundary.



Figures 4.17 and 4.18 – show the southern hedgerow boundary with Harp Hill.

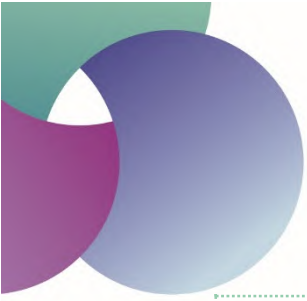


Figure 4.19 – shows the southern hedgerow boundary with Harp Hill with an example of an LED street light along Harp Hill.

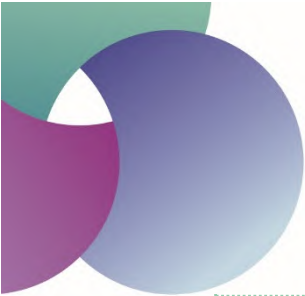
4.5 Measurements of Illuminance at Ecological Receptor Survey Locations

Table 4.2 summarises the levels of illuminance recorded at each survey location. (Levels of illuminance recorded that equal or exceed 0.5 lux have been coloured red, and 0.2 lux have been coloured orange.)

TABLE 4.2: ECOLOGICAL RECEPTOR LOCATIONS - LEVELS OF ILLUMINANCE RECORDED					
Survey Location Reference	Horizontal Illuminance at Ground level	Vertical Illuminance at 1.5m			
		N	E	S	W
E01	2.58	4.53	1.39	0.11	0.86
E02	3.45	2.98	3.85	0.37	0.27
E03	0.18	1.19	0.78	0.03	0.04
E04	0.07	0.02	0.23	0.10	0.00
E05	0.91	0.14	1.66	1.03	0.04
E06	1.70	1.38	1.32	0.08	0.09
E07	0.88	1.08	1.01	0.10	0.04
E08	0.04	0.12	0.10	0.00	0.02
E09	0.00	0.00	0.00	0.00	0.01
E10	0.01	0.06	0.01	0.00	0.02
E11	0.46	0.62	0.06	0.02	0.11
E12	0.01	0.00	0.00	0.00	0.02
E13	0.00	0.00	0.00	0.00	0.01
E14	0.01	0.33	0.25	0.01	0.03
E15	0.01	0.03	0.00	0.00	0.02
E16	0.01	0.02	0.00	0.00	0.00
E17	0.01	0.01	0.01	0.00	0.00
E18	0.01	0.03	0.00	0.00	0.03
E19	0.00	0.02	0.00	0.00	0.01
E20	0.00	0.00	0.01	0.02	0.00
E21	0.00	0.00	0.00	0.01	0.01
E22	0.00	0.02	0.00	0.00	0.03
E23	2.52	0.40	0.06	0.61	2.66
E24	0.82	0.06	0.21	0.61	1.04
E25	0.45	0.03	0.60	0.40	0.61
E26	2.18	0.08	0.10	2.53	0.36



E27	0.71	0.05	0.26	0.37	0.05
E28	0.09	0.01	0.18	0.06	0.05
E29	0.00	0.00	0.01	0.02	0.00
E30	0.00	0.01	0.01	0.00	0.00
E31	0.00	0.00	0.00	0.00	0.00
E32	0.00	0.00	0.00	0.00	0.00
E33	0.00	0.00	0.00	0.00	0.00
E34	0.00	0.01	0.00	0.00	0.02
E35	0.00	0.01	0.00	0.00	0.03
E36	0.04	0.02	0.00	0.06	0.04
E37	4.98	0.10	0.08	3.29	0.50
E38	0.51	0.07	0.69	0.12	0.04
E39	0.01	0.03	0.00	0.00	0.03
E40	0.01	0.03	0.00	0.00	0.02
E41	0.12	0.03	0.00	0.07	0.11
E42	0.13	0.01	0.07	0.19	0.08
E43	0.02	0.02	0.02	0.02	0.01
E44	0.02	0.02	0.01	0.02	0.00
E45	0.02	0.02	0.01	0.01	0.03
E46	0.02	0.02	0.00	0.01	0.03
E47	0.01	0.02	0.00	0.00	0.02
E48	0.01	0.02	0.00	0.00	0.02
E49	0.00	0.00	0.00	0.00	0.00
E50	0.01	0.01	0.00	0.01	0.02
E51	0.02	0.03	0.00	0.01	0.03
E52	0.03	0.03	0.00	0.01	0.04
E53	0.02	0.04	0.00	0.01	0.04
E54	0.02	0.04	0.00	0.01	0.04
E55	0.02	0.04	0.00	0.01	0.04
E56	0.02	0.04	0.00	0.02	0.05
E57	0.01	0.04	0.00	0.00	0.04
E58	0.19	0.05	0.02	0.03	0.04
E59	0.27	0.03	0.00	0.06	0.03
E60	0.21	0.03	0.00	0.39	0.02
E61	0.03	0.02	0.01	0.00	0.00
E62	0.01	0.02	0.01	0.01	0.00



