HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

6.4.67 ES Volume D - WNDA Development App D10-10 - Environmental Lighting Impact Assessment

PINS Reference Number: EN010007

Application Reference Number: 6.4.67

June 2018

Revision 1.0

Regulation Number: 5(2)(a)

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-JAC-PAC-APP-00159

[This page is intentionally blank]

Contents

List of Appendices

List of Tables

List of Figures

1 Environmental Lighting Impact Assessment

1.1 Introduction

1.1.1 This Environmental Lighting Impact Assessment (ELIA) covers the likely lighting effects that would result from the construction, operation and decommissioning of the WNDA Development, which includes the Power Station, the Marine Works, the Site Campus and other on-site development as described in chapter A1 (introduction) (Application Reference Number: 6.1.1) of the Environmental Statement.

1.1.2 This ELIA has been undertaken by competent lighting professionals and covers lighting impacts such as light spill, glare, and sky glow that may arise from new lighting installations. The ELIA includes predictions of the magnitude of change in light conditions, and where appropriate assesse the significance of effects on sensitive receptors. Types of receptors considered include dark skies, nearby communities and ecological receptors.

1.1.3 The reporting of this ELIA has been structured taking into account the Institute of Lighting Professionals' (ILP) *PLG04 Guidance on Undertaking Environmental Lighting Impact Assessments* [RD1] (abbreviated to 'PLG04' in this report) and therefore differs slightly from the assessment chapters in volume D (Application Reference Number: 6.3.1 to 6.3.7) of the Environmental Statement through the inclusion of a sub-section on 'site description' (section 1.2), which provides an overview of the lighting context in the area and the aspects of the Wylfa Newydd Project that could introduce new lighting.

Terminology

1.1.4 The lighting terminology specific to this assessment is set out in the glossary in Annex 1-1. However, the following terminology concerning types of light pollution is relevant to the understanding of this assessment.

- Obtrusive light: Obtrusive light (sometimes also referred to as light pollution) is light that hinders or bothers the human eye.
- Glare: Glare is a result of light emitted from a source that is in sharp contrast to its surroundings.
- Spill light: This is illuminance falling beyond the area that is being lit. Spill light is quantifiable and measurable, and is used to define levels of light trespass.
- Sky glow: This is the visible haze or glow seen above a lighting installation that reduces the ability to view the darkened night-time sky. Sky glow is a combination of light emitted upwards from a light source and reflected light cast downwards from the surface being illuminated reflecting off particles suspended in the atmosphere. The degree of sky glow experienced is dependent on weather conditions. When there is low cloud cover, more particles are present in the atmosphere to scatter the reflected light, increasing the appearance of sky glow. On a clear night, there are less particles present, reducing the appearance of sky glow.

1.2 Site description

1.2.1 This section provides an overview of the Wylfa Newydd Project context, including the light-sensitive receptors of relevance to the ELIA.

1.2.2 The WNDA Development would be constructed within the Wylfa Newydd Development Area, and as described in chapter A1 (Application Reference Number: 6.1.1) includes the Power Station, the Marine Works, the Site Campus and other on-site development. Lighting would be required for the construction, operation and eventual decommissioning of the facilities. Lighting would be required to enable safe working conditions. This would include the lighting of work areas, security lighting as well as aircraft warning lights for tall structures such as the cranes during construction. During operation, there would be lighting of the rooms and other facilities. During operation, construction and decommissioning, external lighting would be required for safe access and for security. Specific details of the indicative lighting strategy that have been considered as part of this ELIA are set out in section 1.5. Given the scale of the development, and the extensive area covered by the Wylfa Newydd Development Area (in excess of 400 hectares), the Wylfa Newydd Project has the potential to considerably influence the lighting context of the area, and therefore the design of lighting requires careful consideration to limit its influence.

1.2.3 The surrounding area is not a pristine environment however. The Existing Power Station, which is in the process of being decommissioned, already emits considerable levels of light. The existing lighting conditions of the Existing Power Station have therefore been assessed as part of the baseline assessment reported in section 1.4 of this report.

1.2.4 The Wylfa Newydd Project is set in the context of the Isle of Anglesey, which is predominantly a rural county that still has some of the darkest skies in the United Kingdom [RD2]. The Isle of Anglesey Area of Outstanding Natural Beauty's (AONB) Joint Advisory Committee is working towards gaining Dark Sky Reserve status for Anglesey as a whole. For this reason, the potential influence on the night-sky environment is a particular consideration for the development of the lighting strategy for the WNDA Development.

1.2.5 The AONB covers approximately one third of the Isle of Anglesey, including most of the coastline, with the notable exception of land between the Existing Power Station and Cemaes. While the majority of the Wylfa Newydd Development Area lies outside of the AONB, the western margin of the site does lie within it. The close proximity of the AONB is therefore a key consideration for the lighting strategy, given the sensitivity of the AONB as a landscape receptor (refer to chapter D10, landscape and visual, Application Reference Number: 6.4.10, for further information).

1.2.6 There are a number of designated nature conservation sites and other ecological interests that may be sensitive to lighting from the Wylfa Newydd Project. This includes Cemlyn Bay which is covered by the following types of designation: Site of Special Scientific Interest (SSSI); Special Area of Conservation (SAC); and Special Protection Area (SPA). Cemlyn Bay supports breeding tern species. The importance of the breeding colonies of

terns and their surrounding habitat is recognised through the designation of the Morwenoliaid Ynys Môn/Anglesey Terns SPA.

1.2.7 The nearest settlements, Tregele and Cemaes, both abut the boundary of the Wylfa Newydd Development Area. There would be potential for residents within these settlements and surrounding farms to be exposed to obtrusive light (nuisance) in the absence of suitable control measures in the design of the lighting scheme for the Wylfa Newydd Project.

1.2.8 The understanding of the above site context has influenced the scope of assessment and the selection of an appropriate study area for the ELIA. The priority areas for survey and assessment are set out below in table 1-1 with an explanation of how these aspects have been assessed through the ELIA.

[This page is intentionally blank]

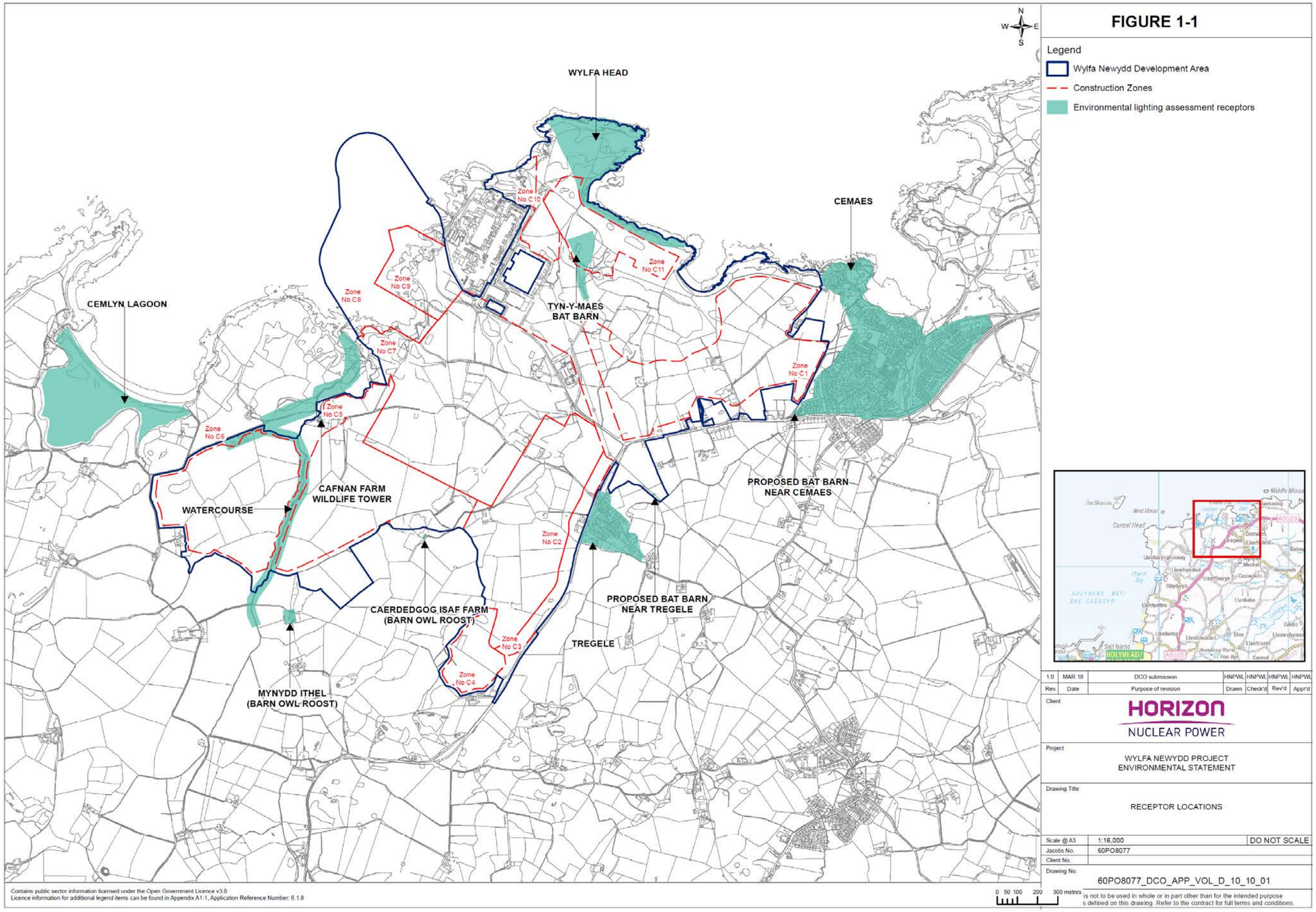


FIGURE 1-1
Legend
Wylfa Newydd Development Area
Construction Zones
Environmental lighting assessment receptors
N
W
E
S
WYLFA HEAD
CEMAES
CEMLYN LAGOON
TYN-Y-MAES BAT BARN
Zone No C10
Zone No C11
Zone No C9
Zone No C8
Zone No C7
Zone No C6
Zone No C5
Zone No C1
Zone No C2
Zone No C3
Zone No C4
CAFNAN FARM WILDLIFE TOWER
WATERCOURSE
CAERDEDGOG ISAF FARM (BARN OWL ROOST)
MYNYDD ITHEL (BARN OWL ROOST)
TREGELE
PROPOSED BAT BARN NEAR CEMAES
PROPOSED BAT BARN NEAR TREGELE
Contains public sector information licensed under the Open Government Licence v3.0
Licence information for additional legend items can be found in Appendix A1-1, Application Reference Number: 6.1.8
0 50 100 200 300 metres
1.0 MAR 18 DCO submission HNPWL HNPWL HNPWL HNPWL
Rev. Date Purpose of revision Drawn Check'd Rev'd Appr'd
Client
HORIZON NUCLEAR POWER
Project
WYLFA NEWYDD PROJECT
ENVIRONMENTAL STATEMENT
Drawing Title
RECEPTOR LOCATIONS
Scale @ A3 1:16,000 DO NOT SCALE
Jacobs No. 60PO8077
Client No.
Drawing No. 60PO8077_DCO_APP_VOL_D_10_10_01
is not to be used in whole or in part other than for the intended purpose
s defined on this drawing. Refer to the contract for full terms and conditions.

[This page is intentionally blank]

1.3 Method of assessment

Guidance

1.3.1 The following documents provide the principal guidance which has informed the approach to the ELIA:

- ILP. 2013. Guidance on Undertaking Environmental Lighting Impact Assessments [RD1] (PLG04).
- ILP. 2011. Guidance Notes for the Reduction of Obtrusive Light GN01:2011 [RD3].
- ILP. 2007. Technical Report 28. Guidelines for Measurement of Lighting Performance on Site [RD4].
- Isle of Anglesey County Council (IACC). March 2010. Supplementary Planning Guidance: Design in the Urban and Rural Built Environment, Guidance Note 10: Lighting [RD2].
- Snowdonia National Park Authority. October 2016. Supplementary Planning Guidance, Guidance Note 14, Obtrusive Lighting (Light Pollution) [RD5].

Study area

1.3.2 There is no specific guidance on determining a study area for an ELIA. The study area applied for this ELIA incorporates the Wylfa Newydd Development Area and extends as far as the distance where modelling indicates that illuminance sourced from lighting associated with the construction and operation of the WNDA Development could exceed a threshold of 0.1lux. The threshold of 0.1lux has been selected as a threshold below which there is no potential for likely significant effects since this is the maximum illumination typically provided by the full moon. The spill light has been modelled based on the preliminary lighting strategy for construction and operation (refer to section 1.5).

1.3.3 The landscape and visual assessment for the WNDA Development (refer to chapter D10, Application Reference Number: 6.4.10) has applied a larger study area to capture potential night-time visual effectss from distant visual receptors. This is because for the night-time visual effects assessment, the study area is determined by potential changes in view, rather than changes in light levels at the receptor site. The night-time viewpoints are presented in appendix D10-9 (night-time viewpoints) (Application Reference Number 6.4.66).

Assessment priorities and approach

1.3.4 A receptor-based approach has been made to enable the potential effects of lighting, based on the indicative design, to be assessed. In this way, the need for additional mitigation to be applied to the detailed design has been identified to address significant adverse effects.

1.3.5 The identification of potential receptors was informed through a combination of desk study and consultation. Information on the baseline for dark skies was sought from the IACC, while advice on the potential locations of light-sensitive ecological and landscape receptors was sought from the landscape architects responsible for the landscape and visual assessment of the WNDA Development and ecologists working on the environmental assessment and Habitats Regulations Assessment (HRA).

1.3.6 To assess effects on light-sensitive receptors, it is necessary to understand the existing sources of light pollution. Therefore, baseline sources of light pollution were also identified through desk-study and were the subject of the baseline survey work undertaken to inform the assessment.

1.3.7 The key baseline sources of light, and light-sensitive receptors covered by this ELIA are summarised in table 1-1 together with a commentary on how they have been considered in this ELIA.

Table 1-1 Summary of assessment priorities and approach

Priority for assessment	Assessment aspect	Reason for selection and how considered in this ELIA
Existing Power Station	Source (Baseline source of lighting)	The Existing Power Station is a major source of existing lighting within close proximity of the Wylfa Newydd Development Area. Understanding the level of light emitted by the Existing Power Station is a key component of the baseline assessment against which to assess the likely effects of the Wylfa Newydd Project. The Existing Power Station has therefore been considered as part of the baseline assessment.
Dark skies	Receptor	The AONB Joint Advisory Committee is working towards gaining Dark Sky Reserve status for Anglesey as a whole. For this reason, 'dark skies' have been considered as a potential receptor. The potential effect of lighting from activities associated with the WNDA Development on dark skies has been assessed based on a description of the design basis and activities (see section 1.5) and commentary on the level of upward lighting predicted from the indicative design.
Cemlyn Bay	Receptor	Cemlyn Bay is covered by statutory nature conservation designations: SSSI; SAC; and, SPA. In particular, it supports colonies of breeding tern species which are qualifying features of the Morwenoliaid Ynys Môn/Anglesey Terns SPA. An assessment of the lighting effects in relation

Priority for assessment	Assessment aspect	Reason for selection and how considered in this ELIA
		to this species has been undertaken to inform the Shadow HRA Report (Application Reference Number: 5.2) by ascertaining whether there is potential to exceed the 0.1lux threshold at the tern colony location and to inform whether additional mitigation is required.
Wylfa Head and the marine environment	Receptor	The coastline and marine environment around Wylfa Head is covered by the Morwenoliaid Ynys Môn/Anglesey Terns SPA. The potential effect of lighting on fish has been identified by the Shadow HRA Report (Application Reference Number: 5.2) as an issue since fish provide a food source for the terns. An assessment of the lighting effects on the marine environment beyond the proposed breakwater (see section 1.5) has been undertaken to inform the Shadow HRA Report (Application Reference Number: 5.2) and whether additional mitigation is required.
Terrestrial and freshwater habitats associated with fish, bats, barn owls and otters.	Receptor	Several locations in and around the Wylfa Newydd Development Area have been identified with the potential for light-sensitive ecological receptors. These include watercourses which provide potential habitat for fish and otter, as well as foraging corridors for bats. There are also some bat roosts and barn owl nesting sites, including buildings which provide compensatory roost habitat which were created as part of another, unrelated project. The light-sensitive ecological locations are indicated on figure 1-1. Reference should be made to (chapter D9, Application Reference Number: 6.4.9) for specific information on the ecological interests present at these sites.
Communities of Tregele and Cemaes	Source (Baseline sources of lighting) Receptor	Tregele and Cemaes are the nearest communities to the Wylfa Newydd Development Area. They are both sources of existing lighting within close proximity of the Wylfa Newydd Development Area. The average levels of light in these locations has been established as part of the baseline assessment against which to

Priority for assessment	Assessment aspect	Reason for selection and how considered in this ELIA
		assess the likely effects of the Wylfa Newydd Project. Due to their close proximity, these communities are also potentially sensitive receptors to light that may be emitted from activities within the Wylfa Newydd Development Area.
Night-time viewpoints	Receptor	A series of representative night-time viewpoints has been identified through the landscape and visual assessment for the WNDA Development (refer to chapter D10, Application Reference Number: 6.4.10). The assessment of predicted light changes within the Wylfa Newydd Development Area has informed the assessment of night-time visual effects, which is a qualitative assessment set out in appendix D10-7 (Application Reference Number: 6.4.64). The night-time viewpoints are presented in appendix D10-9 (Application Reference Number: 6.4.66).

Method of baseline survey

1.3.8 Baseline survey work was conducted to carry out a night-time lighting level survey of the Existing Power Station site and relevant sensitive receptor locations, and to gather existing information on the exterior lighting visible in these locations.

1.3.9 The survey locations were visited to make notes describing existing lighting, establish the Environmental Zone and take illuminance measurements and photographs where applicable.

1.3.10 Surveys were initially undertaken on the 17, 18 and 19 October 2016. However, access restrictions prevented taking light measurements at some locations. Further baseline surveys were conducted 8 to 11 January 2018 to obtain additional light measurements and to update the understanding of the current baseline conditions.

1.3.11 Most of the illuminance level measurements were taken whilst the roads, footways and perimeters were free from obstructions, as the presence of objects can cause reflection and shadow which can create an inaccurate lighting level reading.

1.3.12 Temperatures were recorded as a number of light sources can be affected by cold. Generally, the effect is a reduced lumen output.

1.3.13 The selected survey locations were first visited during the day to assess safety for the night-time visit and to confirm the location for the photograph to be

taken. A daytime photograph was taken before returning after dark for the night-time photograph. Each 'night-time' photograph was taken with the same International Standards Organisation (ISO) light sensitivity setting (3200), exposure setting (1/5 second) and aperture setting (f3.5) so that the images are all directly comparable.

Light measurements

1.3.14 The lighting equipment around the different survey locations varied in height, type and spacing and is therefore not consistent visually or with regards to light output so the approach to measuring the light levels has needed to be in a grid formation.

1.3.15 In line with the ILP's *Technical Report 28 guidelines Measurement of Lighting performance on Site* [RD4], illuminance measurements were taken in grids defined by the boundary of the areas under investigation. The grid spacing used was 5m x 5m with the first grid point located no more than 1m from the perimeter of the area being measured. For footpaths two to three grid points at equal distances were chosen along the length surveyed. For pedestrian crossings, six grid points with grid spacing no greater than 5m between points were chosen within the extents of the crossing. The working plane used was floor or ground level.

1.3.16 The measurements for the 2018 surveys were recorded on a calibrated light meter (light meter: Hagner E2X, calibrated on 3 January 2017).

Survey conditions

1.3.17 The survey was conducted with activities at the Existing Power Station site being in operation. Most of the illuminance level measurements were taken whilst the roads, footways, pedestrian crossings and car parking areas were free of vehicles and pedestrians.

1.3.18 The weather was dry and around 5°C. There was very little moisture in the air and visibility was high. The sky was mostly free from cloud.

Approach to assessment

1.3.19 The ELIA has predicted how light levels would change in relation to the sensitive receptors as a result of the construction, operation and eventual decommissioning of the WNDA Development. It has taken account of the design and anticipated activities involved in the construction, operation and decommissioning, as well as the embedded and good practice mitigation. At this stage, the design is indicative and therefore some assumptions on the realistic worst case have been made to help inform the assessment. The design, activities, embedded mitigation and assumptions that have informed the assessment, are set out in section D1.5. The assessment process has been used to inform the additional mitigation measures set out in section D1.7. The residual effects have then been predicted, based on the assumption that the additional mitigation would be successfully implemented as part of the detailed design, construction and operation of the proposals.

1.3.20 The assessment of effects takes account of elements such as:

- illumination of roads, accesses, parking areas, buildings and other aspects of the WNDA Development;
- light spill;
- source intensity; and
- light presence.

1.3.21 The focus of this lighting assessment has been to identify the degree of change from the baseline and to assess the significance of this in relation to sensitive receptors, including dark skies.

Environmental Zones

1.3.22 The identification of ambient night-time Environmental Zones is crucial to the process of lighting assessment [RD1]. The concept of Environmental Zones was introduced in the 1990s by the Commission Internationale de l'Eclairage and has since been updated by the ILP in 2011 [RD1].

1.3.23 Table 1-2 sets out the range of Environmental Zones. The classification of Environmental Zones enables an appropriate lighting limit for those areas to be determined.