E63	0.01	0.01	0.00	0.00	0.00
E64	0.01	0.03	0.01	0.00	0.00
E65	0.02	0.03	0.01	0.00	0.02
E66	0.01	0.03	0.02	0.00	0.00
E67	0.02	0.00	0.00	0.00	0.00
E68	0.02	0.00	0.00	0.00	0.02
E69	0.01	0.02	0.01	0.01	0.02
E70	0.01	0.01	0.00	0.01	0.02
E71	0.01	0.06	0.04	0.00	0.01
E72	0.01	0.05	0.02	0.00	0.02
E73	0.01	0.03	0.01	0.00	0.00
E74	0.01	0.00	0.02	0.00	0.00
E75	0.00	0.00	0.00	0.00	0.00



5 Proposed Lighting Strategy

5.1 General

The Proposed Development will require lighting for safety, amenity and security during the hours of darkness. This section outlines the requirements for the lighting design, ensuring that it is fit for purpose and sensitive to ecological and environmental receptors.

The external lighting and street lighting proposed for the development will be designed in accordance with industry standards, guidance and recommendations in order to provide an adequate level of illuminance for security, safety and amenity throughout the site, whilst limiting obtrusive light, over-lighting, energy consumption and impacts on the environment and ecological receptors.

The key sources of external lighting for the operational phase of the proposed development will be Street lighting to the Section 38 adoptable roads within the site, and lighting associated with the residential properties.

It is assumed that private roads and drives will predominantly remain unlit, or where necessary be provided with lower levels of illuminance, and luminaires with lower mounting heights than Section 38 adoptable standards require.

5.2 Recommended Lighting Levels

The design standards recognise road lighting in three classes; traffic routes where the needs of the driver are dominant, subsidiary roads where the lighting is primarily intended for the pedestrian and the cyclist, and urban centres, where the lighting is designed to enhance public safety and security, while also providing an attractive night time environment (SLL Lighting Handbook). The photometric recommendations for all types of road lighting in the UK are given in BS EN 13201: Part 2. Advice on implementation of these recommendations is given in BS5489-1. The adoptable roads within the site will be designed in accordance with these recommendations and Gloucestershire County Council's specification and requirements, as far as possible whilst also considering the ecological constraints within the site.

An indicative street lighting strategy has been prepared for the planning application stage based on the assumption of a P5 classification throughout the residential roads, with an average level of illuminance of 3 lux and a minimum of 0.6 lux, and a P6 classification to the cycle/footpath, with an average level of illuminance of 2 lux and a minimum of 0.4 lux. (Refer to Appendix D)

The street lighting strategy has been prepared using Lighting Reality Outdoor Software. This software is used within the industry and by Councils to design street lighting. It is limited in that solid objects and level changes cannot be included within the calculation model.

5.3 Strategy for Luminaire Type and Light Source

The luminaires selected for the street lighting to the residential roads within the development will be provided in accordance with Gloucestershire County Council's specification, which are currently Urbis Ampera Mini luminaires with 3000K warm white LED light sources. These will be mounted on 6m columns. The footpath/ cycle way is proposed to be lit with a combination



of the column mounted luminaires used for the roads, mounted on 5m columns, and low level 1m high LED 3000K bollards with back shields, to minimise light spill and the impact onto the proposed dark zones for bats.

The street lighting luminaires will have good light control and cut off angles to reduce light spillage, control glare and limit sky glow. The Upward Light Output Ratio of the street lighting luminaires will be 0%, and they will be mounted horizontally with no upward tilt to minimise sky glow. The bollards proposed are specialist downward directional bollards with 0.3% Upward Light Output Ratio with 180 degree back shields, to minimise impacts on bats and in terms of sky glow.

Building mounted lighting to the residential properties will be LED with warm white colour temperatures (3000K or less), and downward directional with 0% Upward Light Output Ratios to minimise the impacts on bats and to comply with the requirements for an E1 Environmental Zone.

5.4 External Luminaire Control Strategy

It is expected that the adoptable street lighting will operate on a CMS (Central Management System) with a residential dimming profile, whereby the street lights will dim to 30% of their total light output from midnight to 5:30am, in accordance with Gloucestershire County Council's Street Lighting Policy.

Building mounted luminaries to the residential properties will operate via PIR (movement) detection.

5.5 Mitigating the Impacts in terms of Obtrusive Light

The proposed lighting shall be designed in accordance with the limiting criteria for an E1 Environmental Zone, as detailed in Section 3.2, in order to limit obtrusive light and light pollution.