Table 1-2 Environmental Zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark	UNESCO Starlight Reserves, International Dark Skies Award Dark Sky Parks
E1	Natural	Intrinsically dark	National Parks, AONBs, etc.
E2	Rural	Low district brightness	Village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Small town centres or suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

Calculating potential light levels

1.3.24 Lighting Reality Pro software (version 1.8) has been adopted to calculate the illuminance contours (light spill). It is the latest version and conforms to all major international standards, such as EN13201:2015 and BS5489:2013 (www.lightingreality.com). This is one of the standard software packages used in industry to simulate lighting designs. A separate model was created in DIAlux (version 4.12) for the Marine Off-Loading Facilities (MOLF) cranes as the Operational phase model already contained the Lighting Reality Pro maximum limit of 500 luminaires per model. DIAlux is one of the standard software packages used in British Industry to simulate lighting designs.

Assessment criteria

1.3.25 The assumption in this assessment is that any increase in light is adverse. However, it should be noted that there would be circumstances where some people might find an increase in light in some locations to be beneficial, for example, for reasons of safety.

1.3.26 The degree of change (magnitude) has been assessed using a seven-point scale set out in table 1-3. This relates to the scale of change predicted at the assessment locations, irrespective of the sensitivity of the location or presence of sensitive receptors. The scale is based on guidance in PLG04 [RD1] although the terminology has been adapted from PLG04 to align to that used elsewhere in the Environmental Statement for magnitude (i.e. 'major' has been changed to 'large'; 'moderate' has been changed to 'medium' and so forth to reflect the terminology in table B1-2 chapter B1 (introduction to the assessment process, Application Reference Number 6.2.1).

1.3.27 In accordance with Figure B1-2 and the methodology described in chapter B1 (Application reference Number: 6.2.1), the determination of significance of effects has been assessed by taking into account the sensitivity of receptors that would be affected by the predicted magnitude of change in light levels. For example, although the magnitude of change may be large, if the receptor affected is not particularly sensitive to light, the significance may be minor. In contrast, for a receptor that has a high sensitivity to light, even a small change in light levels may be significant.

1.3.28 This ELIA provides an assessment of significance in relation to potential effects on dark skies as well as on the communities of Cemaes and Tregele, which due to their proximity to the Wylfa Newydd Development Area are potential receptors of obtrusive light. The sensitivity of dark sky and community receptors has been derived using professional judgement. Where a receptor location is already intrinsically dark, it has been judged to be high in terms of sensitivity, since a small amount of new light would be more noticeable. Locations which are already subject to substantial lighting or light pollution have been considered to be less sensitive to new lighting effects.

1.3.29 This ELIA does not assess significance in relation to ecological or night-time viewer receptors. Instead, it provides an assessment of magnitude for changes in lighting levels to inform the assessment of effects on terrestrial and freshwater ecology (Application Reference Number: 6.4.9), marine ecology (Application Reference Number: 6.4.13), the shadow Habitats Regulations Assessment (Application Reference Number: 5.2) and on night-time views as reported in the landscape and visual chapter (Application Reference Number: 6.4.10). Reference should be made to those assessments for the predicted significance of lighting effects on specific receptors.

Table 1-3 Criteria for determining magnitude of lighting change

Nature of change	Magnitude level	Criteria
Beneficial	Large	Substantial improvement in night environment and/or reductions in glare, spill light and sky glow.

Nature of change	Magnitude level	Criteria
	Medium	Noticeable improvement in night environment and/or reductions in glare, spill light and sky glow.
	Small	Slight improvement in night environment and/or reductions in glare, spill light and sky glow.
Neutral	None/negligible	Barely perceptible change in lighting or overall effects balancing out.
Adverse	Small	Slight increase in visibility of lighting, glare and sky glow.
	Medium	Noticeable increase in visibility of lighting, glare and sky glow.
	Large	Substantial problems with increase in visibility of lighting, glare and sky glow.

Limitations

1.3.30 This assessment has been informed by indicative design information. The exact positions of columns and lanterns will not be confirmed until the detail design is completed. Assumptions on the average lighting levels for each area within the Wylfa Newydd Development Area were made in order to assess the potential obtrusive light on key receptor locations around the site.

1.3.31 Crane lighting was added into the calculation as this would contribute to the overall lighting levels on the site. By nature, cranes are not static and the booms would move, sometimes adding light in combination with other cranes. This would affect on-site lighting levels dependent on the crane positions. For assessment purposes, the maximum heights of the cranes have been applied, but in reality these cranes would vary their height.

1.3.32 The proposed mounds would help to reduce obtrusive light. However, it has not been possible to model all existing and proposed topography for this assessment using the Lighting Reality Pro software (version 1.8) due to limitations in the available 3D model and software compatibility. Some illuminance calculations have therefore been made based on calculated grids as a flat surface with no obstructions. Where it is known that there would be topographical or planting present, a judgement has been made as to how much this would reduce light spill.

1.3.33 It was not possible to access some of the proposed survey locations due to a lack of permission to visit some parcels of land (refer to annex 1-2 for details where permission to access could not be obtained). Therefore, other sources of information (aerial imagery and mapping) has been used to make assumptions on topography and other natural screening present.

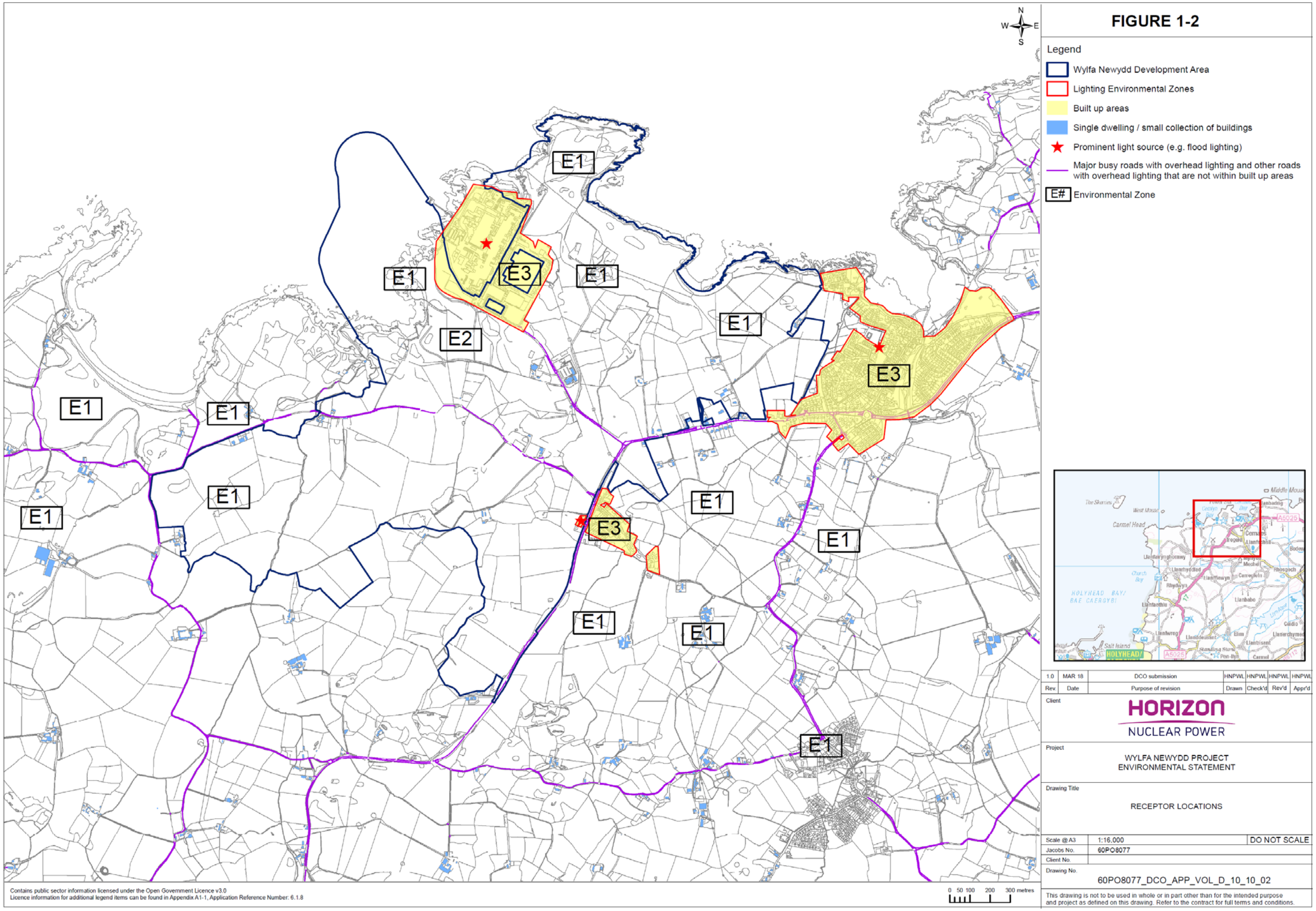
1.4 Baseline assessment

1.4.1 The baseline has been assessed through a combination of desk study, site visits, and light modelling (refer to section 1.3) to understand the current lighting context and how this context would develop in the absence of the Wylfa Newydd Project.

Environmental Zones

1.4.2 The majority of the Wylfa Newydd Development Area lies outside of the AONB and lies immediately adjacent to Cemaes. In addition, the Existing Power Station adjoins the boundary of the Wylfa Newydd Development Area. Taking into account the influence of these elements, it is considered that the Environmental Zone which best reflects the baseline for the Wylfa Newydd Development Area is Environmental Zone E2, 'Rural', meaning it has lighting conditions of low district brightness. Away from the Wylfa Newydd Development Area and into the AONB, there are judged to be class E1 Environmental Zones (intrinsically dark). Figure 1-2 indicates the Environmental Zones deemed present in the baseline.

[This page is intentionally blank]


N
W
E
S
E1
E1
E3
E1
E1
E2
E3
E1
E1
E1
E1
E3
E1
E1
E1
E1
E1
E1
Contains public sector information licensed under the Open Government Licence v3.0
Licence information for additional legend items can be found in Appendix A1-1, Application Reference Number: 6.1.8
0 50 100 200 300 metres
FIGURE 1-2
Legend
Wylfa Newydd Development Area
Lighting Environmental Zones
Built up areas
Single dwelling / small collection of buildings
Prominent light source (e.g. flood lighting)
Major busy roads with overhead lighting and other roads with overhead lighting that are not within built up areas
E# Environmental Zone
Middle Mouse
The Skerries
West Mouse
Carmel Head
Cemaes
Tregele
Llanfechell
Llanbadrig
A5025
Llanfairynghornwy
Mynydd Mechell
Llanrhyddlad
Llanfflewyn
Carreglefn
Rhosgoch
Church Bay
Rhydwyn
HOLYHEAD BAY/ BAE CAERGYBI
Llanbabo
Llanfaethlu
Cefdio
Llanfwrog
Llanddeusant
Elim
Llanerchymedd
Llanbabo
Salt Island
HOLYHEAD/
A5025
Standing Stone
Pen-llyn
Carmel
Llantrisant
1.0 | MAR 18 | DCO submission | HNPWL | HNPWL | HNPWL | HNPWL
Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd
Client
HORIZON
NUCLEAR POWER
Project
WYLFA NEWYDD PROJECT
ENVIRONMENTAL STATEMENT
Drawing Title
RECEPTOR LOCATIONS
Scale @ A3 | 1:16,000 | DO NOT SCALE
Jacobs No. | 60PO8077
Client No.
Drawing No. | 60PO8077_DCO_APP_VOL_D_10_10_02
This drawing is not to be used in whole or in part other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.

[This page is intentionally blank]

Baseline light sources

Existing Power Station

1.4.3 Access to survey the Existing Power Station was gained on 8 January 2018. Due to security restrictions it is not permitted to show the location of specific lighting arrangements and therefore a description of the average lighting levels and general lighting conditions is provided.

1.4.4 The Existing Power Station site has a variety of light sources ranging from low pressure sodium lamps and high pressure sodium lamps, LED and even fluorescent tubes along with various types of light fittings including bulk head fittings, floodlights and street lighting luminaires. The lighting installations also vary with regards to luminaire tilt, ranging between 0 – 45° and luminaire mounting heights start as low as 3m with the highest being 8m. These variances in the lighting result in a spectrum of colour and temperature ranges often appearing as a mismatch of light creating a strobing effect which contributes to the appearance of sky glow from the buildings.

1.4.5 The internal and external perimeter lighting is created using a low pressure sodium lighting source with a glass bowl lens. This arrangement on the internal perimeter fence creates a yellow glow around the main reactor building with the light reflecting up the surface of the building into the night sky.

1.4.6 The majority of the lighting on the site is old and some poorly maintained. This older technology contributes to upward glare as some of the current lighting has very poor upward light cut-off. It was also noted during the survey that poor maintenance has left some of the lighting inoperable which gave an inaccurate perception of what the existing lighting would be if all were maintained to a minimal level (keeping them on).

1.4.7 In the areas selected for light measurements, all luminaires were functioning correctly. When the results from these areas were simulated in a desktop study it showed the average lux levels on the site are in excess of 25lux.

1.4.8 The Existing Power Station is in the process of being decommissioned. According to the Environmental Management Plan prepared as part of the Existing Power Station decommissioning [RD6], during Care and Maintenance Preparations and Final Site Clearance, ‘further lighting may be necessary at times. Use of such lighting, which would only normally be used at the start and end of the working day during the winter months, will be at the discretion of the relevant Site Supervisor. Consideration will be given to the use of directional lighting to minimise any light spill. Existing levels of security lighting will be retained.’ It goes on to state that ‘During Care and Maintenance it is expected that there will be occasional low level ‘street’ lighting on service roads, provided for staff attending site during the hours of darkness, and lighting activated by site security systems.’ [RD6]. The presence of lighting at the Existing Power Station site is therefore anticipated to continue in the future baseline.

Cemaes and Tregele

1.4.9 Cemaes has numerous streetlights with a variety of light source types such as such as high pressure sodium, low pressure sodium and white light. The lighting equipment in all the locations surveyed was old with poor optical control and created a lot of direct upward light. Cemaes had had some LED white light conversions during the period between the 2016 survey and the 2018 survey but from the streets surveyed the degree of tilt on these lighting units was over 0° so light was being directly transmitted into the atmosphere, contributing to sky glow (figure 1-3).

Figure 1-3 Bridge Street, Cemaes. High pressure sodium street lights (left, October 2016) LED lights installed with tilt (right, January 2018)

1.4.10 The street lighting located in the village of Tregele also has poor lighting control. There is upward light pollution caused by the street lighting and there is an over lit petrol station located at the east side of the village.

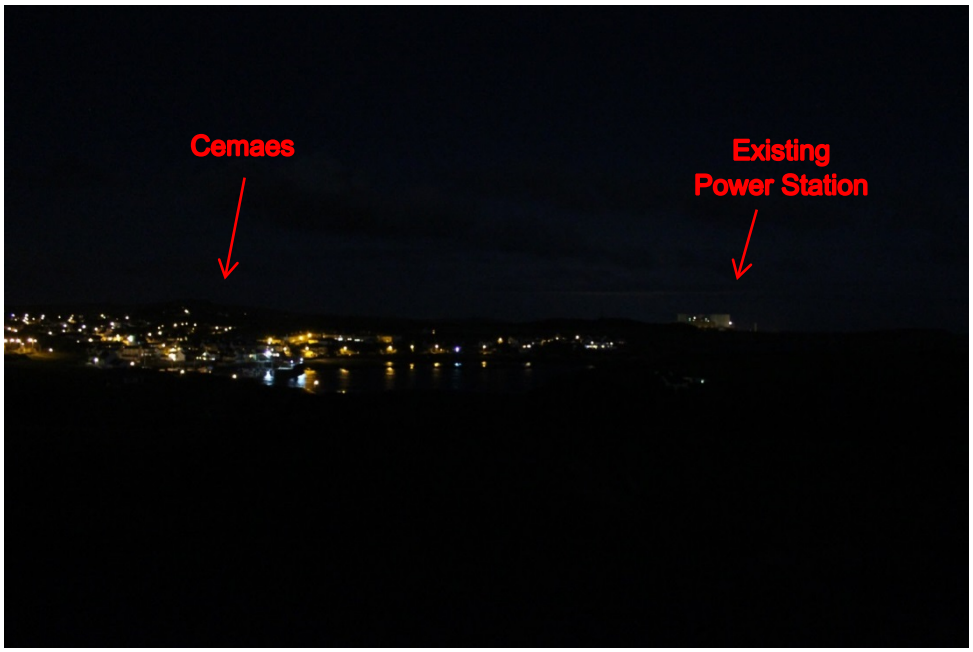
Baseline receptors

Dark skies

1.4.11 To inform a policy on ‘Dark Skies’, the IACC commissioned an assessment of the baseline conditions in 2015 [RD7]. The study, which involved measuring night sky quality at 60 pre-determined locations on Anglesey, found that 75% of the 60 sites surveyed met the IDA’s ‘Silver’ standard at the overhead (zenith) point. These are sites with moderately dark skies but with light pollution from the surrounding environment obvious from all sites. The remaining 25% of sites were of lower, IDA 'Bronze' status. When measurement of the whole sky was taken, 73% of the 60 surveyed sites reached Bronze level, with only 27% attaining the darker Silver level. The very darkest sites on Anglesey were found to be few in number with very limited geographical extent owing to the presence of settlements and their associated lighting never being absent [RD8]. It has been identified that the AONB is particularly affected by light pollution due to its ‘unique doughnut shape’, which means that it is affected by light pollution from external sources such as Bangor, Caernarfon and Dublin. The areas with the lowest light pollution on the island appear to be in the central areas of the island, outside of the AONB [RD7]. Sources of light pollution within Anglesey, identified in the study include the A55 corridor, Royal Air Force (RAF) Valley, the Existing Power Station and population centres such as Holyhead, Llangefni and Amlwch. The study notes

that farm security lights have a disproportionate effect on otherwise dark areas of the island and that poor lighting design and usage is endemic to the area [RD7]. Over time it is expected that the influence of street lighting will reduce as the IACC's Highways department continues to replace the low and high pressure sodium street lamps with low energy, low light pollution LED lights. However, this depends on whether the lighting units are installed with 0° tilt. From lighting surveys undertaken, it was observed that lighting from Cemaes, Tregele and the Existing Power Station already created significant sky glow.

Figure 1-4 Lighting from Cemaes and the Existing Power Station



1.4.12 Since the quality of the night sky is already degraded in the vicinity of the Wylfa Newydd Development Area by existing sources of light pollution, the sensitivity of dark skies in the study area is judged to be medium.

Cemaes

1.4.13 Cemaes is evaluated as Environmental Zone E3 on account of the level of existing lighting within the settlement. The Existing Power Station site is in clear line of sight from parts of the village and is clearly visible at night. As identified above, there are several existing sources of light pollution within the village. Refer to annex 1-2 for photography and baseline measurements. Due to the presence of existing lighting, including sources of light pollution, the sensitivity of this receptor to new lighting effects is judged to be 'medium'.

Tregele

1.4.14 The village of Tregele is in a rural location adjoining the A5025 with woodland screening part of the Existing Power Station. There is street lighting located in the village with poor lighting control. There is upward light pollution caused by the street lighting and the over lit petrol station located at the east side of the village. The site is evaluated as Environmental Zone E3. Due to the existing lighting conditions the sensitivity this receptor to new lighting effects is judged to be 'medium'.

Cemlyn Bay

1.4.15 No lighting is present at this site. However, lighting from the Existing Power Station was clearly visible with some light reflected on the water. This is a visual observation which could not be captured by standard camera equipment. This area was evaluated as E1. Refer to annex 1-2 for photography and baseline measurements.

Existing bat barn at Tyn-y-Maes

1.4.16 Topography and the presence of a dense mix of deciduous and evergreen planting screens some light from buildings at the Existing Power Station. Lighting levels were taken at 0 lux. The area is currently completely dark at night and was evaluated as Environmental Zone E1.

Watercourse and buffer zones within the Wylfa Newydd Development Area and Cafnan Farm wildlife tower

1.4.17 Although located in clear view of the Existing Power Station, the buffer areas around the watercourse and at Cafnan Farm are completely dark. Access to these locations could not be gained for the survey, but modelled lighting levels were at 0 lux. The site is evaluated as Environmental Zone E1. Nocturnal species such as otter and bats use these sites.

Caerdegog Isaf Farm

1.4.18 No survey access could be obtained to this site. However, viewing the site from a publically accessible location indicated that the site is currently in Environmental Zone E2, with low levels of rural lighting in the area.

Mynydd Ithel Farm

1.4.19 No survey access could be obtained to this site. However, viewing the site from a publically accessible location indicated that there was no lighting present in the area, so it has been evaluated as within Environmental Zone E1.

Wylfa Head coastline

1.4.20 The presence of small hills shields some of the security lighting from the Existing Power Station. However, sky glow from the Existing Power Station is clearly visible. The area is evaluated as Environmental Zone E1. The coastline supports breeding populations of chough although these have not been identified by ecologists working on the Wylfa Newydd Project as particularly sensitive to light.

Proposed bat barn near Cemaes

1.4.21 Land access to survey this site was not available, so the site was viewed from a publically accessible location. The Existing Power Station is not visible from the site. The site was evaluated as Environmental Zone E2 based on current lighting conditions in Cemaes.

1.5 Design basis and activities

1.5.1 This section sets out the design basis for this assessment of effects. It sets out where any assumptions have been made to enable the assessment to be carried out at this stage in the evolution of the design. This section also identifies the embedded and good practice mitigation that will be adopted to reduce adverse effects as inherent design features or by implementation of standard industry good working practice.

1.5.2 As described in chapter D1 (proposed development, Application Reference Number 6.4.1), the application for development consent is based on a parameter approach. The assessment described within this appendix has taken into consideration the flexibility afforded by the parameters. The construction lighting assessments have been based on a construction scenario and realistic worst case assumptions developed in consultation with Menter Newydd and Horizon to support the light modelling. The assumptions modelled are set out below and in table 1-4. It is considered that a realistic worst case scenario has been assessed from an environmental lighting perspective within the parameters described in chapter D1.

Construction

Basis of assessment and assumptions

1.5.3 The assessment has been undertaken based on the design details and programme provided in chapter D1 (Application Reference Number 6.4.1.), supplemented with preliminary details of the lighting requirements supplied by Menter Newydd to develop a realistic worst case construction scenario for assessment. The detailed lighting design would be developed to take into account relevant lighting standards and guidance. The standard average area lighting levels for various types of construction activity, as set out in the following guidance, have been applied to the construction scenario for assessment. These average area lighting levels are considered to represent a realistic worst case, since higher levels of average area lighting for a given task would not normally be required, and with modern LED lighting it is possible to achieve the same optical performance with lower levels of illumination.

- Health and Safety Executive – *Lighting at work* HSG38 [RD9].
- BS EN 13201-2:2015 Road lighting. Performance requirements [RD10].
- BS EN 12464-2:2014 Light and lighting. Lighting of work places. Outdoor work places [RD11].
- BS 5489-1:2013 Code of Practice for the design of road lighting. Lighting of roads and public amenity areas (where applicable) [RD12].
- Institute of Lighting Professionals (ILP) – Guidance notes for the reduction of obtrusive light GN01 (2011 Edition) (abbreviated to GN01:2011) [RD3].
- ILP – *High masts for lighting and closed-circuit television* (CCTV) - Professional Lighting Guide (PLG) 07 (2013 edition) [RD13].

- Building Regulations Approved Document L2B (with particular reference to metering and CIBSE TM39) [RD14].
- Chartered Institute of Building Services Engineers (CIBSE) LG06/16 Lighting Guide 06: The Exterior Environment – LG6 [RD15].
- The IACC. March 2010. Supplementary Planning Guidance: Design in the Urban and Rural Built Environment, Guidance Note: 10 Lighting [RD2].

Security lighting

1.5.4 Security lighting would be set up on the fenced perimeter of the Power Station Site during the construction phase and retained during operation. A description of these lighting requirements is set below under the heading 'Operation'.

Construction lighting

1.5.5 The assumptions on lighting requirements have been set out for each of the 11 construction zones referred to in chapter D1 (Application Reference Number: 6.4.1) and shown on figure 1-1. The average lighting levels assumed for each construction zone are set out below in table 1-4. Further detail is provided for those construction zones where 24-hour working is proposed since these would be the areas with the most lighting effects. Further explanation on the assumptions is also provided for Mound E (construction zone C6) due to the close proximity of Cemlyn Bay (a key, light-sensitive ecological receptor).

1.5.6 The parameters in table D1-1 of chapter D1 provide information on the maximum heights of mobile and static cranes. These maximum parameters have informed the landscape and visual assessment (chapter D10, Application Reference Number: 6.4.10) since the aircraft warning lights on the top of these cranes would be potentially visible for some distance from the site (as indicated by the zone of theoretical visibility). The realsistic worst case for the ELIA has been developed to take account of the indicative static crane positions around the site, using information provided by Menter Newydd. The two heavy lifting cranes in construction zone C7, being the tallest cranes on the site at 270m (292m AOD), have been modelled. There would be one mobile heavy lift crane at 220m maximum height. This mobile crane would be moved to various parts of the Wylfa Newydd Development Area but the details of where is it likely to be mainly located and the number of operations that it would be required for are not currently available. An assumption has been made that the majority of mobile cranes would be located within construction zone C7, at the Power Station Site, where the greatest concentration of light and lifting operations would be required.

1.5.7 Within the main laydown area (construction zone C2), information from Menter Newydd has established that it is likely that there would be four 30m high cranes, each approximately 100m long, in operation. These would be located close to construction zone C7, while static cranes within construction zone C7 (the Power Station Site) would be used to collect materials, including material lifted by the 30m cranes, from the laydown area (construction zone C2). The

lighting model used to inform the ELIA has taken account of this construction scenario since it provides the best current understanding of how the cranes would be likely to be positioned and operated.

1.5.8 It was established through a meeting with Menter Newydd on the construction approach that the cranes, both static and mobile, would not be at their maximum heights at all times. Instead they would be raised and lowered dependant on the operations they were performing at a given time. When these cranes are not in operation, only the aircraft warning lights would be on, while the main hook lighting would be off. The static cranes have been modelled with their crane lighting at their maximum heights. The model assumes that they would all be in operation concurrently, although in reality this is unlikely to happen.

1.5.9 The lighting levels modelled for each construction zone, including crane lighting and other task lighting, is summarised in table 1-4.

[This page is intentionally blank]

Table 1-4 Construction lighting assumptions

Parameter Zone	Description	Lighting assumptions			
		Assumed lux levels during construction	Degree of tilt	Upward lighting	Construction hours of operation
Zone C1	Mound A	50lux over a 30m^2 area using mobile lighting units	0° tilt mobile units approximately 9m mounting height.	None assumed	0700-1900 hours
Zone C2	Laydown area/ Mound B	100lux average with a 50lux minimum	0° tilt. Lighting from cranes which are 30m high and between 85m-100m long this lighting will be supplemented with high masts at 20-30m and 6m along Mound B.	None assumed	Laydown during main construction 24-hour
Zone C3	Mound B	50lux over a 30m^2 area using mobile lighting units	0° tilt mobile units approximately 9m mounting height.	None assumed	0700-1900 hours
Zone C4	Mound C	50lux over a 30m^2 area using mobile lighting units	0° tilt mobile units approximately 9m mounting height.	None assumed	0700-1900 hours
Zone C5	Laydown area/ Mound D	100lux average with a 50lux minimum	0° tilt. Lighting from cranes which are 30m high and between 85m-100m long this lighting will be supplemented	None assumed	During main construction 24-hour

Parameter Zone	Description	Lighting assumptions			
		Assumed lux levels during construction	Degree of tilt	Upward lighting	Construction hours of operation
			with high masts at 20-30m.		
Zone C6	Mound E	50lux over a 30m^2 area using mobile lighting units	0° tilt mobile units approximately 9m mounting height.	None assumed	0700-1900 hours
Zone C7	Power Station Site	100lux – 200lux average. Up to 500lux average dependent on the safety standard for the particular task	0° tilt, with main area high masts. High mast heights ranging from 10m to 30m. Two cranes of up to 270m for limited number of operations. Utilisation of static crane locations to place luminaires to avoid the creation of dark spots.	Yes – during construction when rebar work is taking place contractor will require upward and downward light to comply with safe working requirements. This will be for limited periods when walls are being constructed.	24-hour
Zone C8	Breakwaters	100lux average along the breakwater (no lighting once construction of breakwater completed)	0° tilt, with main area luminaires. The columns heights ranging from 10m. Three crawler cranes in operation with 60m boom.	None assumed	24-hour

Parameter Zone	Description	Lighting assumptions			
		Assumed lux levels during construction	Degree of tilt	Upward lighting	Construction hours of operation
Zone C9	MOLF	200lux associated with dredging operations 20lux – 120lux during construction of the MOLF (land based activities) 20lux – 50lux during operation of the MOLF (land based activities)	0° tilt, with main area luminaires. The columns' heights range from 10m to 30m. Utilisation of static crane locations to place luminaires to avoid the creation of dark spots.	None assumed	0700-1800 hours except crane, barges, tugs and MOLF dredging which would be a 24-hour operation
Zone C10	Cooling Water outfall	100lux average with specific temporary task lighting up to 500lux.	0° tilt. Lighting from cranes which are 30m high and between 85m-100m long will be supplemented with high masts at 20-30m.	Yes – during construction when rebar work is taking place, contractor will require upward and downward light to comply with safe working requirements. This will be for limited periods when walls are being constructed.	24-hour
Zone C11	Site Campus	100lux average with specific temporary	0° tilt. Luminaires located on internal	Some limited upward lighting may	24-hour

Parameter Zone	Description	Lighting assumptions			
		Assumed lux levels during construction	Degree of tilt	Upward lighting	Construction hours of operation
		task lighting up to 500lux.	wall to avoid spill light along the coastline. Low level lighting from accommodation block to mess hall.	be required for installation of pre-fabricated accommodation units.	

Power Station Site (construction zone C7), laydown areas and Mounds B and D (construction zones C2 and C5)

1.5.10 Where practicable the construction lighting would be designed to comply with Environmental Zone E2 in accordance with guidance for reducing obtrusive light set out in GN01:2011 [RD3]. However, there would be specific tasks during the construction stage where these lighting limits would not be practicable as outlined below.

1.5.11 Every reasonable effort would be made to control upward light to within the maximum 2.5% set out in guidance (GN01:2011) [RD3]. However, for certain activities there will be a requirement to light from the ground, such as when constructing walls around the power block, back up building and intake structure for limited periods when reinforcing bar (rebar) work is being completed. For these types of activities there would be a requirement for specific task lighting with an uplift to 200 – 500lux average depending on the task. This would be achieved by bringing in portable lighting units to the required area, keeping the higher lighting levels very localised.

1.5.12 GN01:2011 acknowledges instances where a recommended upward light ratio (ULR) cannot be maintained. It states ‘Some lighting schemes require deliberate and careful use of upward light’ and also states ‘care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and lighting control attachments’ [RD3].

1.5.13 General area lighting for the main construction areas would be an average of 100lux with a minimum of 50lux. This will be achieved with high mast units all high mast lighting will be directed at the ground with 0° tilt. This will keep the ULR for the general lighting at 0%. For the assessment it has been assumed that the inner security site would be lit to an average of 100lux with 40% uniformity, while the perimeter security fence and outer site would be lit to an average of 5lux and 50lux respectively. For specific task lighting, the level may need to be increased to 200-500lux during construction for limited times. This lighting would be provided by mobile lighting units. For assessment, column mounting heights have been assumed as 30m, 15m and 6m for the inner security site, outer site and perimeter fences, all with a 0° tilt to keep the ULR at 0%. Luminaire data which have informed the assessment are set out in figure 1-5 below.

Figure 1-5 Luminaire data used for assessment

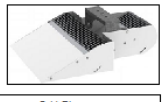
Luminaire A Data

Supplier	
Type	HMAO.L584.SQ
Lamp(s)	4000K LED with 70CRI
Lamp Flux (klm)	60.99
File Name	HMAO.L584.SQ.ies
Maintenance Factor	1.00
Imax70,80,90(cd/klm)	289.9, 15.0, 0.0

Luminaire B Data

Supplier	Holophane Europe
Type	VMX.L034.V1.F4Q1
Lamp(s)	LED C.3000LM - 4000K
Lamp Flux (klm)	3.25
File Name	VMX.L034.V1.F4Q1.IES
Maintenance Factor	1.00
Imax70,80,90(cd/klm)	461.8, 69.9, 0.0

Luminaire C Data



Supplier	C U Phosco
Type	FL800R-3-A3-CW-D700-458W
Lamp(s)	757P CW
Lamp Flux (klm)	49.15
File Name	FL800R-3-A3-CW-D700-458W.ies
Maintenance Factor	1.00
Imax70,80,90(cd/klm)	32.4, 3.7, 0.0

1.5.14 It is assumed during construction that up to 40 cranes at heights of up to 192m would be in operation. These would have specific luminaires to light the crane

hook when in operation. The lights would have a 0° tilt since their purpose is to enable the crane operator to see the hook below, hence no tilt is required.

1.5.15 Two cranes with a maximum height of approximately 270m would be required for a limited number of specific operations during the course of the whole construction period. The lighting from the top of the cranes would be directed downwards with no tilt so the crane operator can see the hook. Crane lighting would be on during the operation of the cranes only, and therefore this would be a relatively limited source of lighting.

1.5.16 Aircraft warning lights would be required on all the cranes and tall stacks.

1.5.17 For the earthworks, an average of 50lux would be required on routes within the construction site to and from construction zones C2 and C5 (Mounds B and D) for any working after nightfall.

1.5.18 The car parking areas would be lit to comply with the current BS5489 lighting standards [RD10] and HSG 38 (Lighting at Work) [RD9] at an average of 20lux with a 30% uniformity. All units would be at 0° tilt with a mounting height of up to 10m. LED lighting would be used, which allows the human eye to work more efficiently and colour can be identified.

1.5.19 The extensive laydown area in construction zone C5 would require average lighting of 100lux, with a minimum of 50lux to ensure the safety of the construction workers undertaking activities in this location. High mast lighting would be at 0° tilt to keep the ULR at 0% close to the four cranes as these stand at 30m high but column heights will taper down towards Tregele in order to reduce the potential for spill light.

Mound E (construction zone C6)

1.5.20 Construction activities on Mound E would only take place between 07:00 hours and 19:00 hours, limiting the amount of lighting that would be required overall at this location.

1.5.21 Mobile lighting units would be used to allow safe passage for earthworks vehicles to and from the mound. In the drop-off zone an area of 30m^2 would be lit at a time and the location of the drop-off would be moved as required. The maximum height of these mobile units would be 9m. An average lighting level of 50lux has been assumed for the assessment. This complies with the HSE lighting standard [RD9].

1.5.22 Due to the proximity of Mound E to the nesting tern colonies associated with Cemlyn Bay and the associated SAC and SPA, certain restrictions would be applied to the timing and method of construction activities in this location.

1.5.23 There would be a 500m stand-off zone from the boundary of the SAC between 15 April and 15 May while the tern nesting season becomes established. Therefore, earthworks would only take place on the western side of the mound after 15 May, by which time the daylight hours would exceed 19:00 hours, and therefore lighting would not be required on the slopes facing the tern colony during the sensitive period when nests become established.

Marine Works: Breakwaters, MOLF and Cooling Water intake structure (construction zones C8, C9 and C10)

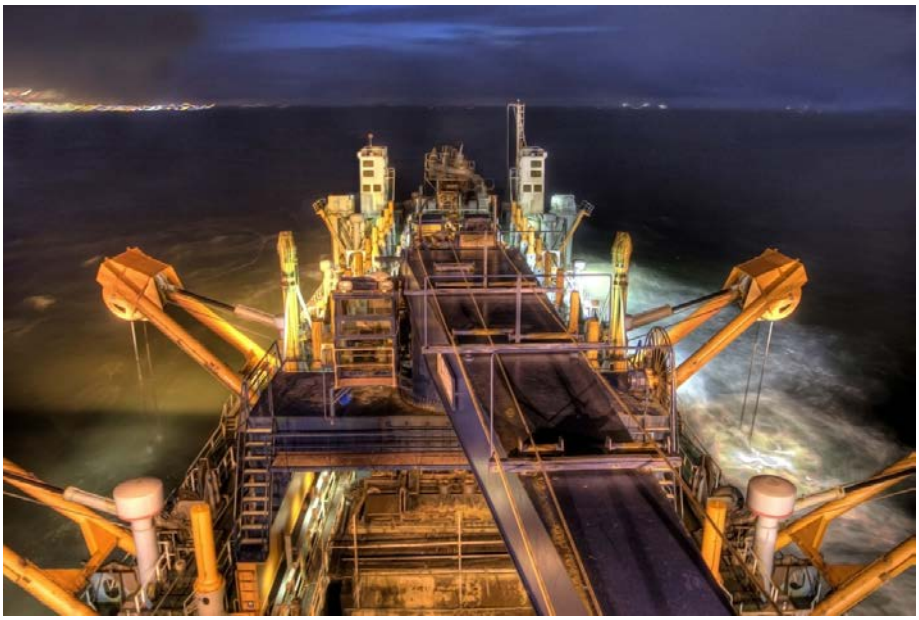
1.5.24 Whilst constructing the breakwater, mobile crawler cranes at 25-30m high with a 60m boom would be in operation. The crawler cranes would move along the breakwater placing amour units. The boom could be pointing seaward or pointing towards the MOLF. An indicative scenario has been produced to inform the ELIA as by nature these units are not static. Once the breakwater is completed the construction lighting would be removed.

1.5.25 Lighting levels would be required to be as uniform as possible, thereby offering an even field of view and the elimination of unnecessary bright spots. The reduction of glare is of particular importance for the moving of vehicular and trailer-mounted cargo within the area together with the effect on the approach to the MOLF from the Power Station Site. Lighting levels would vary based on the construction activity with maximum levels of 200lux associated with dredging operations. Land based activities would have light levels between 20lux and 120lux while the MOLF is under construction. Once constructed, and in use, the light levels of land based activities would be between 20lux and 50lux.

1.5.26 Dolphin walkway lighting would typically consist of low-level luminaires mounted along the walkway. The mobile harbour cranes located on each platform would feature on-board lighting for the purpose of providing specific supplementary lighting, task lighting, and for operational purposes to supplement the berth platform vulnerable areas (i.e. remove shadows created when the crane moves on the platform).

1.5.27 Task lighting would be required for dredging operations. The dredging activities required are set out in appendix D1-1 (Construction Method Statement, Application Reference Number: 6.4.17). This is likely to be a 24 hours a day operation. A typical example of lighting during dredging can be seen in figure 1-6 below.

Figure 1-6 Example of lighting of dredging vessel



1.5.28 Task lighting would be fully controlled and would have limited direct effects on surrounding areas. Since the dredging vessel would be moving, the effects would be transient.

Site Campus (construction zone C11)

1.5.29 The Site Campus would be located within an area assessed as being Environmental Zone E1 and therefore lighting would be carefully designed and controlled.

1.5.30 Once constructed, the Site Campus external lighting would comprise a combination of column mounted luminaires and building mounted luminaires. Care has been taken to design the exterior lighting so that it is mounted on the internal sides of the buildings to keep light trespass onto the coastline and bay to a minimum. A Central Management System would be utilised, which would be remotely accessible. LED lighting would be used, with a proximity detection system to provide lighting only when required for access.

1.5.31 During construction, sufficient lighting would be required to complete these activities. The level of lighting would be an average of 100lux – 200lux average, but up to 500lux dependent on the safety standard for the particular task being carried out.

Embedded mitigation

1.5.32 There are embedded measures in the project design that would reduce the lighting effects from construction.

1.5.33 As detailed in the Phasing Strategy (Application Reference Number: 8.29) and appendix D1-1 (construction method statement) (Application Reference Number: 6.4.17) earth mounds would be located at the north-east (Mound A), south (Mound B) and south-west (Mound E) extents of the Wylfa Newydd Development Area; these would help to obscure some light spill onto sensitive receptors (Cemaes, Tregele and Cemlyn lagoon).

1.5.34 As detailed in volume 3 of the Design and Access Statement (Application Reference Number: 8.2.3) all regularly occupied spaces within the buildings including the amenity building, will be fitted with user-operated control, such as blinds to prevent light spill onto the surrounding area.

1.5.35 As detailed in the Wylfa Newydd Code of Construction Practice (Application Reference Number: 8.6) technologies used would include a Central Management System. Although this could not be seen as a mitigation due to the fact the management of the system could not be guaranteed, a Central Management System would give flexibility to amend lighting levels once installed. This is an intelligent dimming system that links though a wireless network and would be an effective way of controlling nuisance lighting. Each individual luminaire can be controlled independently from a computer desktop. Lighting can be dimmed by setting timers online. This can be reviewed daily, weekly or monthly and dimming levels increased or decreased by logging into the system and amending the percentage of dimming and timings required. Seasonal variations can be applied and in the event of an emergency, lighting can be triggered to revert back to 100%. The ELIA has not assumed any

zoning or dimming, but the inclusion of the Central Management System as embedded design is highlighted since it would allow potential issues of lighting nuisance to be managed and controlled through the construction period.

1.5.36 As detailed in the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) no lighting would be used for the multi-use games area after 21:00 hours during winter months due to the proximity of the Tyn-y-Maes bat barn and a requirement to avoid light trespass into that ecological mitigation area.

Good practice mitigation

1.5.37 The Wylfa Newydd Code of Construction Practice (Application Reference Number: 8.6) sets out requirements for appropriate good practice lighting control measures to be identified, giving consideration to BS EN 12464-2:2014 [RD11] and Guidance Notes for the Reduction of Obtrusive Light [RD3]. This guidance includes specific control measures as follows.

- Lighting would be positioned and directed so as not to spill unnecessarily outside of the construction areas. Construction vehicle headlights would be dipped when approaching the site perimeter to limit light spill and glare beyond the site boundary.
- To avoid sky glow, lighting would be kept at 0° tilt to keep the ULR at 0% where practicable.
- Cowls would be used where practicable if the tilt required on floodlights is greater than 5°.
- Construction lighting would be switched off when not required.

1.5.38 The Wylfa Newydd Code of Construction Practice (Application Reference Number: 8.6) requires that the lighting designs would be developed to reduce light spill onto sensitive receptors (including ecological receptors) where practicable to below thresholds where significant effects are avoided, to maintain a uniform lighting solution to reduce dark and light spots, and to limit the visibility of new lighting at distant receptors.

Operation

Basis of assessment and assumptions

1.5.39 The assessment has been undertaken based on the design details and programme provided in chapter D1 (Application Reference Number 6.4.1.). A summary of the key features of the Wylfa Newydd Development Area during operation of the Power Station, which are of relevance to this assessment, are set out below.

General operational site lighting

1.5.40 External lighting would be provided for the Power Station Site with lighting levels generally at the minimum necessary to enable safe and secure operation. Excessive lighting levels would be avoided and, wherever practical,

dimming would be provided. The minimum illumination would exceed 3lux over the defined area with a uniformity of 3:1 (average to minimum).