5.6 Mitigating the Impacts on Flora and Fauna

Various areas within the site have been identified as being ecologically sensitive, with light sensitive Lesser Horseshoe bats present on site. Areas and corridors to remain dark, where levels of illuminance of <0.5 lux is required have been identified on the Proposed Dark Corridors Plan in Appendix C. Levels of illuminance are required to be <0.5 lux, or no greater than the existing levels of illuminance, within the identified dark zones. At locations where the dark corridors cross the roads or footpath/cycleway light spill is to be minimised as far as possible.

The street lighting strategy (Appendix C) demonstrates how light spill onto the dark corridors can be minimised, with integral backshields utilised, and careful positioning at bat crossing points to space street lights as far from the crossing point as possible, whilst achieving the required lighting standard. The dimming regime will further reduce impacts between midnight and 5:30am.

It is proposed that the existing boundary hedgerows and vegetation will be enhanced to provide additional screening from existing light sources outside the site onto the proposed



dark corridors, particularly along the southern and northern boundaries. The proposed landscape strategy will also introduce additional trees and hedgerows to aid the connectivity of the dark corridors, with trees being planted either side of the road/ footpath at bat crossing points.

Levels of illuminance from lighting within the site onto the proposed dark zones will be limited to <0.5 lux by adopting the additional mitigation measures described below.

- No artificial lighting to be proposed to private drives/ roads located within the proposed dark zones.
- Private external lighting to residential properties adjacent to the proposed dark zones to be carefully positioned, and limited in number. No private external lighting will be provided to rear and side elevations that are adjacent to proposed dark zones. It is recommended that covenants are put in place to prevent lighting being added to these elevations in the future in order to maintain the dark zones.
- Private external lighting to residential properties to operate by PIR (movement) detectors.
- Luminaires to the residential properties to be specified as downward directional with 0% Upward Light Output Ratios.
- If any additional low level lighting is required to private drives, roads or parking courts, specialist downward directional bollard luminaires will be utilised.
- All external lighting will utilise LED lights sources, with warm white colour temperatures of 3000K or less.
- Careful consideration to be given to the locations and orientations of proposed dwellings located adjacent to the proposed dark zones. Where possible these should be positioned with their gable end elevation facing the dark zone. Where the front or rear elevations of any proposed dwellings face the dark zones, sufficient offsets will be required between the two.
- Screening to be provided to the edges of the dark zones in the form of vegetation, hedgerows, and hedge banks, with temporary fencing where required until the vegetation matures to a minimum height of 2m. The landscape strategy shall be coordinated with the lighting strategy at the reserved matters stage to minimise light spill onto the proposed dark zones.
- Additional screening such as 1.8m close boarded fencing to be provided to rear and side garden extents that face the dark zones, where necessary.
- If required, recessed lighting should be provided in properties adjacent the proposed dark zones. Typically, downlight luminaires used, and sold for use, in residential properties will have beam angles of 30-40 degrees. The recessed nature of downlights, and smaller beam angles reduces light spill, compared with pendant luminaires.
- Consideration may also be given to window locations, head heights and size, to reduce impacts from internal light spill into the proposed dark zones.

It is anticipated that separate detailed analysis, including lighting calculations and assessment will be provided at the reserved matters application stage to ensure that light spill from



external lighting and internal light spill from buildings will meet the ecological requirements outlined.



6 Conclusion/ Summary

The Lighting Strategy outlines the criteria for the proposed lighting within the site, and mitigation measures proposed to reduce the impacts in terms of ecological receptors.

The site has been assessed as Environmental Zone E1, with the lighting strategy outlining a scheme and parameters that will comply with the limiting criteria for that zone, in order to limit obtrusive light and light pollution to an acceptable level.

The external lighting and street lighting proposed for the development will be designed in accordance with industry standards, guidance and recommendations in order to provide an adequate level of illuminance for security, safety and amenity throughout the site, whilst limiting obtrusive light, over-lighting, energy consumption and impacts on the environment and ecological receptors.

Luminaries utilised throughout the scheme will be downward directional with LED light sources, with warm white colour temperatures, to minimise the impacts on ecological receptors and dark skies within the AONB.

The measurements recorded as part of the baseline lighting survey show that the majority of the site is dark with the exception of the access lane, and areas along the northern and southern boundaries.

Levels of illuminance from lighting within the site onto the proposed dark corridors for bats will be limited to <0.5 lux, or no greater than the existing levels of illuminance, within the identified dark zones by the lighting strategy and mitigation measures outlined in Section 5. At locations where the dark corridors cross the roads or footpath/cycleway light spill will be minimised as far as possible.

It is anticipated that separate detailed analysis, including lighting calculations and assessment will be provided at the reserved matters application stage to ensure that light spill from external lighting and internal light spill from buildings will meet the ecological requirements outlined. Post installation monitoring and checks to verify that the light levels and parameters are in accordance with the Lighting Strategy outlined, are also anticipated.