1.5.41 Lamps would be chosen to balance energy efficiency and colour rendering whilst considering the need to avoid or reduce potential adverse effects to the local environment and night-time visual receptors. LED use would be promoted and colour choice carefully selected to reduce effects. Lamps would also be chosen to limit light spill and sky glow including high efficiency bulbs and directional lighting, and accessories such as barn door shields. Roadway lamps would be selected with a zero upward light component.

1.5.42 During operation, it is likely that lighting would be required for the main stacks (aviation warning lights), the site access road, permanent site roadways and car parks, office buildings and perimeter lighting of the inner and outer security fences, which is a statutory requirement for nuclear sites. In addition, there would be a low level of pedestrian amenity lighting required across the Power Station Site to aid safe pedestrian movement.

Security lighting

1.5.43 Lighting would be used on the perimeter boundary primarily to support the CCTV system, patrol guarding and response, and therefore must be consistent with the operational requirements of the CCTV system and the security contractor. The following assumptions will inform the design.

- The lighting columns and their lanterns would be located so that the ground immediately outside the fence is adequately illuminated but the inside face of the fence is not, allowing guards clear vision through the fence fabric.
- Lighting columns would be positioned at least 2m inside the outer fence line so they would not aid an intruder to scale any physical barrier or defeat any Perimeter Intruder Detection System.
- The installation must illuminate the 10m sterile zone between the fences and the 10m clear zone external to the outer fence.
- The minimum operational value of illumination would be 3lux at 100mm above ground level.
- For horizontal illumination a uniformity figure of 3:1 (average to minimum) should be achieved. The design should account for any existing or known proposed CCTV installation with luminaires selected and positioned to ensure that they do not have a detrimental effect on the CCTV coverage.
- The maximum column/mounting height would be 8m. It is assumed luminaires would be spaced at three to four times their mounting height.
- The minimum colour rendering value should be Ra>60 to support the use of colour CCTV.
- It is assumed that commercial street lighting luminaires would be used.

Vehicle access points

1.5.44 Lighting at vehicle access points would be required to be capable of illuminating vehicles at a point outside the vehicle barriers). The typical lighting levels would be 50 to 150lux in directional floodlight LED luminaires.

1.5.45 Light levels would be appropriate for the location and operation of CCTV systems. The required minimum colour rendering value would be Ra>80 to enable the colour of approaching vehicles, their number plates and the occupants of the vehicle to be clearly seen. The lighting would be designed so as not to adversely affect the driver's vision.

Vehicle locks/Inspection areas

1.5.46 Additional lighting would be required to assist those carrying out vehicle searches. The vehicle inspection area would be provided with lighting between 100 and 150lux at the road surface taking into account light reflection from the road surface, colour rendition and the use of mirrors for under vehicle inspections.

1.5.47 The lighting would be required to be directed so that it does not adversely affect the adjacent perimeter lighting and any CCTV system that covers these areas.

1.5.48 With the exception of perimeter lighting which is required to cover these areas, lighting for vehicle searches would be switched off when not required.

Asset lighting

1.5.49 Lighting would be designed to provide uniform lighting on the vertical surfaces of assets where required. Where single point, visible light illumination is required, such as doorways and emergency exits, a level of 6lux at the face of the door is required.

Embedded mitigation

1.5.50 As detailed in the Wylfa Newydd Code of Operational Practice (Application Reference Number: 8.13) lighting control measures (refer to annex 1-9 for examples) would be incorporated into the lighting design to limit visual intrusiveness onto occupied residential properties, limit light spill to surrounding areas (including the AONB and Heritage Coast) and sensitive wildlife habitats, and recognise Anglesey's aim of achieving international Dark Skies status, while maintaining the light levels required to ensure safe working conditions and to maintain security during operation. LED lighting would be used, as set out in volume 2 of the Design and Access Statement (Application Reference Number: 8.2.2), which can be dimmed if required, subject to safety requirements.

Good practice mitigation

1.5.51 The requirement to develop appropriate good practice lighting control measures into the lighting design, giving consideration to BS EN 12464-2:2014 [RD11] and the Institute of Lighting Engineers' Guidance Notes for the

Reduction of Obtrusive Light [RD3], is set out in the Code of Operational Practice (Application Reference Number: 8.13).

Decommissioning

Basis of assessment and assumptions

1.5.52 At the end of the 60-year operating stage, the Power Station would be decommissioned. In the absence of details, this assessment has been based on current technology, since lighting technology and practice is likely to have developed substantially over the 60-year period.

1.5.53 Due to the lack of detail about the decommissioning activities, it is only possible to present a very high-level assessment of decommissioning, from the information available at the time of the assessment, a summary of which is set out below.

1.5.54 It has been assumed that lighting would be provided in conjunction with the following:

- perimeter security fence;
- dismantling of Power Station buildings and ancillary infrastructure; and
- lighting of tower cranes.

1.5.55 The assessment assumes that task lighting similar to that used during construction would be used. The effects of the decommissioning phase are therefore predicted to be similar as to construction.

Embedded mitigation

1.5.56 The details of embedded mitigation for decommissioning are not known at this time. To facilitate this lighting assessment, it has been assumed that measures similar to those set out above for construction would be adopted as embedded mitigation for decommissioning.

Good practice mitigation

1.5.57 The details of good practice mitigation for decommissioning are not known at this time, as it is not known what would be considered good practice in the future. To facilitate this lighting assessment, it has been assumed that measures similar to those set out above for construction would be good practice mitigation for decommissioning.

1.6 Assessment of effects

Construction

Dark skies

1.6.1 Human induced sky glow, which affects the darkness of the night-time sky and visibility of stars, can be caused in two main ways:

- light from a luminaire that is poorly controlled and emits light directly upward into the atmosphere; and

- reflection from the ground that reflects onto dust and gas particles in the atmosphere which produces a luminous glow.

1.6.2 During construction, although it is assumed that the exterior luminaires would generally be designed and positioned to avoid emitting light upwards, there would be an increase in dust and this would create some reflection and sky glow. Furthermore, as set out above in section 1.5, there would be a requirement for some occasional deliberate use of upward lighting for some construction activities. This would also contribute to sky glow on a temporary, intermittent basis throughout the construction stage of the Wylfa Newydd Project.

1.6.3 Due to the scale of the construction activities within the Wylfa Newydd Development Area, the increase in sky glow over and above that already generated by the baseline sources is predicted to be substantial, and therefore the magnitude of change on dark skies in the study area is assessed as large adverse. Since the nocturnal sky is already compromised by baseline light sources, the significance of this potential effect is predicted to be moderate adverse.

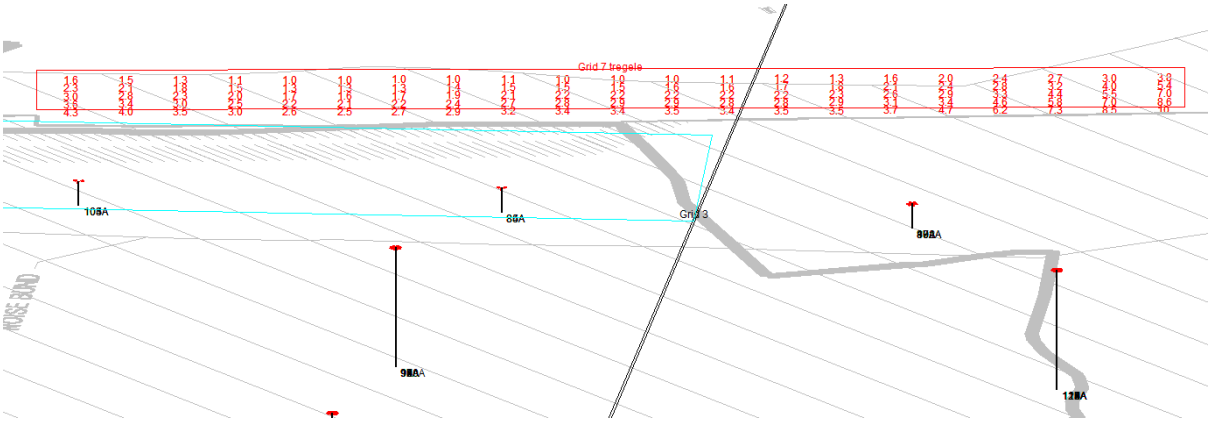
Cemaes

1.6.4 Lighting associated with construction would increase the extent of visible light sources (mainly from the cranes) and sky glow in this location due to the combination of the Power Station construction with the Existing Power Station. It is not anticipated that these light sources would increase light levels noticeably within Cemaes due to the distance, topography (including the proposed Mound A) and the presence of other existing light around Cemaes. The predicted effect is on views out of Cemaes, rather than changes to light levels within Cemaes. The magnitude of change is predicted to be small adverse and the significance of effect on sky glow from Cemaes is predicted to be minor adverse, since sky glow is already visible from the Existing Power Station.

Tregele

1.6.5 The nearest construction activities to Tregele would be associated with the construction of Mound B and activities in the laydown area in construction zone C2. Vertical illuminance results have been calculated to the east of the laydown area on the western boundary of Tregele (figure 1-7 below). It should be noted that the calculation excludes the proposed noise and screening bund (Mound B) which would be 7m in height. The grid height has been set from ground level to a height of 10m and the grid is located 50m east of the edge of Mound B (the nearest lighting column to the village) which based on indicative design would be 80m away.

Figure 1-7 Vertical illuminance results at western boundary of Tregele



1.6.6 The vertical grid indicates that the maximum levels of light trespass on the boundary of Tregele would be 10lux and the minimum would be 1lux. However, as stated above, this figure assumes there are no barriers between the light source and the calculation zone. The construction of the bund, which would be one of the early activities in the construction period, would substantially lower the levels of light reaching Tregele from the Wylfa Newydd Development Area. It is predicted that this would result in a medium adverse magnitude of change at Tregele from construction, since the lighting would be noticeable and visible, however it is not anticipated that this would cause substantial problems in terms of potential nuisance. Since Tregele is in fairly close proximity, and so likely to be relatively sensitive to the lighting, the significance of effect is predicted to be moderate adverse.

Cemlyn Bay

1.6.7 The nearest construction activities to Cemlyn Bay would be associated with the construction of Mound E (construction zone C6). The hours of working on this area would be 07:00 – 19:00 hours. Since earthworks are involved, the construction of this mound is assumed to be through the spring and summer months when working conditions are generally drier. As a consequence, very little working during hours of darkness is anticipated..

1.6.8 Calculations have been made taking account of average lighting levels of 50lux, advised by Menter Newydd for the construction of the bund. Lights have been positioned in different locations to represent the task lighting that would be mobile (annex 1-3). Vertical grid calculations have been made for two locations: the edge of the tern colony nesting area, and the edge of Cemlyn Bay (figure 1-8). The results are set out in table 1-5.

Figure 1-8 Location of illuminance calculation grids for Cemlyn Bay

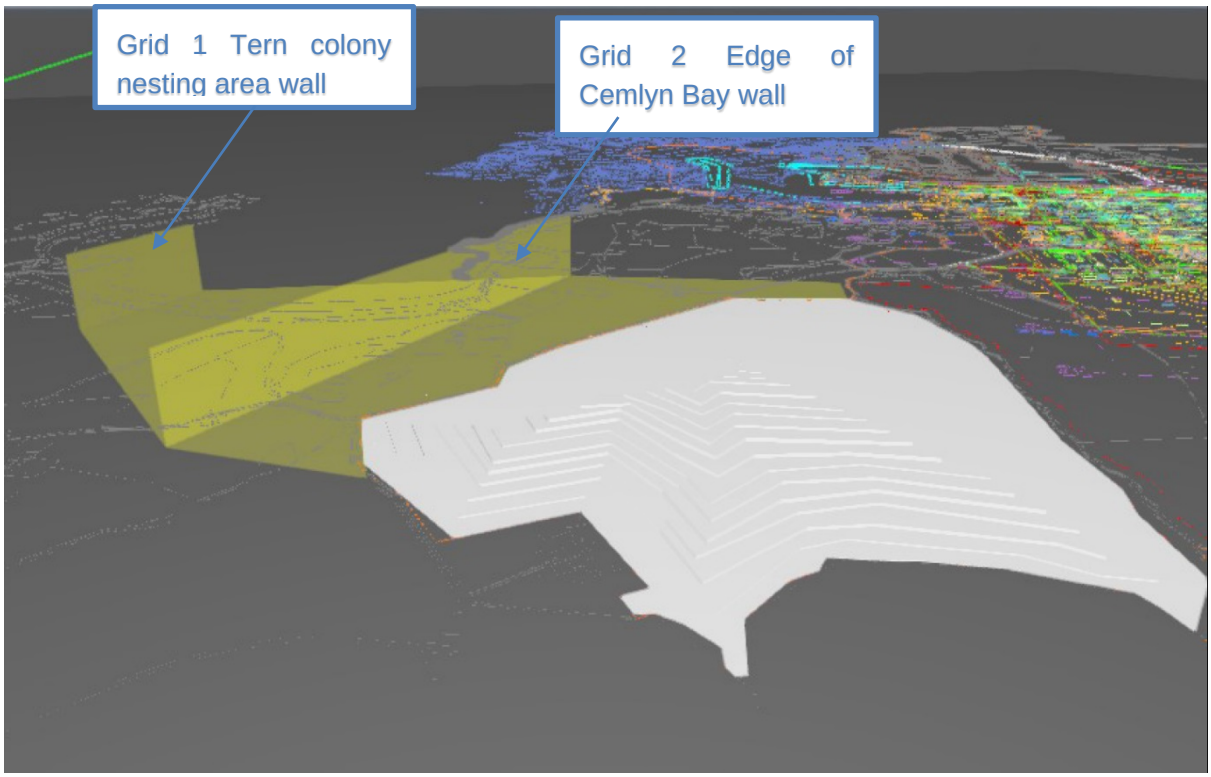


Table 1-5 Potential lighting effects at Cemlyn Bay (based on 30m grid at 50lux)

Position of 30m grid (see annex 1-3)	Tern colony nesting area (grid 1)		Edge of Cemlyn Bay area (grid 2)	
	Average lux level	Maximum lux level	Average lux level	Maximum lux level
Ground 1	0.02	0.35	0.11	0.55
Ground 2	0.03	0.49	0.2	1.43
Ground 3	0.04	0.96	0.25	1.14
Ground 4	0.03	0.53	0.29	1.44
Ground 5	0.03	0.41	0.35	1.41
Mid-level 1	0.02	0.51	0.07	0.73
Mid-level 2	0.02	0.6	0.11	0.78
Mid-level 3	0.02	0.73	0.06	0.63
Top level 1	0.01	0.54	0.02	0.49

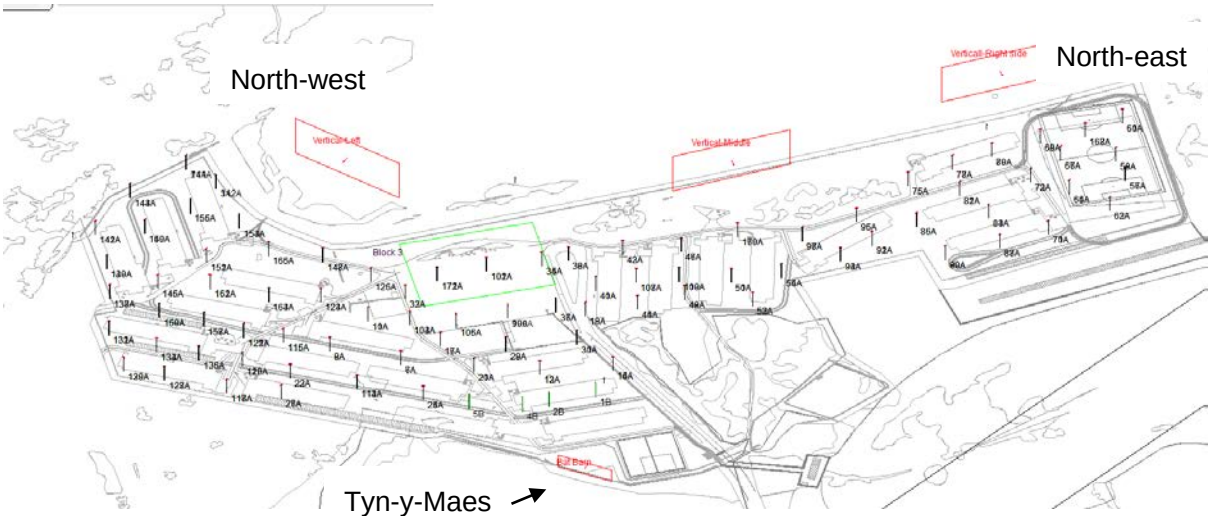
1.6.9 The assessment shows that there are potential exceedances of the 0.1lux threshold from task lighting at Cemlyn Bay, including the areas where terns are known to have nested in the past. The potential exceedances of the 0.1lux threshold are considered to represent a small adverse magnitude of change.

Additional lighting mitigation would be required to bring lighting levels below the 0.1lux threshold.

Coastline at Wylfa Head and Tyn-y-Maes bat barn

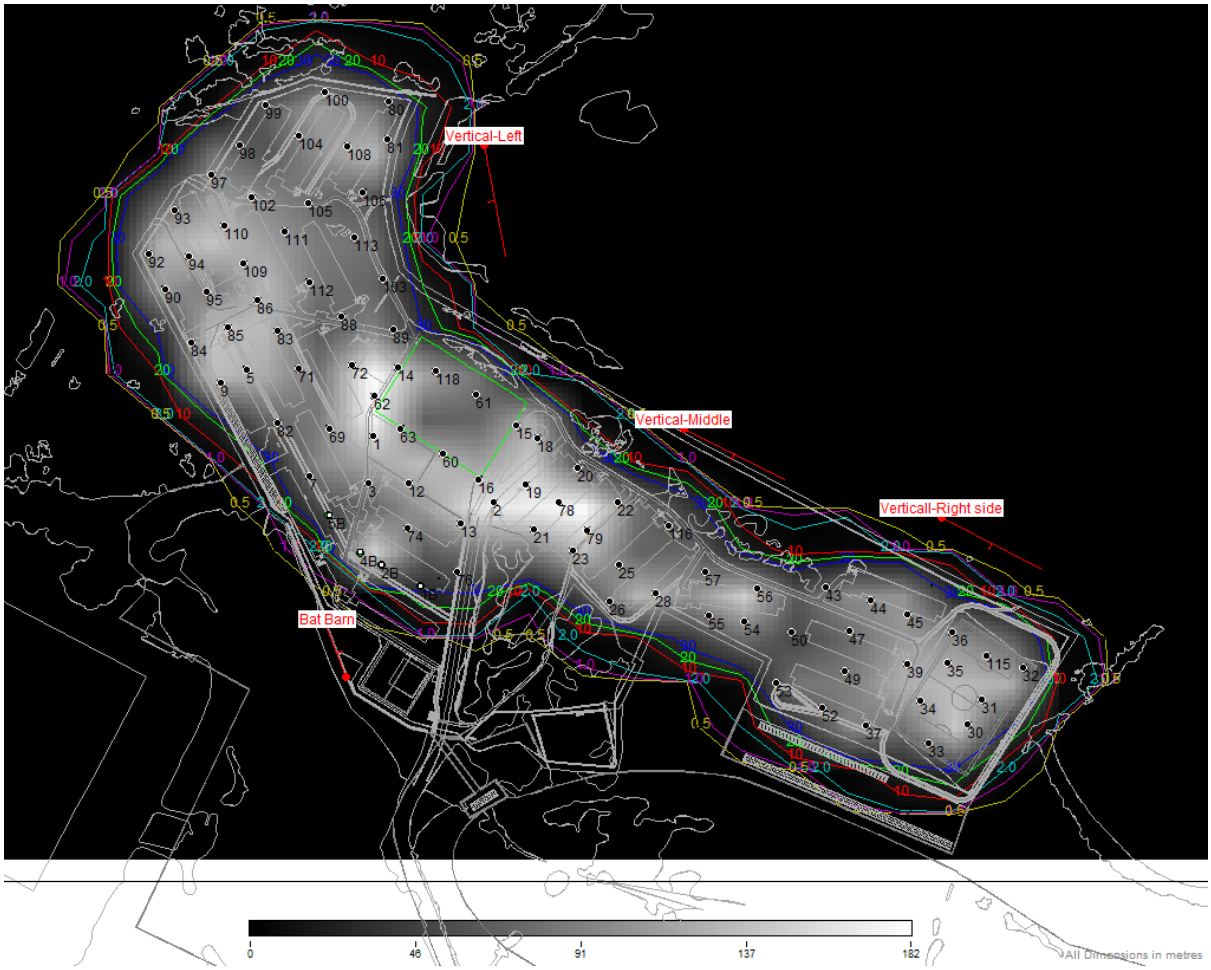
1.6.10 The Site Campus would be situated on the coastline at Wylfa Head. Figure 1-9 shows the Site Campus layout and locations of vertical grids calculated to show lighting effects in three locations off the coastline as well as at the location of the existing Tyn-y-Maes bat barn.

Figure 1-9 Site Campus layout and vertical grids for coastline ('vertical left', 'vertical middle' and 'vertical right') and Tyn-y-Maes bat barn



1.6.11 During construction of the Site Campus the whole area would be lit to a 100lux average with uniformity of 40%. Figure 1-10 shows greyscale results and light contours calculated for construction light spill onto the coast and the Tyn-y-Maes bat barn.

Figure 1-10 Site Campus area light contour results



Existing bat barn at Tyn-y-Maes

1.6.12 The Site Campus would be located within close proximity to the bat barn at Tyn-y-Maes. Figure 1-11 indicates the layout of the bat barn in relation to the proposed Site Campus.

Figure 1-11 Layout showing Tyn-y-Maes bat barn and associated bat mitigation in relation to proposed Site Campus

1.6.13 A vertical grid has been calculated at the location just outside the proposed fence line of the Site Campus adjacent to the bat barn (figure 1-12). The grid height has been set from ground level to a height of 10m. The nearest lighting column from the bat barn, based on indicative design, would be 70m away.

Figure 1-12 Vertical illuminance results for the bat barn at Tyn-y-Maes during construction of Site Campus

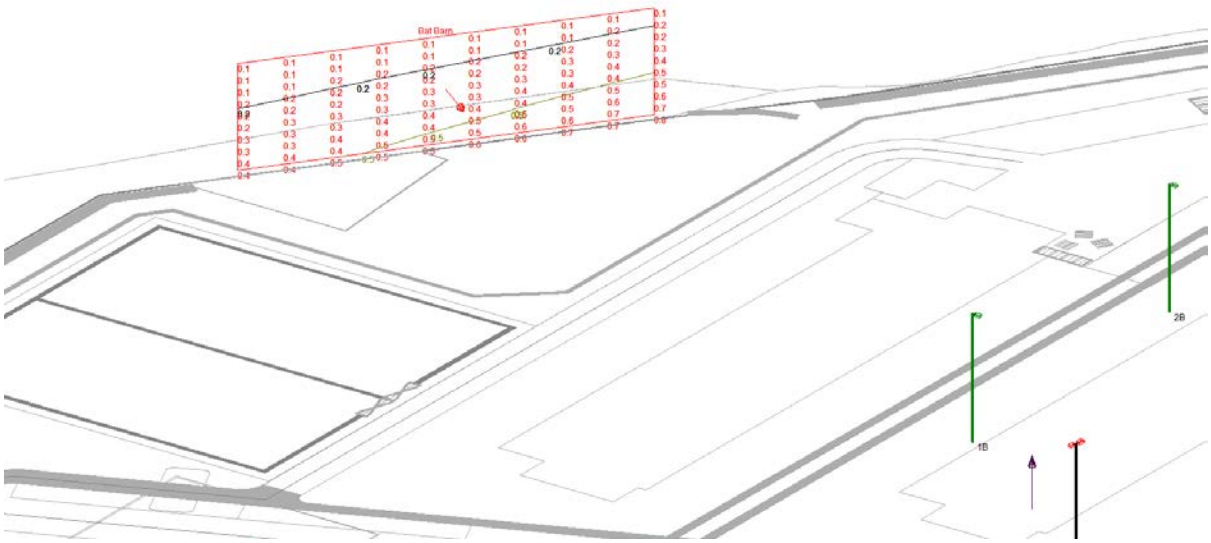
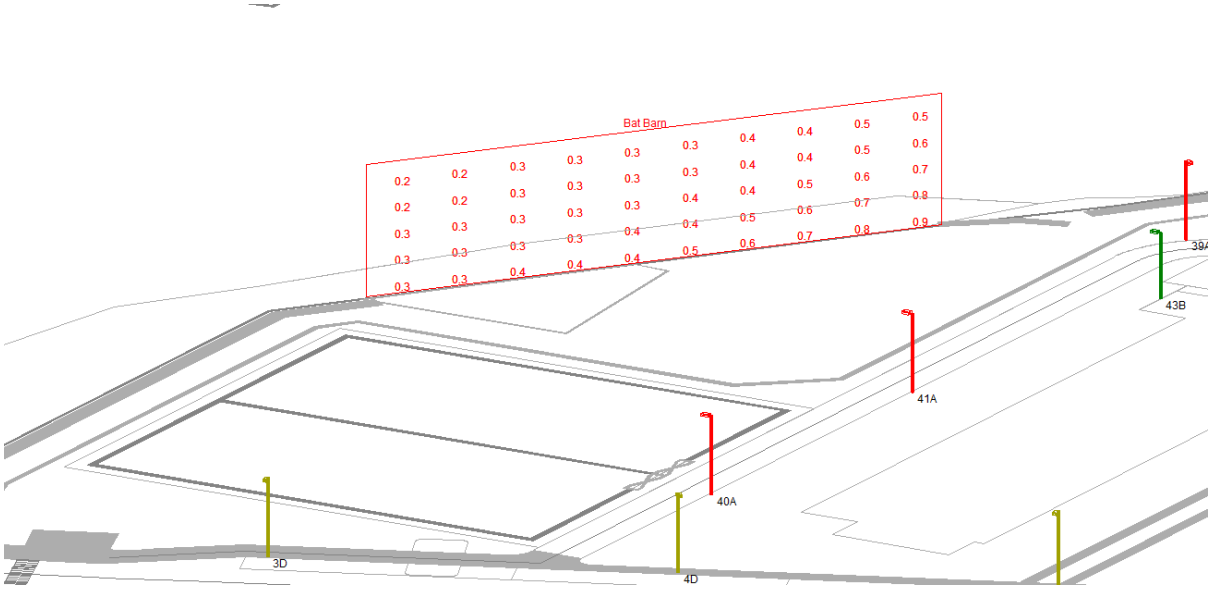


Figure 1-13 Vertical illuminance results for the bat barn at Tyn-y-Maes during operation of Site Campus



1.6.14 During construction of the Site Campus, the vertical grid shows that the potential maximum levels near the bat barn would be 0.77lux and the minimum would be 0.1lux (figure 1-12). This is achieved on the basis that lighting is directed inwards towards building '2' (as indicated on figure 1-11). This would be a small adverse magnitude of change.

1.6.15 During operation of the Site Campus the average illuminance levels would be 0.56lux, with a maximum of 0.89lux (figure 1-13). The columns located near to the accommodation block (approximately 30m away from the bat barn) which would be either wall mounted or column mounted would be used to light the footpath and entrance of the accommodation blocks. The proposed embedded mitigation, which includes the use of sensors and Central Management System control for the luminaires on the footpath and entrance to the blocks near this area would further reduce the light spill when lights are dimmed.

1.6.16 The existing bat mitigation planting of trees and shrubs has not been included in the above calculations so the vertical grids assume there are no barriers between the light source and the calculation zone. The retained dense planting (which includes a mix of evergreen and deciduous species) would act as a wall and reduce the light levels to 0 lux or negligible levels. This assessment is based on effects after 21:00 hours when the multi-use games area by building 2 would not be lit, as this would have a direct effect on the light levels at the bat barn.

Wylfa Head coastline

1.6.17 Figures 1a – 3b (in annex 1-4) show the vertical illuminance levels at sea from three different sections of the coastline during the construction and operation of the Site Campus. The vertical grids have been set to a height of 30m (20m above sea level as the grid starts at minus 10m, taking account of the fact that the site campus is 10m above sea level). The grids are located at sea between

20m and 60m from the coastline where the Site Campus is proposed to be built. The lanterns used during construction and operation of the Site Campus would be orientated away from the coast to reduce light spill.

1.6.18 The results of the assessment are shown in table 1-6. As shown in the table, the greatest change in illuminance levels is predicted for the coastline surrounding the north section of the Site Campus. Here, the Site Campus would be located in close proximity to the coast. Lighting near this area would be positioned facing away from the coast. As the Site Campus would be located 10m above sea level and all luminaires would be mounted at 0° tilt; the levels on the bottom section of the grid (figures 2a and 2b in annex 1-4) are predicted to be slightly greater compared to those at the top of the grid. The magnitude of change is predicted to be medium adverse.

1.6.19 As identified in the section 1.5, a Central Management System would be included in the Site Campus design and lighting would be dimmed at a curfew time. Lighting would be activated by proximity sensors. These sensors would be zoned so only the paths that require lighting would be lit. When the lights are dimmed the light spill would reduce to 0 lux.

Table 1-6 Illuminance calculations around coastline near proposed Site Campus

Assessed location at sea with distance from coastline	Construction of Site Campus		Operation of Site Campus	
	Average lux level	Maximum lux level	Average lux level	Maximum lux level
30m north-east of coastline ('vertical right side' grid	0.98	3.21	0.12	0.22
20m from north of coastline ('vertical middle' grid	0.90	4.17	0.60	0.79
60m from north-west of coastline ('vertical left' grid)	0.7	2.47	0.23	0.45

Proposed bat barn at Cemaes

1.6.20 Calculations made for the proposed bat barn at Cemaes showed no increase in illuminance from construction activities in the Wylfa Newydd Development Area (annex 1-5). This was due to the position of the proposed bat barn on the downward slope of a large hill. Therefore, no change in light levels is predicted for this site.

Caerdegog Isaf Farm and Mynydd Ithel Farm (barn owl roosts)

1.6.21 Calculations made for the barn owl roosts at Caerdegog Isaf Farm and Mynydd Ithel Farm showed light spill levels from construction activities in the Wylfa Newydd Development Area to be a maximum level of 0.1lux (annex 1-

6). Therefore, a negligible adverse magnitiude of change in light levels is predicted for these sites.

Buffer zones along watercourses within the Wylfa Newydd Development Area and Cafnan Farm wildlife tower

1.6.22 There is potential for headlights associated with traffic moving on the haul road to Mound E to affect these sites. However, since construction of the mound would be limited to 07:00 – 19:00 hours, this effect would be very limited in duration and only intermittent.

1.6.23 Calculations made for the watercourse buffer zones within the Wylfa Newydd Development Area showed light spill levels from construction activities in the Wylfa Newydd Development Area to be 0 lux (annex 1-6) although an increase in sky glow would be visible. Since the concern with these sites is the potential presence of light-sensitive species of wildlife (e.g. otters, bats and fish), the issue of concern is light spill rather than sky glow. Therefore, a small adverse magnitude of change in light levels is predicted for these sites.

Proposed bat barn north of Tregele

1.6.24 Calculations made for the bat barn currently under construction to the north of Tregele (annex 1-7) indicate that maximum levels near the bat barn would be 0.3lux, while the minimum would be 0.1lux. However, this result was modelled without the presence of an existing small hill which would act as a screen for this location. Therefore, taking into account the presence of the hill, a negligible magnitude of change in light levels is predicted.

Marine environment surrounding MOLF

1.6.25 The lighting levels on the sea beyond the breakwaters have been assessed (annex 1-8). During construction of the breakwater, with a mobile crawler crane in operation (refer to section 1.5), it is assessed that illuminance levels could be up to 7lux at 50m out to sea, which is assessed as a medium adverse magnitude of change. The maximum level would occur only at times when the boom is pointing seaward (table 1-7). This would be a temporary effect as the mobile crawler crane would be constantly moving as it places armour units. Once the breakwater is completed the construction lighting would be removed from this location and the illuminance levels would drop to 0 lux.

Table 1-7 Illuminance calculations around coastline near proposed MOLF

Assessed location at sea beyond breakwater	Construction of MOLF and breakwaters		Operation of MOLF and breakwaters	
	Average lux level	Maximum lux level	Average lux level	Maximum lux level
50m west of proposed breakwater (towards Cemlyn Bay)	0.4	6.99	0	0

Assessed location at sea beyond breakwater	Construction of MOLF and breakwaters		Operation of MOLF and breakwaters	
	Average lux level	Maximum lux level	Average lux level	Maximum lux level
50m south-west of proposed breakwater (towards Cemlyn Bay)	0.03	0.12	0	0
50m south of proposed breakwater (Porth-y-pistyll)	0.02	0.11	0	0

Operation

1.6.26 Embedded and good practice mitigation would limit light trespass. However, security lighting around the site would be visible in the night-time views of some locations.

1.6.27 Light reflection off some buildings would potentially contribute to sky glow, in addition to the baseline sources of sky glow (the Existing Power Station site, Cemaes and Tregele).

1.6.28 During operation of the Power Station, a moderate increase in sky glow over and above that already generated by the baseline sources is predicted resulting in a medium adverse magnitude of change. Since the nocturnal sky is already compromised by baseline light sources, the significance of this potential effect is predicted to be moderate adverse.

1.6.29 For the nearest community receptors, Tregele and Cemaes, the magnitude of change is predicted to be small adverse. The distance and topography would help to prevent problems of light spill. Very little of the Power Station is predicted to be visible for receptors at Cemaes and the sky glow caused is likely to be less noticeable than that caused by the Existing Power Station, due to the better optical control of the proposed new lighting. Therefore, the significance of effect from Cemaes is likely to be negligible adverse. For Tregele, the significance of effect is predicted to be minor adverse accounting for the greater sensitivity of the location due to its closer proximity to the proposed Power Station.

1.6.30 No notable potential lighting effects are predicted on the ecological receptors since the Site Campus and its associated lighting would have been removed and there are no plans for the MOLF to be in operation.

1.6.31 The effects during operation would therefore be associated with sky glow and increased visible light in the night-time views, rather than light spill onto sensitive receptors.

Decommissioning

1.6.32 Lighting effects during decommissioning are expected to be similar to those during construction, in particular the effects of security, crane and task lighting. However, sensitive locations including Cemlyn Bay and buffer areas around

Tyn-y-Maes bat barn are not likely to be affected by decommissioning since the Site Campus would have been removed at the end of Main Construction and Mound E would be retained, hence no activities requiring lighting are anticipated in the vicinity of such sensitive locations during decommissioning.

1.7 Additional mitigation

1.7.1 The lighting designs for both construction and operation would be developed using the best available technologies. Additional mitigation would be developed to address potentially significant adverse effects by achieving the following:

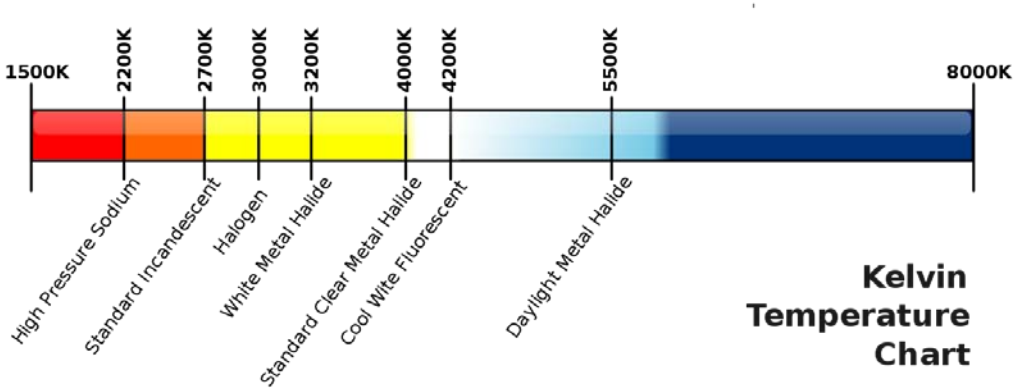
- reduce light spill onto sensitive receptors to below thresholds where significant effects are predicted; and
- limit visibility of new lighting at distant receptors.

1.7.2 Back shields would be used where required, for example, where light spill onto a sensitive receptor is identified. Back shields provide a physical barrier which blocks any backward lighting from a luminaire that is not required. These can be used as a direct barrier which stops lighting on the ground. Shields can also be implemented to reduce the effect of light visible from a distance. Some examples of back shields are provided in annex 1-9.

1.7.3 Additional mitigation would be required at Mound E during construction, for any works undertaken during hours of darkness to ensure light spill onto Cemlyn Bay is maintained below the threshold where significant effects on ecological receptors would be considered likely.

1.7.4 Close consideration would be taken when choosing the colour temperature of the lighting within the boundaries of the Wylfa Newydd Development Area. Typically, residential street lighting is closer to 3000K and motorways typically between 4000K – 5000K. This is as the higher the colour temperature, the more efficiently LEDs work. As the colour temperature gets to 4000K and above the eye perceives this lighting as glary. LEDs can be coated with a phosphate which would reduce the colour temperature, reducing glare. A chart identifying colour temperature can be seen below in figure 1-14.

Figure 1-14 Kelvin temperature chart



1.7.5 As detailed in volume 2 of the Design and Access Statement (Application Reference Number: 8.2.2) the colour scheme for the Power Station buildings would be developed to help reduce their visual effects. The choice of colour and material would influence the degree of light reflection from building façades.

1.7.6 Lighting technology is a rapidly advancing field, and it is uncertain what the best available technologies would be at the time when the detailed design is developed. The following provides some details of some newer and emerging technologies that could be used to further mitigate lighting effects where appropriate.

1.7.7 Lighting for biodiversity is a new technique of controlling the colour rendering index to negate any effects on migrating birds and nocturnal animals whilst still providing an efficient lighting solution. The colour of light has an effect on the attraction of bats and migrating birds.

- Long wavelength light (>600 nm) for minimum disturbance of bats.
- Short wavelength light (<600 nm) for minimum disturbance of migration birds.

1.7.8 New technology, such as Philips ClearSky (reduces effects on migratory birds) and ClearField (reduces effects on bats) technologies retain sufficient light for human perception and judgement at night whilst not interfering with certain ecological receptors.

1.8 Residual effects

1.8.1 The implementation of the additional mitigation would ensure that lighting levels would be limited as far as practicable. During construction, the addition of light would be visible and there would be noticeable effects of sky glow due to the scale of the construction activities, requirements for occasional upward lighting and light reflection of surfaces and dust. However, with modern lighting standards and controls on upward light ratios, the Power Station lighting would be less prominent during operation than the Existing Power Station lighting set out in the baseline. The residual significance of effects from sky glow and obtrusive light on relevant receptors is set out in table 1-8.

Table 1-8 Summary of residual effects

Receptor	Summary of baseline ligting condition / Sensitivity of receptor	Description of potential effect	Nature of effect	Potential magnitude of change	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Construction							
Dark skies (over Wylfa Newydd Development Area)	Dark skies already compromised by sky glow caused by lighting from Existing Power Station, Cemaes and Tregele. Medium sensitivity to potential further effects of sky glow.	Occasional effects from deliberate and careful use of upward light required for some construction operations. Some light would also reflect off surfaces. Upward light generally limited through use of directional luminaires and lighting control measures.	Temporary adverse	Large adverse	None identified.	Large adverse	Moderate adverse (for sky glow).
Cemaes	Several existing light sources present, some with poor optical control. Lighting from Existing Power Station is visible from Cemaes. Evaluated as Environmental Zone E3. Medium sensitivity to potential further effects of new lighting.	Crane lighting would be visible from this village. Potential for obtrusive light from task lighting but this would be limited by good practice of keeping crane lighting to face downwards. High mast lighting to be at 0° tilt.	Temporary adverse	Small adverse	None identified.	Small adverse	Minor adverse (for sky glow and obtrusive light). Refer to chapter D10 (Application Reference Number: 6.4.10).
Tregele	Several existing light sources present, some with poor optical control. Lighting from Existing Power Station is partially visible from Tregele. Evaluated as Environmental Zone E3. Medium sensitivity to potential further effects of new lighting.	High mast lighting and crane lighting would be visible from Tregele although some light screened by Mound B. If the lighting is not correctly controlled it could create obtrusive light, light intrusion and sky glow.	Temporary adverse	Medium adverse	Blackout blinds would be provided where nuisance identified.	Medium adverse	Moderate adverse (for sky glow and obtrusive light). Refer to chapter D10 (Application Reference Number: 6.4.10).
Cemlyn Bay	Lighting from Existing Power Station is visible although the lagoon is	There is potential for some task lighting and headlights associated	Temporary adverse	Small adverse	Additional lighting control measures to be applied to	Negligible	Refer to Shadow HRA Report (Application Reference Number: 5.2) for effects in relation to the SPA.

Receptor	Summary of baseline ligting condition / Sensitivity of receptor	Description of potential effect	Nature of effect	Potential magnitude of change	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
	dark. Evaluated as Environmental Zone E1. Refer to Shadow HRA Report (Application Reference Number: 5.2) and chapter D9 (Application Reference Number: 6.4.9) for sensitivity of species associated with this area to lighting.	with construction of Mound E to affect lagoon. Due to limited working hours at this location, effects would be limited. However short-term exceedances of the 0.1lux threshold are predicted.			keep lighting levels to below 0.1lux threshold.		Refer to chapter D9 (Application Reference Number: 6.4.9) for significance of lighting effects on ecology.
Wylfa Head	Topography shields some light but sky glow from the Existing Power Station is clearly visible. Evaluated as Environmental Zone E1. Refer to chapter D9 (Application Reference Number: 6.4.9) and chapter D13 (Application Reference Number: 6.4.13) for sensitivity of species associated with this area to lighting.	Temporary increase in illuminance onto coastline and sea from Site Campus lighting, particularly from the northern area of the Site Campus.	Temporary adverse	Medium adverse	None identified.	Medium adverse	Refer to chapter D9 (Application Reference Number: 6.4.9) and chapter D13 (Application Reference Number: 6.4.13) for significance of lighting effects on ecology.
Existing bat barn at Tyn-y-Maes	Intrinsically dark. Evaluated as Environmental Zone E1. Refer to chapter D9 (Application Reference Number: 6.4.9) for sensitivity of species associated with this area to lighting.	Some light trespass from construction and operation of Site Campus may affect buffer zone surrounding bat barn but vegetation should screen light at the bat barn.	Temporary adverse	Negligible	None identified.	Negligible	Refer to chapter D9 (Application Reference Number: 6.4.9) for significance of lighting effects on ecology.
Proposed bat barn at Cemaes	Lighting from Cemaes close to site. Evaluated as Environmental Zone E2.	No noticeable increase in lighting predicted due to topography.	Neutral	Negligible	None identified.	N/A	Refer to chapter D9 (Application Reference Number: 6.4.9) for significance of lighting effects on ecology.