APPENDIX A

Lighting Terminology





Lighting Terminology

For the purpose of this report, the definitions given below apply:

CIBSE: Chartered Institute of Building Services Engineers

Colour Rendering Index (CRI): A scale of the colour appearance of an object under a particular light source compared to its colour appearance under a reference light source. Expressed on a scale of 1 to 100 Ra, where 100 Ra represents the colour rendering of natural daylight i.e. perfect colour.

Illuminance: Illuminance is the quantity of light, or luminous flux, falling on a unit area of a surface. It is designated by the symbol E. The unit is the lux (lx). One lux equals one lumen per square metre (lm/m²).

Light Pollution: The spillage of light into areas where it is not required.

Light Intrusion: Light that impacts on a surface outside of the area designed to be lit by a lighting installation.

Disability Glare: Glare which impairs the vision of objects but may not cause discomfort.

Discomfort Glare: Glare causing discomfort which may not impair the ability to see objects.

Photocell: A unit which senses light to control luminaires.

Curfew: The time after which stricter requirements (for the control of obtrusive light) will apply; often a condition of use of lighting applied by a government controlling authority, usually the local government (CIE, 2003).

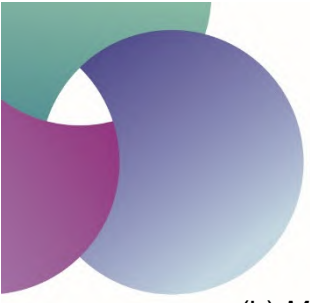
Environmental Zones: Area where specific activities take place or are planned and where specific requirements for the restriction of obtrusive light are recommended. Zones are indicated by the zone rating (E1... E4) (CIE, 2003).

Obtrusive Light: Spill light which because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information (CIE, 2003).

Residential Property: Land upon which a dwelling exists (CIE, 2003).

Sky Glow: The brightening of the night sky caused by artificial lighting resulting from the reflection of radiation (visible and non-visible), scattered from the constituents of the atmosphere (gas molecules, aerosols and particulate matter), in the direction of observation. It comprises two separate components as follows:

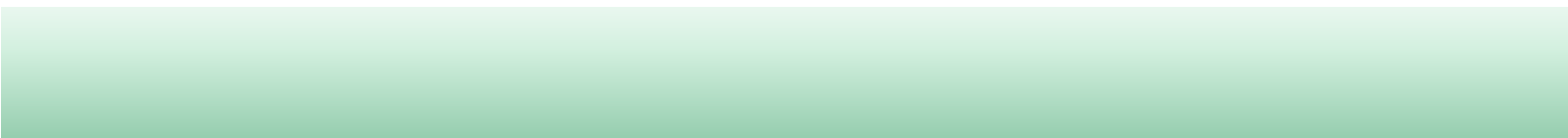
(a) *Natural sky glow* - That part of the sky glow which is attributable to radiation from celestial sources and luminescent processes in the Earth's upper atmosphere.



(b) *Man-made sky glow* - That part of the sky glow which is attributable to man-made sources of radiation (e.g. outdoor electric lighting), including radiation that is emitted directly upwards and radiation that is reflected from the surface of the Earth (CIE, 2003).

Spill Light (Stray Light): Light emitted by a lighting installation which falls outside the boundaries of the property for which the lighting installation is designed (CIE, 2003).