Receptor	Summary of baseline ligting condition / Sensitivity of receptor	Description of potential effect	Nature of effect	Potential magnitude of change	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
	Refer to chapter D9 (Application Reference Number: 6.4.9) for sensitivity of species associated with this area to lighting.						
Proposed bat barn near Tregele	Lighting from A5025 close to site. Evaluated as Environmental Zone E2. Refer to chapter D9 (Application Reference Number: 6.4.9) for sensitivity of species associated with this area to lighting.	No noticeable increase in lighting predicted due to topography.	Neutral	Negligible	None identified.	N/A	Refer to chapter D9 (Application Reference Number: 6.4.9) for significance of lighting effects on ecology.
Caerdegog Farm	Low levels of lighting present. Evaluated as Environmental Zone E2. Refer to chapter D9 (Application Reference Number: 6.4.9) for sensitivity of species associated with this area to lighting.	No noticeable increase in lighting predicted due to distance.	Neutral	Negligible	None identified.	N/A	Refer to chapter D9 (Application Reference Number: 6.4.9) for significance of lighting effects on ecology.
Mynydd Ithel Farm	Intrinsically dark. Evaluated as Environmental Zone E1. Refer to chapter D9 (Application Reference Number: 6.4.9) for sensitivity of species associated with this area to lighting.	No noticeable increase in lighting predicted due to distance.	Neutral	Negligible	None identified.	N/A	Refer to chapter D9 (Application Reference Number: 6.4.9) for significance of lighting effects on ecology.

Receptor	Summary of baseline ligting condition / Sensitivity of receptor	Description of potential effect	Nature of effect	Potential magnitude of change	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Cafnan Farm	Intrinsically dark. Evaluated as Environmental Zone E1. Refer to chapter D9 (Application Reference Number: 6.4.9) for sensitivity of species associated with this area to lighting.	Lighting from haul route associated with Mound E would have potential to intermittently trespass into buffer zone on watercourse. Effect limited by time restrictions on work. No noticeable change from other construction lighting.	Temporary adverse	Small adverse	None identified.	Small adverse	Refer to chapter D9 (Application Reference Number: 6.4.9) for significance of lighting effects on ecology.
Buffer zones along watercourses within the Wylfa Newydd Development Area	Intrinsically dark. Evaluated as Environmental Zone E1. Refer to chapter D9 (Application Reference Number: 6.4.9) for sensitivity of species associated with this area to lighting.	Lighting from haul route associated with Mound E would have potential to intermittently trespass into buffer zone on watercourse. Effect limited by time restrictions on work. No noticeable change from other construction lighting.	Temporary adverse	Small adverse	None identified.	Small adverse	Refer to chapter D9 (Application Reference Number: 6.4.9) for significance of lighting effects on ecology.
Marine environment (beyond breakwaters)	Intrinsically dark although light visible from Existing Power Station. Refer to chapter D13 (Application Reference Number: 6.4.13) for sensitivity of species associated with this area to lighting.	Intermittent increases in illuminance from crane lighting during construction of breakwaters. Negligible effects once breakwaters completed.	Temporary adverse	Medium adverse to negligible	None identified.	Medium adverse to negligible	Refer to chapter D13 (Application Reference Number: 6.4.13) for significance of lighting effects on ecology.

Receptor	Summary of baseline ligting condition / Sensitivity of receptor	Description of potential effect	Nature of effect	Potential magnitude of change	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Operation							
Dark skies (over Wylfa Newydd Development Area) Medium sensitivity to potential further effects of sky glow.	Dark skies already compromised by sky glow caused by lighting from Existing Power Station, Cemaes and Tregele.	Lighting reflecting off building surfaces and water contributing to sky glow.	Long-term adverse	Medium adverse	None identified.	Medium adverse	Moderate adverse (for sky glow).
Cemaes Medium sensitivity to potential further effects of new lighting.	Several existing light sources present, some with poor optical control. Lighting from Existing Power Station is visible from Cemaes. Evaluated as Environmental Zone E3.	Potential sky glow visible caused by light reflecting off buildings.	Long-term adverse	Small adverse	None identified.	Small adverse	Negligible (for sky glow and obtrusive light). Refer to chapter D10 (Application Reference Number: 6.4.10).
Tregele Medium sensitivity to potential further effects of new lighting.	Several existing light sources present, some with poor optical control. Lighting from Existing Power Station is partially visible from Tregele. Evaluated as Environmental Zone E3.	Security lighting around the site if not properly controlled would create obtrusive light, light intrusion and sky glow although Mound B would screen a lot of this light.	Long-term adverse	Small adverse	None identified.	Small adverse	Minor adverse (for sky glow and obtrusive light). Refer to chapter D10 (Application Reference Number: 6.4.10).

[This page is intentionally blank]

1.9 References

Table 1-9 Schedule of references

ID	Reference
RD1	Institute of Lighting Professionals. 2013. *PLG04 Guidance on Undertaking Environmental Lighting Impact Assessments* [Online]. [Accessed: 26 January 2018]. Available from: https://www.theilp.org.uk/resources/ilp-general-reports/plg04/
RD2	Isle of Anglesey County Council. 2010. *Supplementary Planning Guidance: Design in the Urban and Rural Built Environment, Guidance Note 10: Lighting -2010* [Online]. [Accessed: 26 January 2018]. Available from: http://www.anglesey.gov.uk/Journals/public/attachments/120/SPG_Lighting_Adopted_English.pdf
RD3	Institute of Lighting Professionals. 2011. *Guidance Notes for the Reduction of Obtrusive Light GN01:2011* [Online]. [Accessed: 26 January 2018]. Available from: https://www.theilp.org.uk/documents/obtrusive-light/
RD4	Institute of Lighting Professionals. 2007. *Technical Report 28-2007 Guidelines Measurement of Lighting performance on site* [Online]. [Accessed: 26 January 2018]. Available from: https://www.theilp.org.uk/home
RD5	Snowdonia National Park Authority. 2016. *Supplementary Planning Guidance, Guidance Note 14, Obtrusive Lighting (Light Pollution)* [Online]. [Accessed: 26 January 2018]. Available from: http://www.snowdonia.gov.wales/__data/assets/pdf_file/0010/758026/merged_document_6.pdf
RD6	Magnox Ltd. 2017. *Wylfa Site Environmental Management Plan, Issue Six* [Online]. [Accessed: 26 January 2018]. Available from: https://magnoxsites.com/wp-content/uploads/2018/01/Wylfa-Environmental-Management-Plan-Issue-6.pdf.
RD7	Parkes, Matthew. 2014. *Awyr Dywyll Môn / Anglesey Dark Skies*.[Online]. [Accessed: 26 January 2018]. Available from: http://www.anglesey.gov.uk/Journals/z/j/s/anglesey-dark-skies.pdf
RD8	Rowlands, John. 2015. Anglesey Night Sky Quality Baseline Assessment: Summary of Findings and Recommendations [Online]. [Accessed: 26 January 2018]. Available from: http://www.anglesey.gov.uk/Journals/y/i/b/summary_findings.pdf
RD9	Health and Safety Executive. 1997. *HSG38: Lighting at work* [Online]. [Accessed: 26 January 2018]. Available from: http://www.hse.gov.uk/pubns/books/hsg38.htm
RD10	British Standards Institution. 2015. *BS EN 13201-2:2015 Road lighting. Performance requirements* [Online]. [Accessed: 26 January 2018].

ID	Reference
	Available from: https://shop.bsigroup.com/ProductDetail/?pid=000000000030271222
RD11	British Standards Institution. 2014. *BS EN 12464-2:2014 Light and lighting – Lighting of work places: Outdoor work places*. [Online]. [Accessed: 26 January 2018]. Available from: https://shop.bsigroup.com/ProductDetail/?pid=000000000030281364
RD12	British Standards Institution. 2013. *BS 5489-1:2013 Code of Practice for the design of road lighting: Lighting of roads and public amenity areas* [Online]. [Accessed: 26 January 2018]. Available from: https://shop.bsigroup.com/ProductDetail/?pid=000000000030217237
RD13	Institute of Lighting Professionals. 2013. *PLG07 High masts for lighting and CCTV* [Online]. [Accessed: 26 January 2018]. Available from: https://www.theilp.org.uk/resources/ilp-general-reports/plg07-high-masts-for-lighting-and-cctv-2013-edition/
RD14	Her Majesty's Government. 2015. *Approved Document L2B: Conservation of fuel and power in existing buildings other than dwellings* (2010 edition incorporating 2010, 2011, 2013 and 2016 amendments [Online]. [Accessed: 26 January 2018]. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/540329/BR_PDF_AD_L2B_2013_with_2016_amendments.pdf
RD15	Chartered Institute of Building Services Engineers. 2016. *LG06/16 Lighting Guide 06: The Exterior Environment – LG6* [Online]. [Accessed: 26 January 2018]. Available from: https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q20000008K5EsAAK
RD16	British Standards Institute. 2013. BS5489-2013-1 Code of practice for the design of road lighting: Lighting of roads and public amenity areas [Online]. [Accessed: 26 January 2018]. Available from: https://shop.bsigroup.com/ProductDetail/?pid=000000000030217237
RD17	Landscape Institute and Institute of Environmental Management and Assessment. 2013. *Guidelines for Landscape and Visual Impact Assessment Third Edition (GLVIA3)*. Abingdon: Routledge.

Appendix 1-1 Glossary of lighting

Term	Meaning
Asset lighting	A generic term for any external lighting that may be required to illuminate particular buildings, structures or plant within the Wylfa Newydd Development Area.
Cowl	Physical light spill control accessory.
Dark Sky Park	Land possessing an exceptional or distinguished quality of starry nights and a nocturnal environment that is specifically protected for its scientific, natural, educational, cultural heritage, and/or public enjoyment. The land may be publically owned, or privately owned provided that the landowner(s) consent to the right of permanent, ongoing public access to specific areas included in the IDA designation.
Dark Sky Reserve	Public or private land possessing an exceptional or distinguished quality of starry nights and nocturnal environment that is specifically protected for its scientific, natural, educational, cultural, heritage and/or public enjoyment. Reserves consist of a core area meeting minimum criteria for sky quality and natural darkness, and a peripheral area that supports dark sky preservation in the core. Reserves are formed through a partnership of multiple land managers who have recognised the value of the natural night-time environment through regulations and long-term planning.
Diffuse	Term describing dispersed light distribution referring to the scattering of light.
Disability Glare	The presence of a sufficient amount of glare to cause discomfort. Visual tasks are performed but it is uncomfortable.
Glare	Glare is a result of light emitted from a source that is in sharp contrast to its surroundings.
High Mast	System of lighting for large areas using masts carrying clusters of luminaires.
High pressure sodium lamp	A lamp whose light is produced by radiation from high pressure sodium vapour which usually includes a small amount of UV light.
Hood	Physical light spill control accessory.

Term	Meaning
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.
International Dark Skies Association (IDA)	A non-profit organisation that works to help stop light pollution and protect the night skies for present and future generations.
IDA 'Bronze' status	Night-time environments that do not meet the requirements of IDA 'Silver' status but offer people, plants and animals a respite from a degraded nocturnal environment and suitable for communicating the issue of light pollution and connecting people with the many aspects of the night sky.
IDA 'Silver' status	Night-time environments that have minor impacts from light pollution and other artificial light disturbance, yet still display good quality night skies and have exemplary night-time lightscapes.
Light cone	The angle at which the beam falls off to 50% of peak intensity.
Light pollution	The spillage of light into areas where it is not required. Also known as obtrusive light.
Light spill	The light that falls outside the light cone.
Light trespass (nuisance)	The spillage of light into areas where it is not required. Also known as obtrusive light.
Louvres	Physical light spill control accessory.
Low pressure sodium	A discharge lamp in which light is produced by radiation from low pressure sodium vapour. Emits light predominantly at 589nm which creates a yellow/orange glow.
Lumen	The unit of light output from a lamp.
Luminaire	Light fitting or unit designed to distribute light from a lamp or lamps.
Luminance	The physical measure of the stimulus that produces the sensation of brightness measured by the luminous intensity reflected in a given direction. The unit is the candela per square metre (cd/m^2).
Lux	Illuminance is the quantity of light or luminous flux, falling on a unit area of a surface in the environment. It is designated by the symbol E. The unit is lux.

Term	Meaning
Nuisance Glare	The presence of a sufficient amount of glare to be bothersome, but not enough to prevent visual task performance or lead to discomfort.
Obtrusive Light	Obtrusive light that hinders or bothers the human eye.
Shield	Physical light spill control accessory.
Sky glow	The brightening of the night sky caused by artificial lighting. Sky glow is a combination of light emitted upwards from a light source and reflected light cast downwards from the surface being illuminated reflecting off particles suspended in the atmosphere.
Spill light	Illuminance falling beyond the area that is being lit. Spill light is quantifiable and measurable, and is used to define levels of light trespass.
Ultra violet	Radiation that is shorter in wavelength and higher in frequency than visible violet light.
Voltage	The difference in electrical potential between two points of an electrical circuit.
Watt (W)	The unit for measuring electrical power.

[This page is intentionally blank]

Appendix 1-2 Baseline survey information

Cemaes

1-2.1.1 Photographs (figures 1-15 and 1-16) were taken facing west from layby and seating area on Bridge Street in Cemaes overlooking Cemaes harbour (figure 1-1).

GPS 53.413587, -4.448240

Survey notes for Cemaes

1-2.1.2 This area is located on a hill looking south over Cemaes with the Existing Power Station in the distance.

Figure 1-15 View looking south over the village of Cemaes with Existing Power Station visible in the background

Figure 1-16 Night-time view looking south over the village of Cemaes with Existing Power Station visible in the background

1-2.1.1 As you can see from figure 1-16 Cemaes has a mixture of light sources with varying degrees of optical control. You can see the Existing Power Station illuminated in the background. This is why the baseline assessment has given this area an Environmental rating of E3 due to the amount of obtrusive light it generates.

1-2.1.2 A light level survey was completed on the viewpoint in the photograph in figure 1-17 (results shown in figure 1-18) and it was found the average level was 6lux equating to a P4 lighting standard. This section of road is white light LED but you will see from the 5-degree uplift on the column side entry mounting bracket that this creates light pollution. This was not installed in line with Anglesey's SPG 10 [RD2]. By mounting these LED luminaires in this manner it creates upward light over the 90 degree cut off recommend in GN01 "Guidance notes for the reduction of Obtrusive light" and does nothing to help improve their dark sky status.

1-2.1.3 The same viewpoint was visited in October 2016 where a similar photograph was taken (figure 1-19) showing a HPS SON installation.

1-2.1.4 It had rained earlier in the evening but the weather was clear and dry during the survey and the temperature was 5°C.

Figure 1-17 View of Bridge street in Cemaes (2018)

Figure 1-18 Lux levels on Bridge street in Cemaes

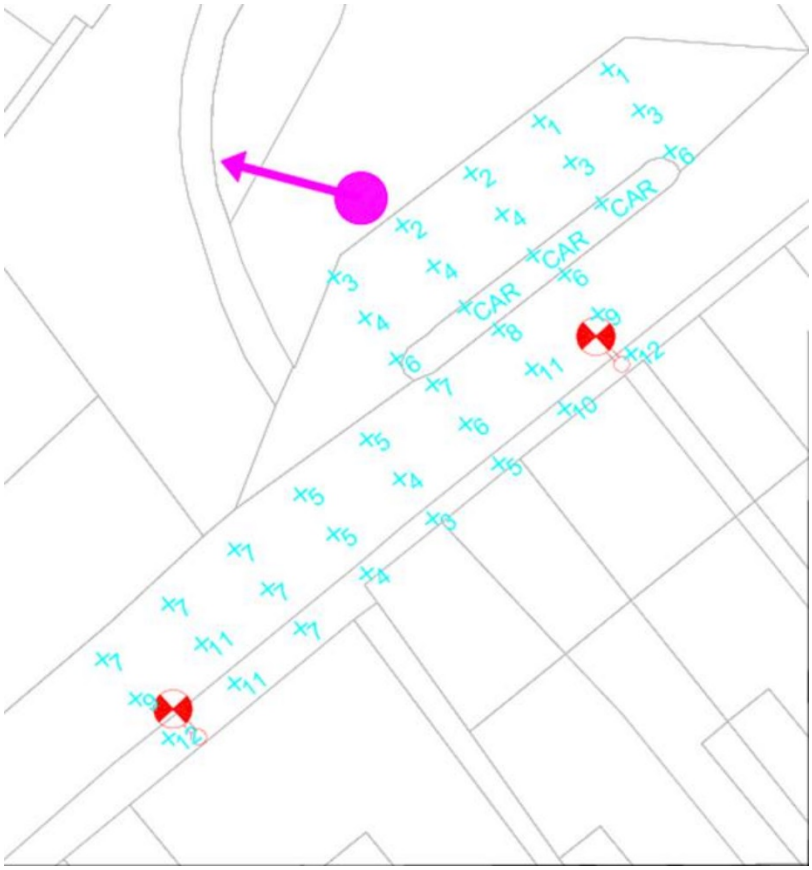


Figure 1-19 HPS SON 2016 (Bridge Street, Cemaes, 2016)

Tregele

1-2.1.1 Photography was taken from the A5025 on western edge of Tregele (figure 1-20). (GPS 53.404831, -4.474337)

Survey notes for Tregele

1-2.1.2 This viewpoint is located east of the Existing Power Station on the western edge of Tregele. The Horizon site offices can be seen to the right of the Existing Power Station. The terrain was muddy but accessible. The Existing Power Station is clearly visible in the view (figure 1-20).

Figure 1-20 Near A5025, Tregele

1-2.1.1 The night-time view (figure 1-21) shows that the Existing Power Station is visible from the A5025 at Tregele. Also the Horizon site offices can be clearly seen. There was also sky glow that was not picked up in the photography but was visible to the human eye. It was a clear night, so the sky glow would be expected to be greater on a cloudy night. This area has an environmental rating E3 based on lighting currently present around Tregele village. The average lighting level in this area was 8lux (figure 1-22) which was sourced from a combination of the petrol station lighting and street lighting. The street lighting has recently been upgraded to LED.

Figure 1-21 Night-time view from Tregele, near A5025

Figure 1-22 Lux levels Tregele

Cemlyn Bay (GPS 53.413587, -4.448240)

Survey notes for Cemlyn Bay

1-2.1.1 Due to weather conditions we visited this viewpoint during the day in December and then returned in January 2018 to undertake the night-time assessment. From the daytime photograph (figure 1-23) you can see the Existing Power Station in the background.

1-2.1.2 This viewpoint is to the south-east of the Existing Power Station site. It is surrounded by scrubland and overlooks the bay. The photograph has been taken to show the effect of lighting from the Existing Power Station has on the shoreline. The image is at Cemlyn bay which is a protected area for

species of tern. As can be seen the land dips down before rising back up around the Existing Power Station. There are very few trees around this area with most vegetation being species of grass and general brush (thistle, ferns etc.). The bay is very rocky although there are a few sandy beaches, these look to be mostly covered during high tide.

Figure 1-23 View north-east from Cemlyn Bay, south-east of Pen Carreg farmstead

1-2.1.1 At night, the Existing Power Station can be clearly seen from this viewpoint (figure 1-24). As you can see there is a lot of light from the Existing Power Station although the majority of light is blocked by the bay (directly ahead). There is however still a small amount of spill into the bay with light reflecting on the water; this is visible to the naked eye but does not translate in figure 1-24 below. There is also a very bright green light on the end of the pontoon believed to be there for safety reasons. The Environmental Zone for this area is evaluated as E1.

Figure 1-24 Night-time view north-east from Cemlyn Bay, south-east of Pen Carreg farmstead

Proposed bat barn location near Cemaes

1-2.1.1 GPS 53.408412, -4.461168

Survey notes for proposed bat barn location, Cemaes

1-2.1.2 Viewpoint B (figure 1-1) - Land access permission was not granted at the time of the survey.

1-2.1.3 Viewpoint B is located at the start of Cemaes Village and is adjacent to a lit car sales yard and Ffordd Caergybi Road is also lit. As can be seen in figure 1-25, the Existing Power Station is not visible from this viewpoint. Without access we could not survey baseline conditions. Currently evaluated as Environmental Zone E2 based on current lighting conditions in Cemaes.

Figure 1-25 Car Sales yard adjacent to Proposed Bat Barn at Cemaes

Proposed bat barn north of Tregele

1-2.1.1 GPS 53.405501, -4.471532 (viewpoint C, figure 1-1)

Survey notes for proposed bat barn location near Tregele

1-2.1.2 This viewpoint is located to the North of Tregele. The bat barn was under construction at the time of survey (January 2018).

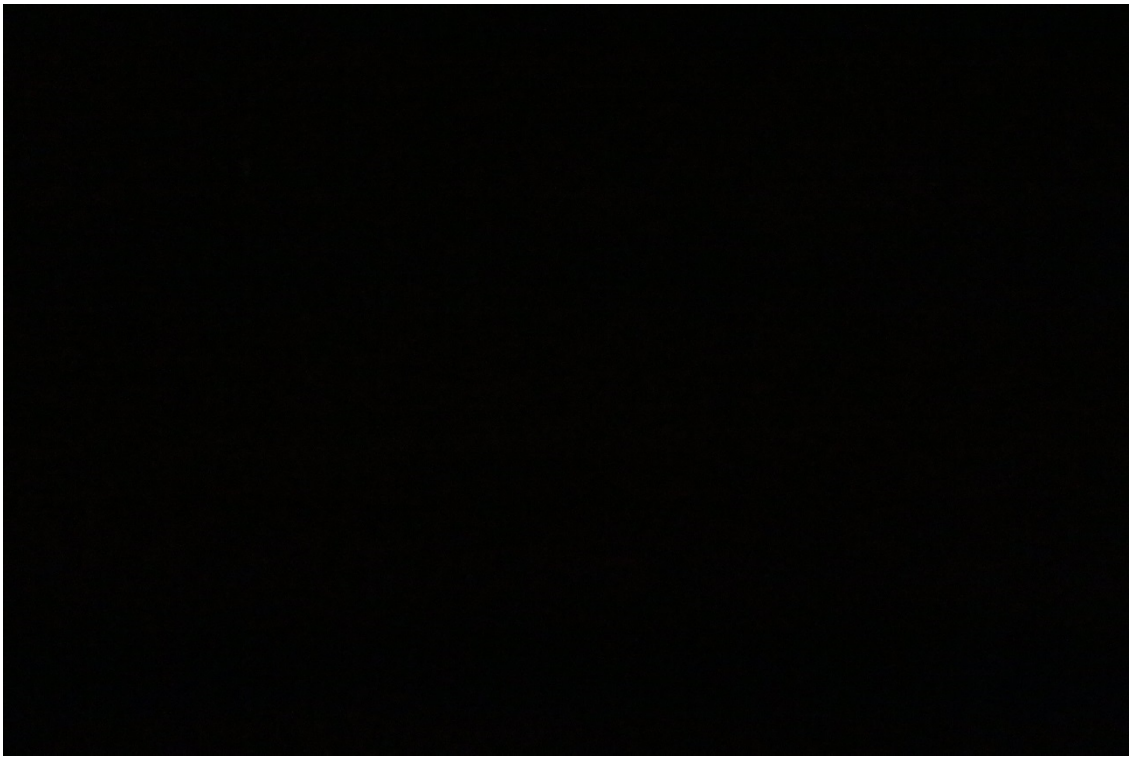
1-2.1.3 The viewpoint is shielded by a mound approximately 4m high, the Existing Power Station is not visible from this viewpoint (figure 1-26). There is existing lighting in the area on A5025 close to this viewpoint.

1-2.1.4 The night visit to this area showed no light trespass from the existing road lighting with a small amount of sky glow from Tregele Village (photography was unable to pick up the sky glow (figure 1-27)). The main contributor to this sky glow was the Tregele petrol station. The average lighting level around the Tregele petrol station and along the lit A5025 is 7lux average while the garage is in operation. The garage is located approximately 300m south-west of the proposed bat barn. Currently evaluated as Environmental Zone E2 based on current lighting in Tregele.

1-2.1.5 Limitation: Camera was not able to pick up sky glow.

Figure 1-26 View from Proposed bat barn north of Tregele

Figure 1-27 Night-time View from Proposed bat barn north of Tregele



Existing bat barn at Tyn-y-Maes (GPS 53.416183, -4.476712)

Survey notes

1-2.1.1 This viewpoint is located in a hilly area surround by trees which are a mix of deciduous and evergreen trees, this forms a natural screen from the Existing Power Station. There is a partial view of the Existing Power Station but the high trees and shrubs shield this viewpoint from light.

Figure 1-28 Tyn-y-Maes bat barn

1-2.1.1 Night-time visit confirmed that the area was in complete darkness. Some sky glow can be seen from the Existing Power Station turbine building although this is not captured in a photograph. Overall this area is currently an E1 Environmental Zone and is shielded by the topography of the land and remains dark.

1-2.1.2 Limitation: Camera unable to capture sky glow.

Wylfa Head

Survey notes

1-2.1.3 This viewpoint was a difficult area to access during the day. The terrain was rough and rocky and it was close the cliff edge. The Existing Power Station is very clearly visible.

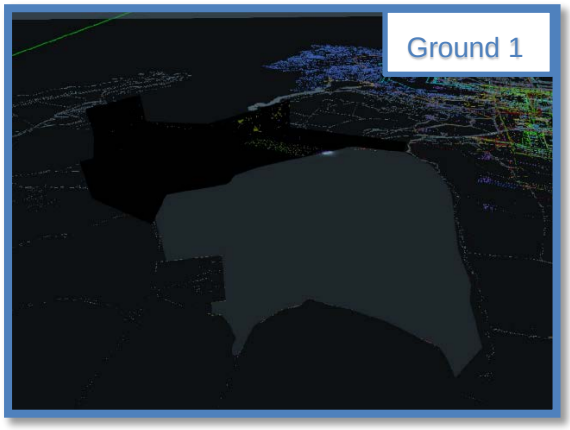
Figure 1-29 Wylfa Head

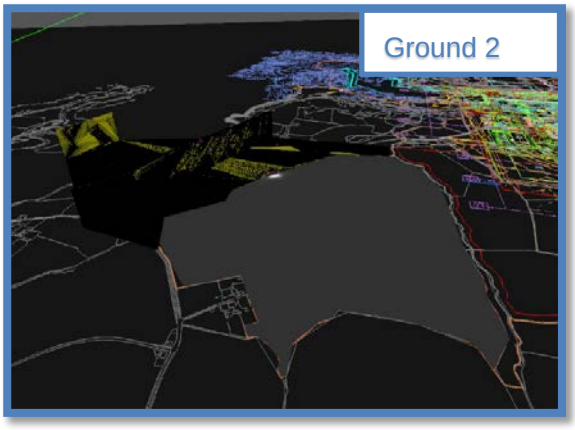
1-2.1.1 At night there is some shielding of the security lighting from the small hills seen in figure 1-30. The sky glow from the Existing Power Station is clearly visible and the buildings can be clearly seen against the night sky. This area is an E1 Environmental Zone.

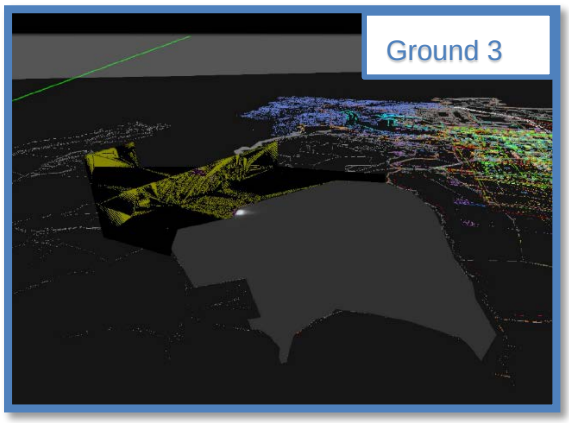
Figure 1-30 Night-time view on Wylfa Head

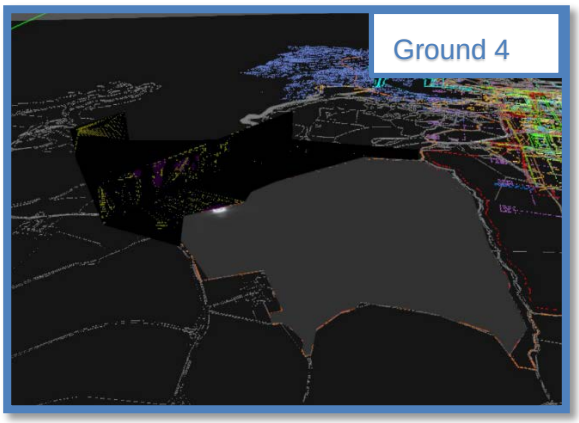
[This page is intentionally blank]

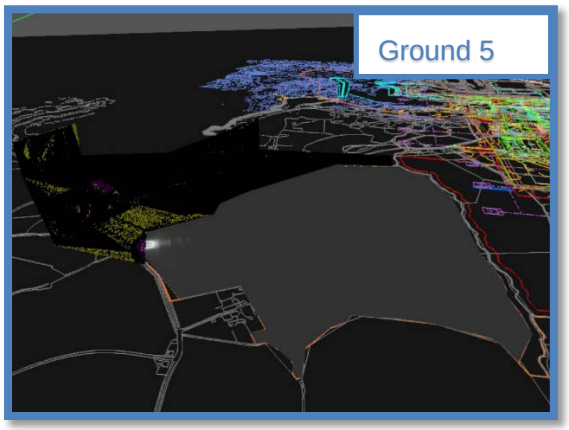
Appendix 1-3 Lighting positions calculated for Mound E

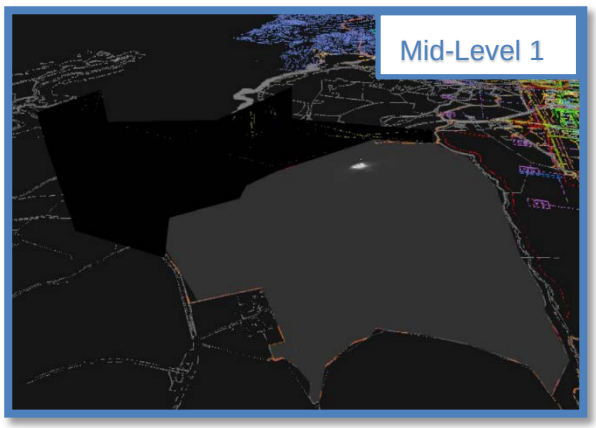


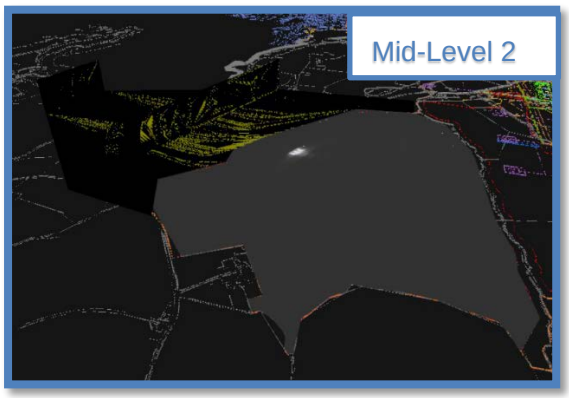


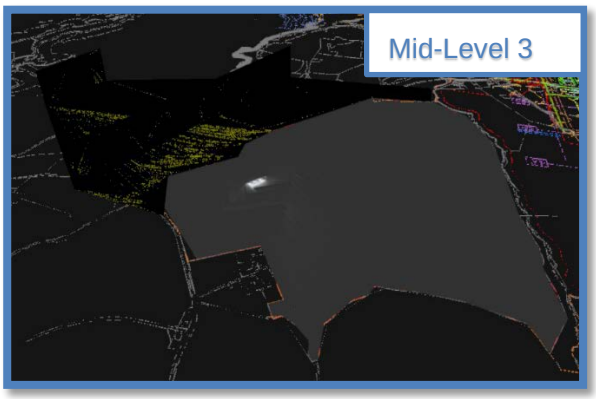


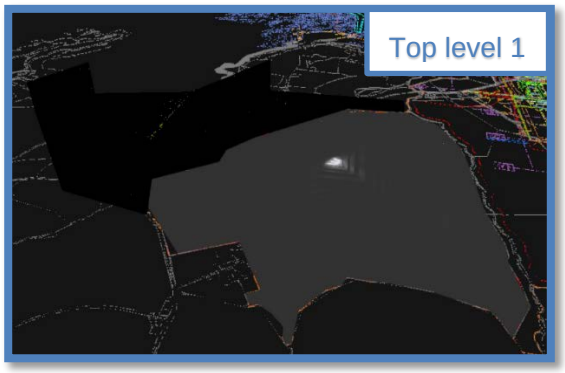







Mid-Level 2


Mid-Level 3


Top level 1

Appendix 1-4Coastline grid illuminance results

Figure 1-31 Coastline north-east of the Site Campus ('vertical right side' grid) during construction of Site Campus

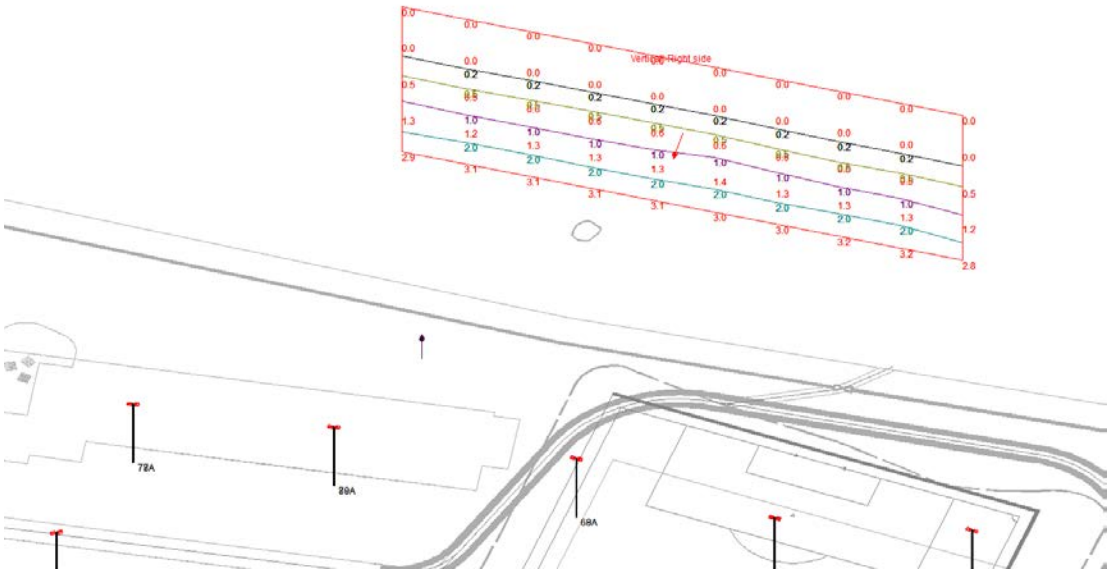


Figure 1-32 Coastline north-east of the Site Campus ('vertical right side' grid) during operation of Site Campus

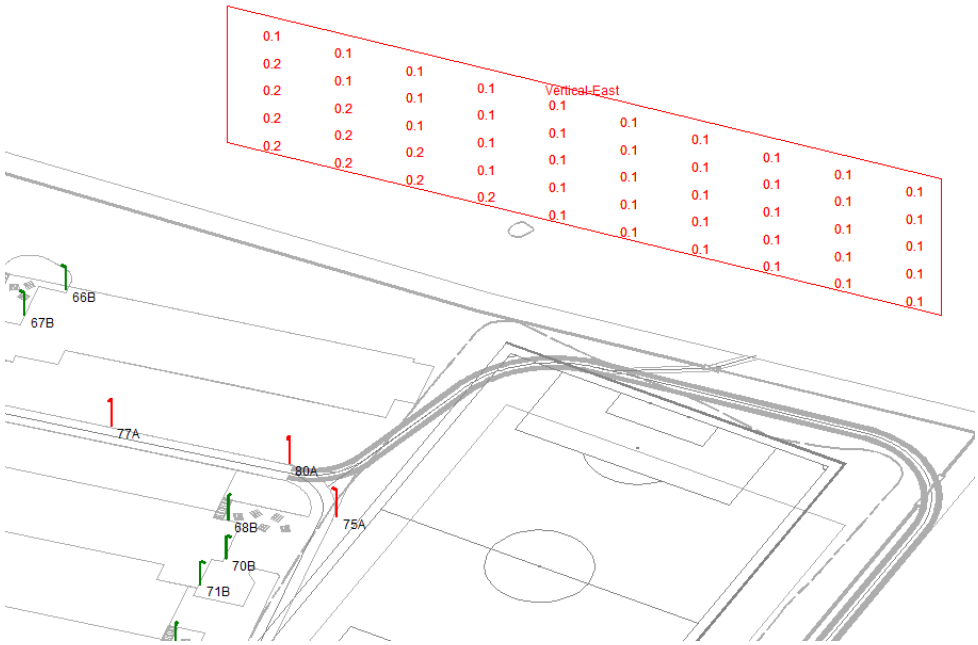


Figure 1-33 Coastline north of the Site Campus ('vertical middle' grid) during construction of Site Campus

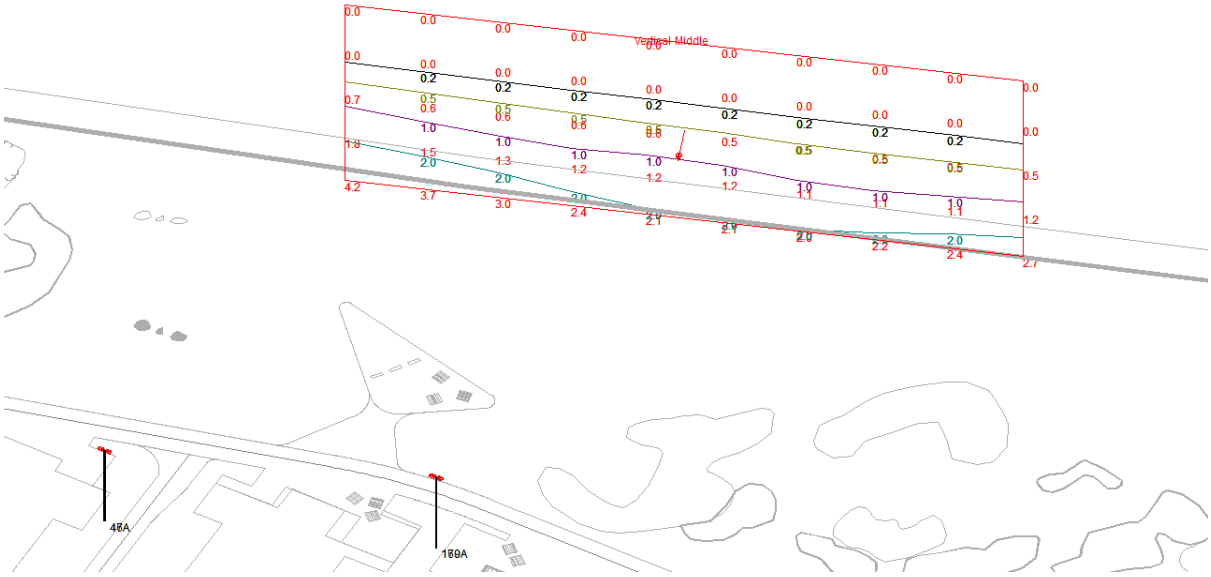


Figure 1-34 Coastline north of the Site Campus ('vertical middle' grid) during operation of Site Campus

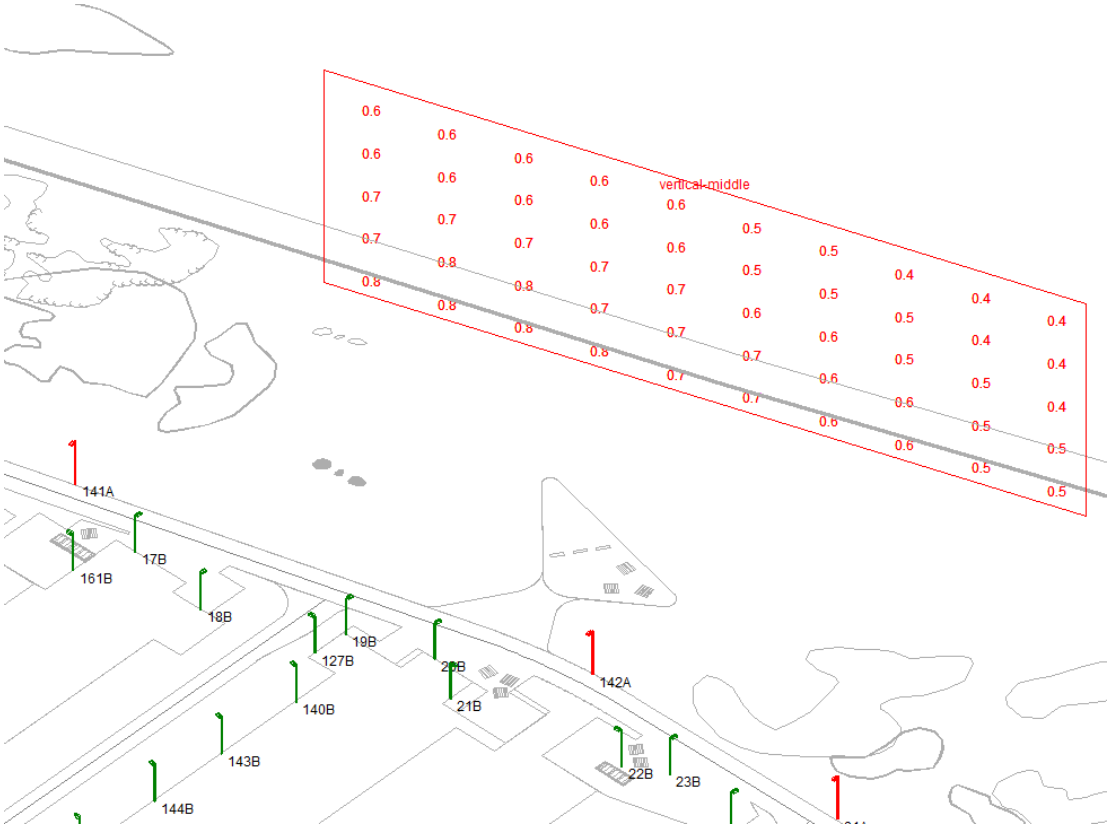


Figure 1-35 Coastline north-west of the Site Campus ('vertical left' grid) during construction of Site Campus