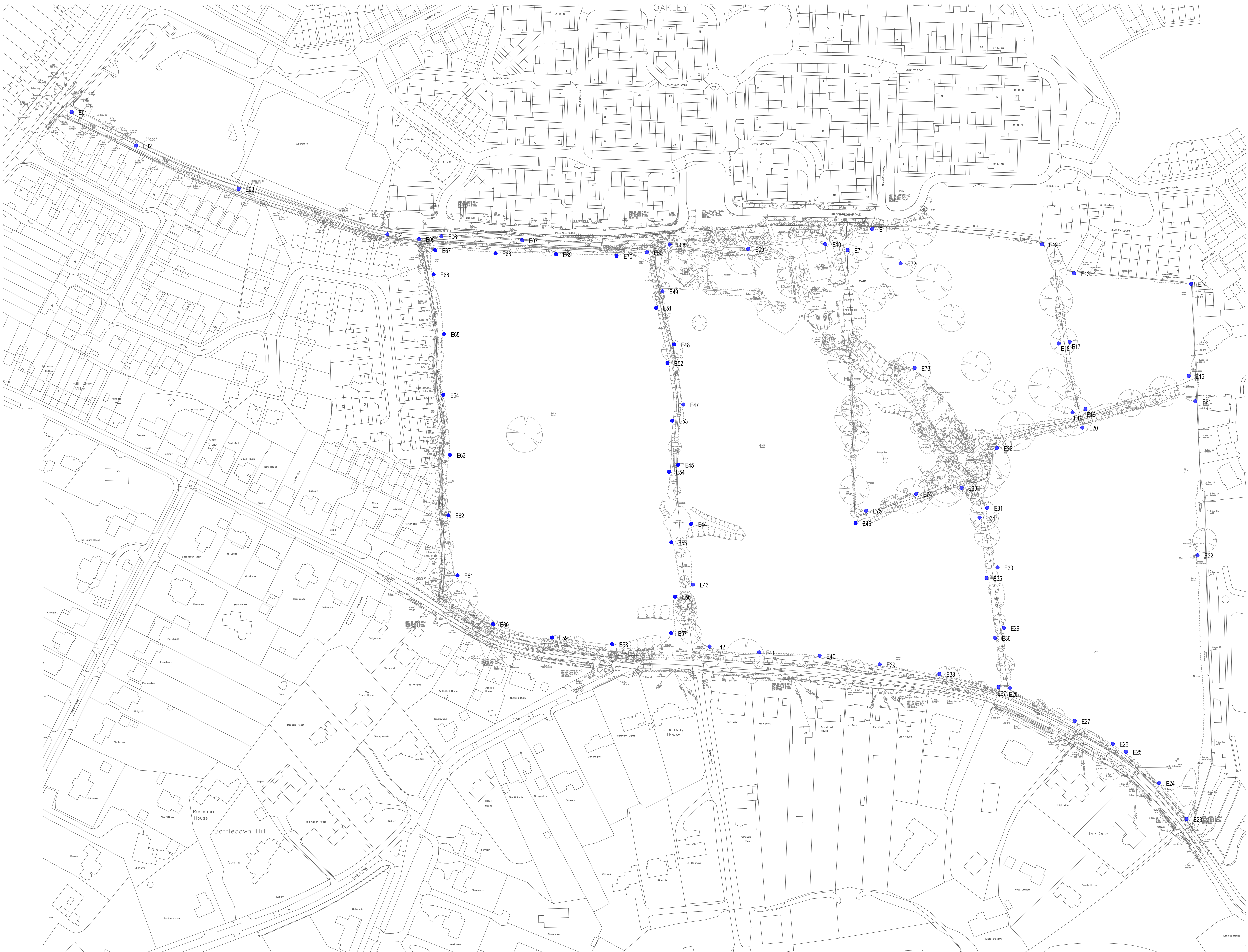
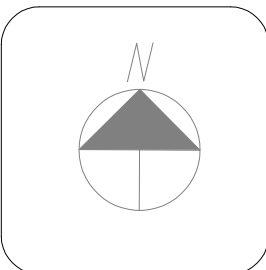
Upward Light Ratio: The maximum permitted percentage of luminaire flux for the total installation that goes directly into the sky.



APPENDIX B

Baseline Lighting Survey Location Plan





LEGEND

 SURVEY LOCATION

NOTES

- POSITIONS SHOWN ON LOCATION PLAN ARE INDICATIVE. PLEASE REFER TO BASELINE SURVEY REPORT AND GPS LOCATIONS

P01	FIRST ISSUE	MB	28/01/21
Rev	Details	Dm / Chkd	Date



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Client
ROBERT HITCHENS LIMITED

Project
LAND OFF HARP HILL
BATTLEDOWN

Drawing Title
BASELINE SURVEY
LOCATION PLAN

Scale at A1
1:1250

Discipline
LIGHTING

Job Number
4218

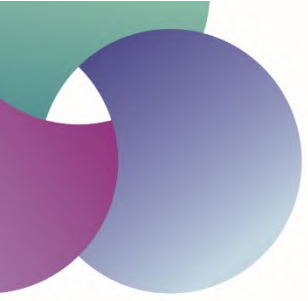
Job Status
PLANNING

Issue
P01

Drawing Number
4218-ID-DR-1001

APPENDIX C

Proposed Dark Corridors Plan and Site Illustrative Masterplan



Based upon the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright. Ecology Solutions Ltd, Farncombe Estate, Broadway, Worcestershire, WR12 7LJ. CEIM20130000228



KEY:

- SITE BOUNDARY
- PROPOSED DARK CORRIDORS (0.5 LUX MAX)
- BAT ROAD CROSSINGS

NOTE: BAT ROAD CROSSING POINTS WILL BE DESIGNED IN DETAIL TO MINIMISE ILLUMINATION AND REDUCE LIGHT SPILL INTO DARK CORRIDORS WHICH WILL ALLOW BATS TO CROSS THESE AREAS SAFELY.





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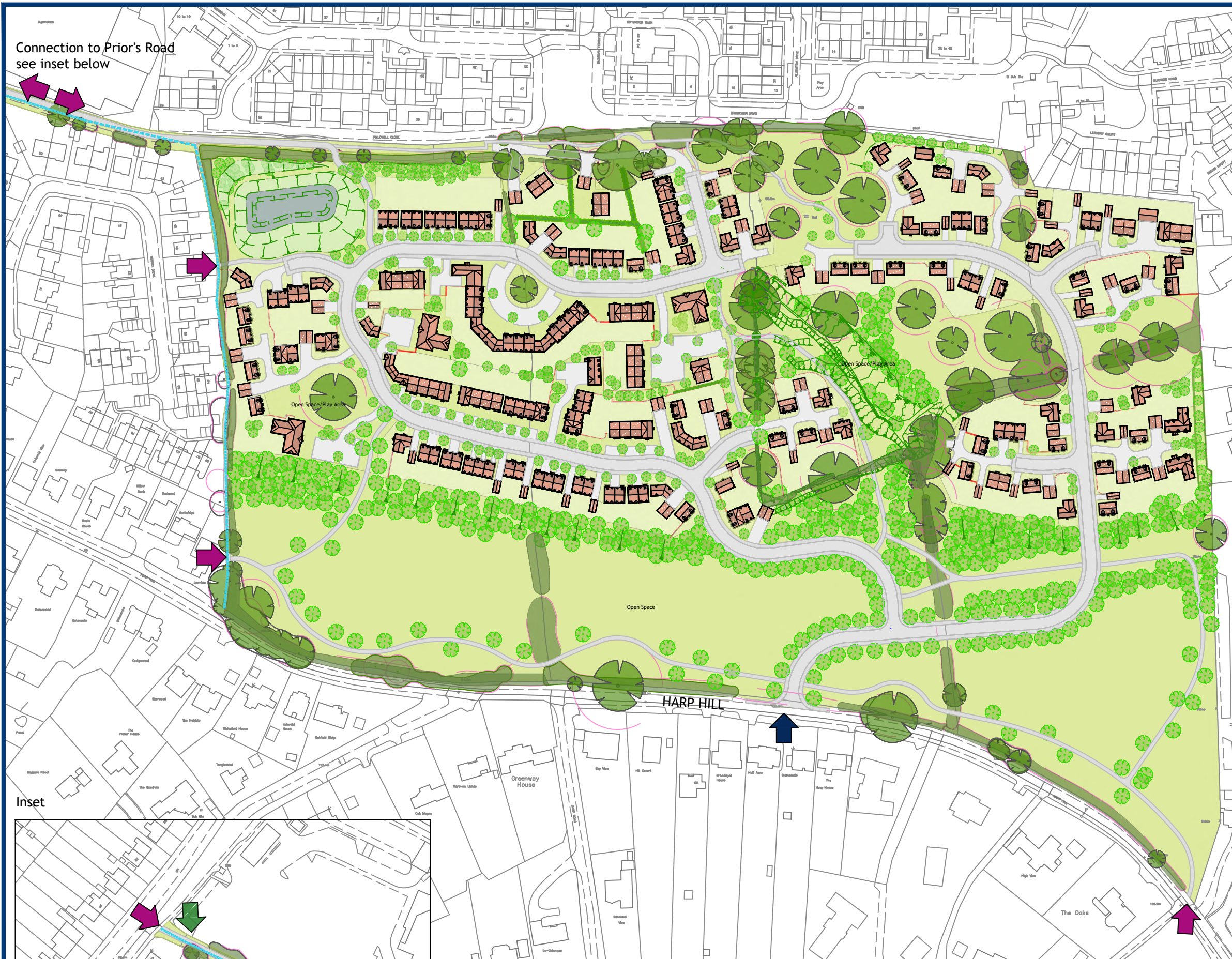
Farncombe House
Farncombe Estate | Broadway
Worcestershire | WR12 7LJ

+44(0)1451 870767
info@ecologysolutions.co.uk
ecologysolutions.co.uk

**7807: LAND AT OAKLEY FARM,
BATTLEDOWN, CHELTENHAM**

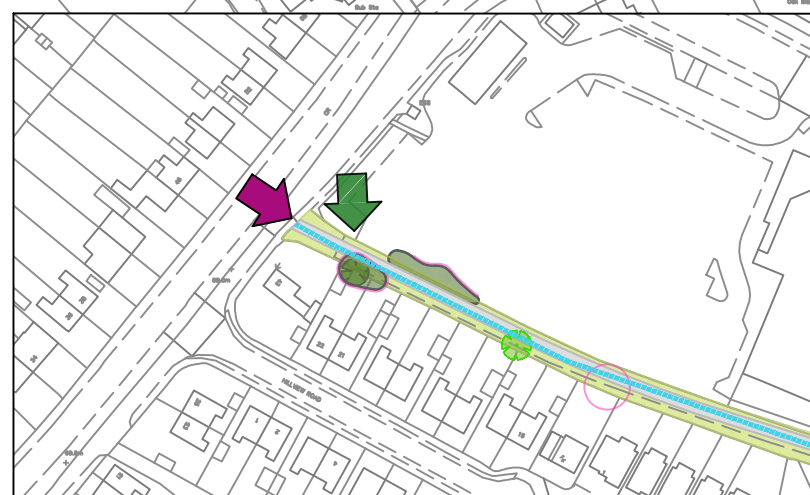
**PLAN ECO3:
PROPOSED DARK CORRIDORS**

Rev: B
Feb 21



Connection to Prior's Road
see inset below

Inset



- Key:**
- Existing Public Right of Way
 - Principal Access
 - Pedestrian Access
 - Possible Emergency Access
 - Existing Trees Retained
 - Existing Hedgerow Retained
 - Proposed Trees
 - Proposed New Native Hedgerows
 - Residential
 - Garages
 - Proposed Indicative Landscaped Drainage Pond
 - Primary Street (with road narrowing to avoid Root protection Zones)
 - Re-graded land with new tree planting
 - Proposed Bound Gravel footpaths should be designed to minimise the section of hedgerow to be removed.
 - Proposed 3m cycle link to Prior's Road
 - Root Protection Areas

Site Name: Land at Oakley Farm		Drawing Number: 333.P.3.9		Revision: E
Drawing Title: Illustrative Masterplan		Drawn By: POK	Date: 01.08.2019	Scale: 1:2000@A3

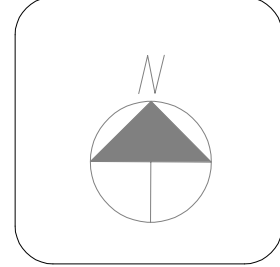
Robert Hitchins
The Complete Development Solution

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APPENDIX D

Street Lighting Strategy





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ISOLINE LEGEND

- = 10 LUX
- = 5 LUX
- = 4 LUX
- = 2 LUX
- = 1 LUX
- = 0.5 LUX
- = 0.2 LUX

LUMINAIRE LEGEND

- X1A** IP68 3000K LED LUMINAIRE POST TOP MOUNTED ON A 6M COLUMN, AS URBIS AMPERA MINI 16 LED 350mA (2.01 km) C/W 5118 OPTIC. COLUMN TO BE MANUFACTURED BY CU PHOSCO PART NO. FR2506T01S355SL2.
- X1B** IP68 3000K LED LUMINAIRE POST TOP MOUNTED ON A 6M COLUMN, AS URBIS AMPERA MINI 16 LED 350mA (2.01 km) C/W 5118 OPTIC AND INTEGRAL BACK LOUVRES/SHIELD. COLUMN TO BE MANUFACTURED BY CU PHOSCO PART NO. FR2506T01S355SL2.
- X2** IP68 3000K LED LUMINAIRE POST TOP MOUNTED ON A 5M RAISE AND LOWER COLUMN, AS URBIS AMPERA MINI 16 LED 350mA (1.0 km) C/W 5118 OPTIC. 5M POST TOP MID FLEX COLUMN TO BE MANUFACTURED BY MALLATITE.
- X3** IP68 3000K 1M HIGH DOWNWARD DIRECTIONAL, LED BOLLARD LUMINAIRE C/W 180° BACKSHIELD, AS DW WINDSOR PHAROLA DS (0.43 km).

ALL STREET LIGHTING COLUMNS ARE TO BE HOT DIPPED GALVANISED TO BS EN ISO 1461 AND ARE TO HAVE THE PAINT PROTECTION SYSTEM APPLIED INTERNALLY AND EXTERNALLY AT THE PLACE OF MANUFACTURE. DACTYLATE 2 PINK IN ACCORDANCE WITH GCC SPEC TABLE 10.3. ALL STREET LIGHTING COLUMNS TO HAVE THE FOLLOWING PAINT COLOUR APPLIED: COLUMN SHAFT BS4800 12B21 (LIGHT GREEN), COLUMN BASE BS4800 12B23 (DARK GREEN).

ALL LANTERNS TO BE PROVIDED COMPLETE WITH A PHILIPS XITANUM LED DRIVER WITH CONSTANT LIGHT OUTPUT (CLO) AND DALI DIMMABLE PROGRAMMABLE DIMMING.

ALL LANTERNS TO BE PROVIDED COMPLETE WITH A PIN NEMA SOCKET AND A 5 PIN TELESEA OPS ENABLED CMS 20mm DIAMETER TELECELL, PRODUCT CODE: T2E1N-G-3. CMS SYSTEM SHALL BE INSTALLED THAT DIMS AS FOLLOWS: DUSK TILL 12AM - NO DIMMING
12AM TILL 5:30AM - DIM TO 30% OF TOTAL LIGHT OUTPUT
5:30AM TILL DAWN - NO DIMMING

NOTES

- SECTION 38 STREET LIGHTING FOR THE RESIDENTIAL ROADS HAS BEEN DESIGNED TO BS 5489:2013 CLASS P5 (3 LUX EAV AND 0.5 LUX MIN). FOOTPATH CYCLEWAY HAS BEEN DESIGNED TO CLASS P5 (2 LUX EAV/0.4 LUX MIN).
- LUMINAIRES, COLUMNS, CONTROLS AND EQUIPMENT FOR SECTION 38 STREET LIGHTING TO BE PROVIDED IN ACCORDANCE WITH GLOUCESTERSHIRE COUNTY COUNCIL REQUIREMENTS.
- FOR FULL SECTION 38 STREET LIGHTING SPECIFICATION REFER TO GLOUCESTERSHIRE COUNCIL DOCUMENTATION. REFER MANUAL FOR GLOUCESTERSHIRE STREETS SECTION 10.
- THE DESIGN MITIGATES THE IMPACT ON THE REQUIRED DARK ZONES FOR BATS WITHIN THE SITE. LOW LEVEL DOWNWARD DIRECTIONAL BOLLARDS ARE PROPOSED TO A SECTION OF THE FOOTPATH / CYCLEWAY TO MINIMISE THE IMPACT ON BATS. ALL LUMINAIRES WILL BE LED 3000K WARM WHITE TO MINIMISE THE IMPACT ON BATS.
- LEVELS OF ILLUMINANCE ARE CALCULATED AND SHOWN HORIZONTALLY AT GROUND LEVEL.
- THIS DRAWING SHOWS THE LUMINAIRES AT FULL OUTPUT WITH A MAINTENANCE FACTOR OF 1.10 TO REPRESENT THE WORST CASE SCENARIO FOR ASSESSMENT PURPOSES.
- COLUMNS SHOULD BE SITED IN ACCORDANCE WITH BS 5489, AND GENERALLY BE PLANTED IN THE FOOTPATH AT THE REAR OR IN THE ABSENCE OF A FOOTPATH, A MINIMUM OF 0.8 METRES FROM THE KERB EDGE TO THE FACE OF THE COLUMN, AND WITHIN THE HIGHWAY TO BE ADOPTED.
- COLUMN DOORS TO BE INSTALLED SO THAT THE DOOR APERTURE IS FACING AWAY FROM ONCOMING TRAFFIC SO AS TO PROVIDE SAFETY FOR OPERATIVES WORKING ON THE UNIT.
- REFER TO ACCOMPANYING DESIGNERS RISK ASSESSMENT FOR DETAILS OF DESIGN RISKS IDENTIFIED.

P01	FIRST ISSUE	MB	BB	03/03/21
Rev	Details	Dm / Cms	Date	

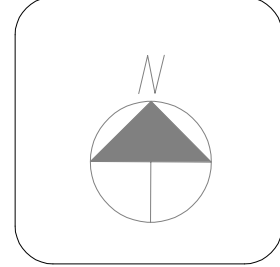


Client: ROBERT HITCHENS LIMITED

Project: LAND OFF HARP HILL, BATTLEDOWN

Drawing Title: STREET LIGHTING STRATEGY
FULL OUTPUT SHOWN (MF=1)
SHEET 1 OF 2

Scale at:	A0 @ 1:500
Discipline:	LIGHTING
Job Code:	4218
Status:	PLANNING
Drawing Number:	4218-ID-DR-2001



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- = 5 LUX
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- = 0.5 LUX
- = 0.2 LUX

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- X1B** IP68 3000K LED LUMINAIRE POST TOP MOUNTED ON A 6M COLUMN, AS URBIS AMPERA MINI 16 LED 300mA (2.01 km) CW 5118 OPTIC. COLUMN TO BE MANUFACTURED BY CU PHOSCO PART NO. FR2508T01S355SL2.
- X2** IP68 3000K LED LUMINAIRE POST TOP MOUNTED ON A 5M ARM AND LOWER COLUMN, AS URBIS AMPERA MINI 8 LED 300mA (1.0 km) CW 5118 OPTIC. 5M POST TOP MID FLEX COLUMN TO BE MANUFACTURED BY MALLATITE.
- X3** IP68 3000K 1M HIGH DOWNWARD DIRECTIONAL LED BOLLARD LUMINAIRE CW 180° BACKSHIELD, AS DW WINDSOR PHAROLA DS (0.43 km).

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P01	FIRST ISSUE	MB / SB	03/02/21
Rev	Details	Dm / Chgd	Date



Client: **ROBERT HITCHENS LIMITED**

Project: **LAND OFF HARP HILL BATTLEDOWN**

Drawing Title: **STREET LIGHTING STRATEGY FULL OUTPUT SHOWN (MF=1) SHEET 2 OF 2**

Scale at:	A0 @ 1:500
Discipline:	LIGHTING
Job Code:	4218
Status:	PLANNING
Drawing Number:	4218-ID-DR-2002



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e c o l o g y s o l u t i o n s f o r p l a n n e r s a n d d e v e l o p e r s