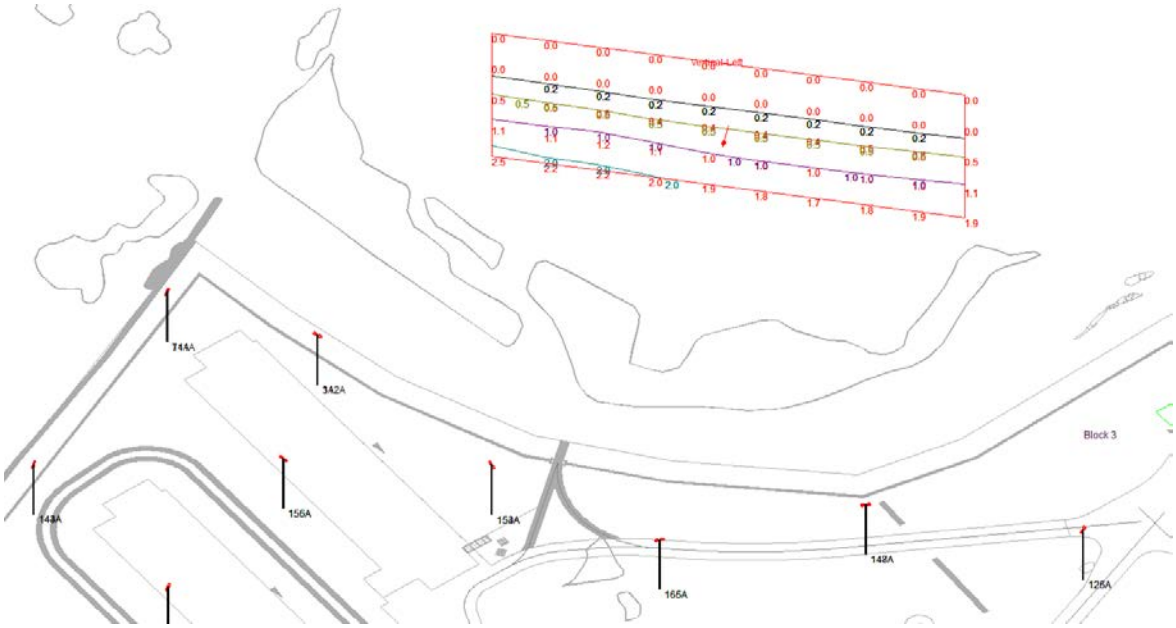
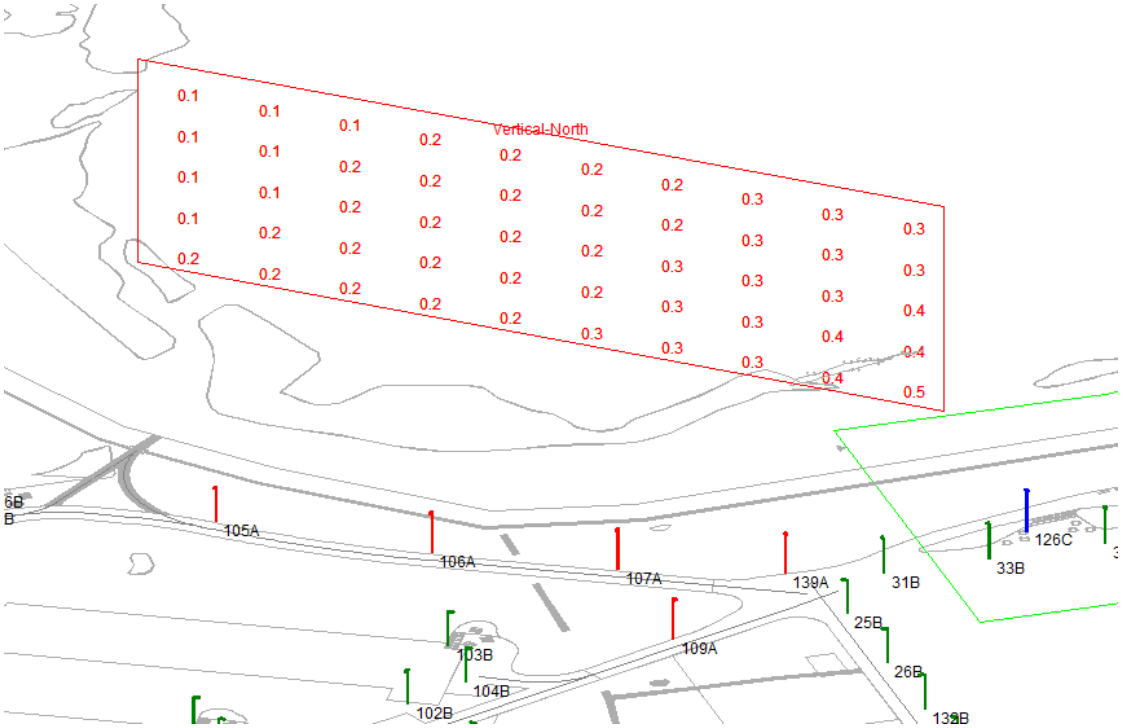


Figure 1-36 Coastline north-west of the Site Campus ('vertical left' grid) during operation of Site Campus



[This page is intentionally blank]

Appendix 1-5Illuminance results for proposed bat barn location near Cemaes

Figure 1-37 Grid location (Proposed at barn near Cemaes)

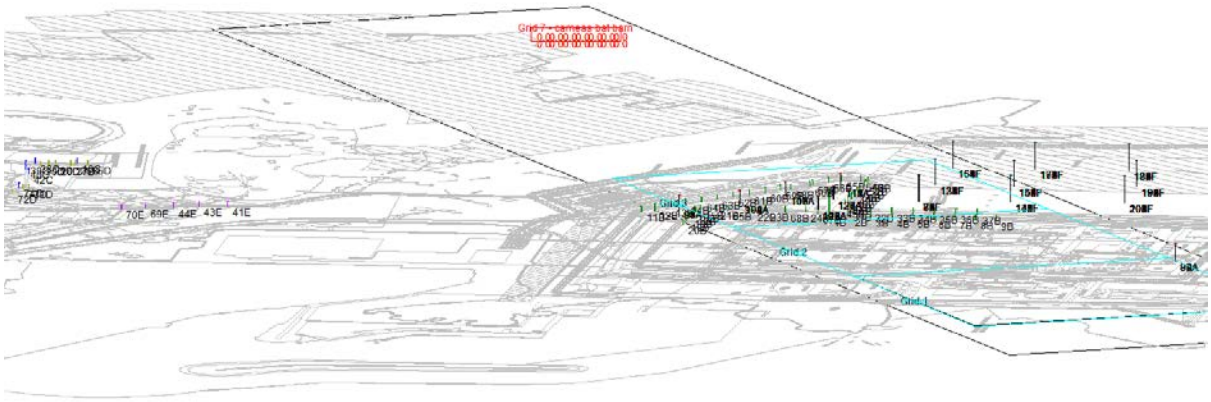
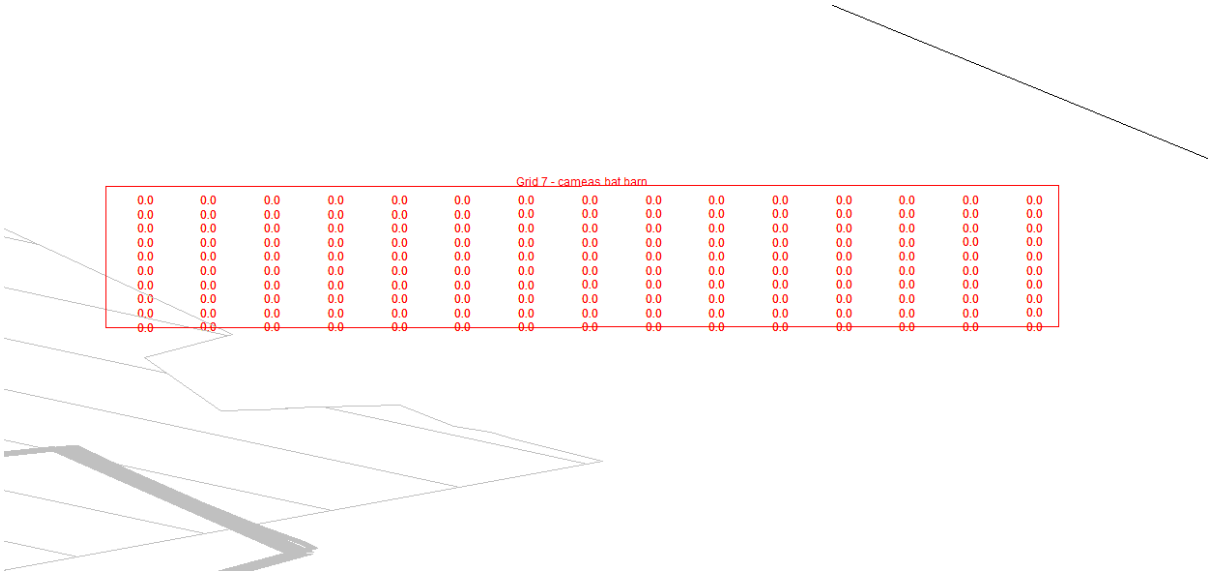


Figure 1-38 Illuminance results (Proposed at barn near Cemaes)



[This page is intentionally blank]

Appendix 1-6 Caerdegog Isaf Farm (barn owl roost) and Watercourse (on-site ecological receptor location) illuminance results

Figure 1-39 Location of vertical grids in relation to the Power Station Site (south-west, south and east)

1-6.1.1 The indicative construction area lighting has been divided into sections which include perimeter fences, outer site and inner security site that have been designed to an average of 5lux, 50lux and 100lux respectively with 40% uniformity. For specific task lighting the level may need to be increased to 200lux for a limited time; the additional light would be provided by mobile lighting units. The spill light assessment has been calculated at a maintenance factor of 1 as outlined in PLG04 [RD1].

1-6.1.2 The column mounting heights are 30m, 15m and 6m for the inner security site, outer site and perimeter fences with a 0° tilt to maintain the ULR of 0 %. Luminaires are positioned so they are facing away from the coast, the bat barn at Tregele and SSSIs. The varying mounting heights allow for good coverage with fewer columns around the inner construction zone and tapering down towards the boundary. This reduces the amount of light trespass over the boundaries.

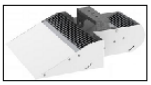
Luminaire A Data

Supplier	
Type	HMAO.L584.SQ
Lamp(s)	4000K LED with 70CRI
Lamp Flux (klm)	60.99
File Name	HMAO.L584.SQ.ies
Maintenance Factor	1.00
Imax70,80,90(cd/klm)	289.9, 15.0, 0.0

Luminaire B Data

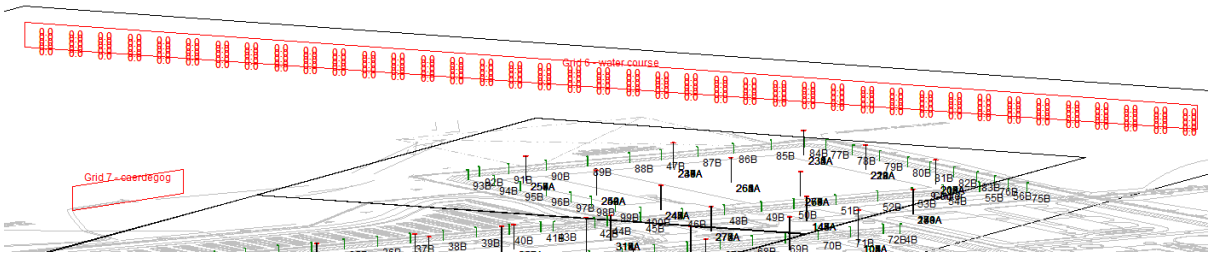
Supplier	Holophane Europe
Type	VMX.L034.V1.F4Q1
Lamp(s)	LED C.3000LM - 4000K
Lamp Flux (klm)	3.25
File Name	VMX.L034.V1.F4Q1.IES
Maintenance Factor	1.00
Imax70,80,90(cd/klm)	461.8, 69.9, 0.0

Luminaire C Data



Supplier	C U Phosco
Type	FL800R-3-A3-CW-D700-458W
Lamp(s)	757P CW
Lamp Flux (klm)	49.15
File Name	FL800R-3-A3-CW-D700-458W.ies
Maintenance Factor	1.00
Imax70,80,90(cd/klm)	32.4, 3.7, 0.0

Figure 1-40 Illuminance results for buffer zone along watercourse (ecological receptor) within Wylfa Newydd Development Area



1-6.1.1 The grid height is set from ground level to height of 15m and the grid is located 300m south of the proposed fence line of the site. The nearest lighting column from the watercourse is 175m away. The above vertical grid shows that the level near the watercourse is 0 lux. The watercourse runs along the south-west of the main site. There would be an increase of sky glow during construction which is deemed to be a small adverse magnitude of change due to proximity of the site.

Figure 1-41 Caerdegog farm with Power Station Site lighting

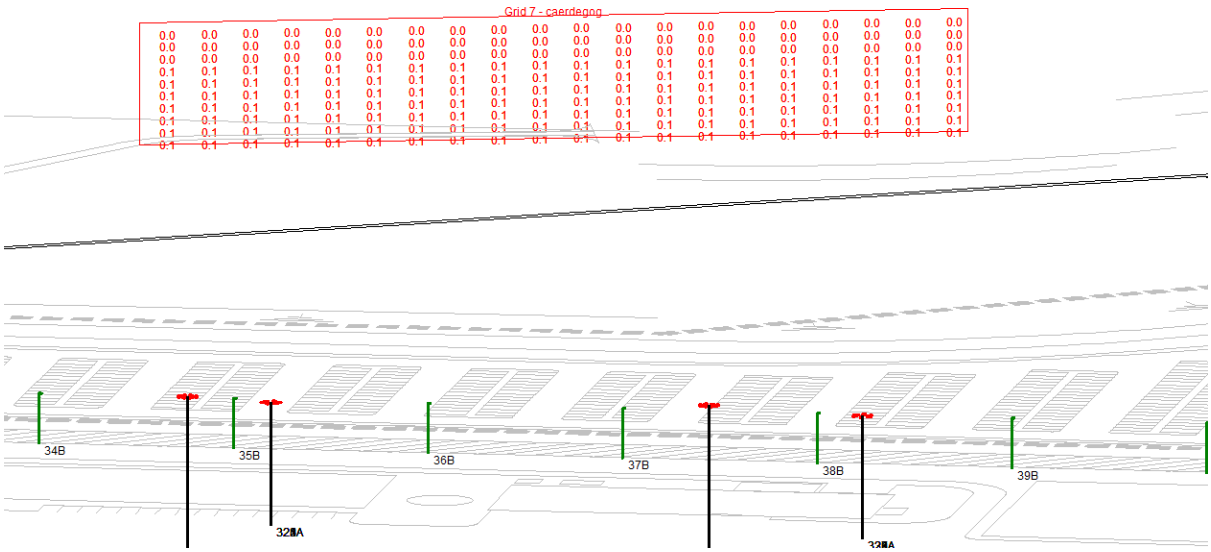
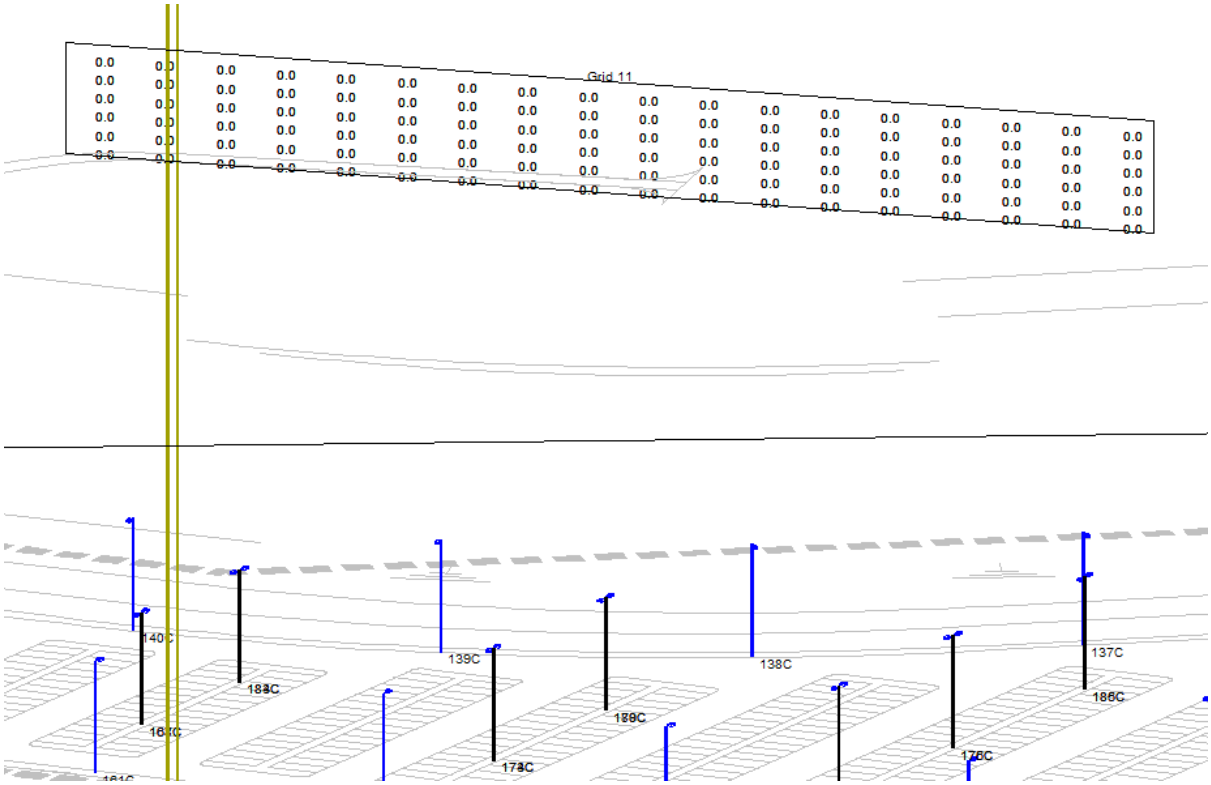


Figure 1-42 Caerdegog farm with car park lighting



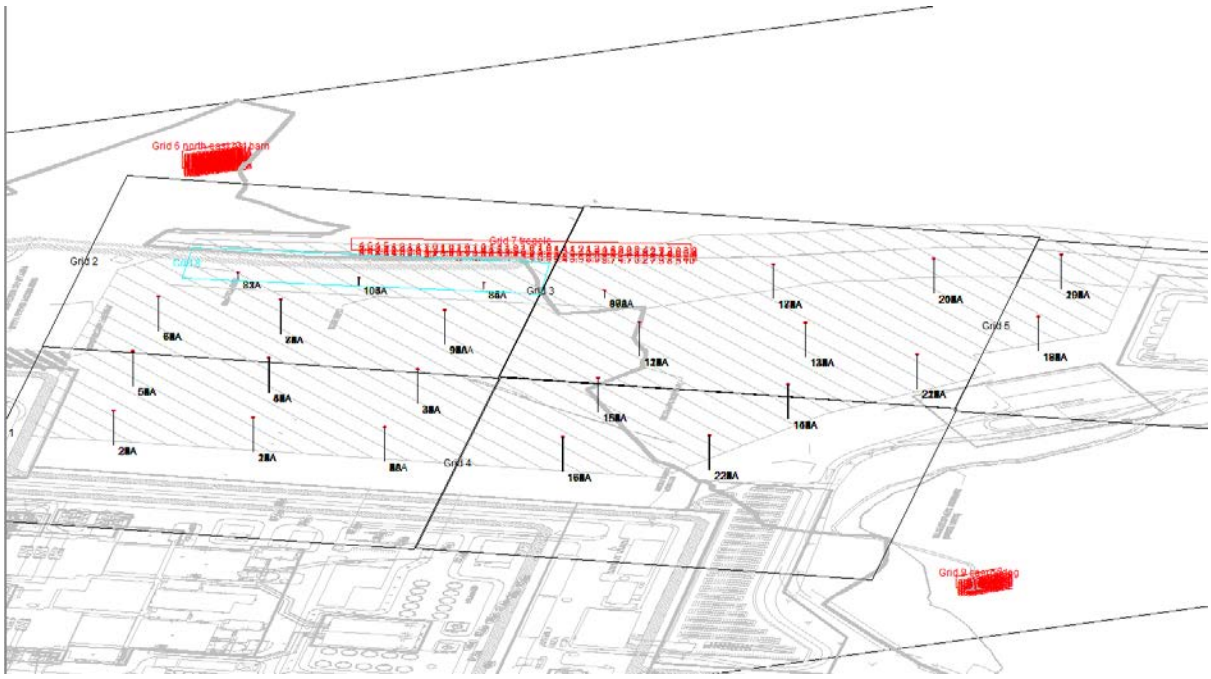
1-6.1.1 The grid in figure 1-41 shows the vertical illuminance levels of the Caerdegog area located south of the site. The nearest lighting column from this grid is 185m away. These high masts are mounted at a height of either 15m or 30m; also there are 6m lighting columns along the perimeter fence. As the height of the columns reduces moving outwards from the main site, the light spill is predicted to be negligible as shown on the above figure. Figure 1-41 shows that the maximum level of light spill would be 0.1lux. These levels of light spill would be further reduced by the trees located adjacent to the farm.

1-6.1.2 Figure 1-42 shows an average amount of 0 lux light spill from the car park lighting located on the south of the site. These results combined with the results from figure 1-41 would still be at negligible levels of 0.1lux.

[This page is intentionally blank]

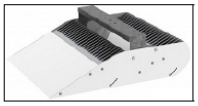
Appendix 1-7Bat barn north of Tregele illuminance results

Figure 1-43 Overall laydown area showing indicative vertical grids (north-east, east and south)



1-7.1.1 The indicative laydown area lighting has been designed to an average of 100lux average with 40% uniformity. For specific task lighting the level may need to be increased to 200lux for a limited time; the additional light would be provided by mobile lighting units. The spill light assessment has been calculated at a maintenance factor of 1 as outlined in. The luminaires are oriented away from the areas of significance to reduce light spill.

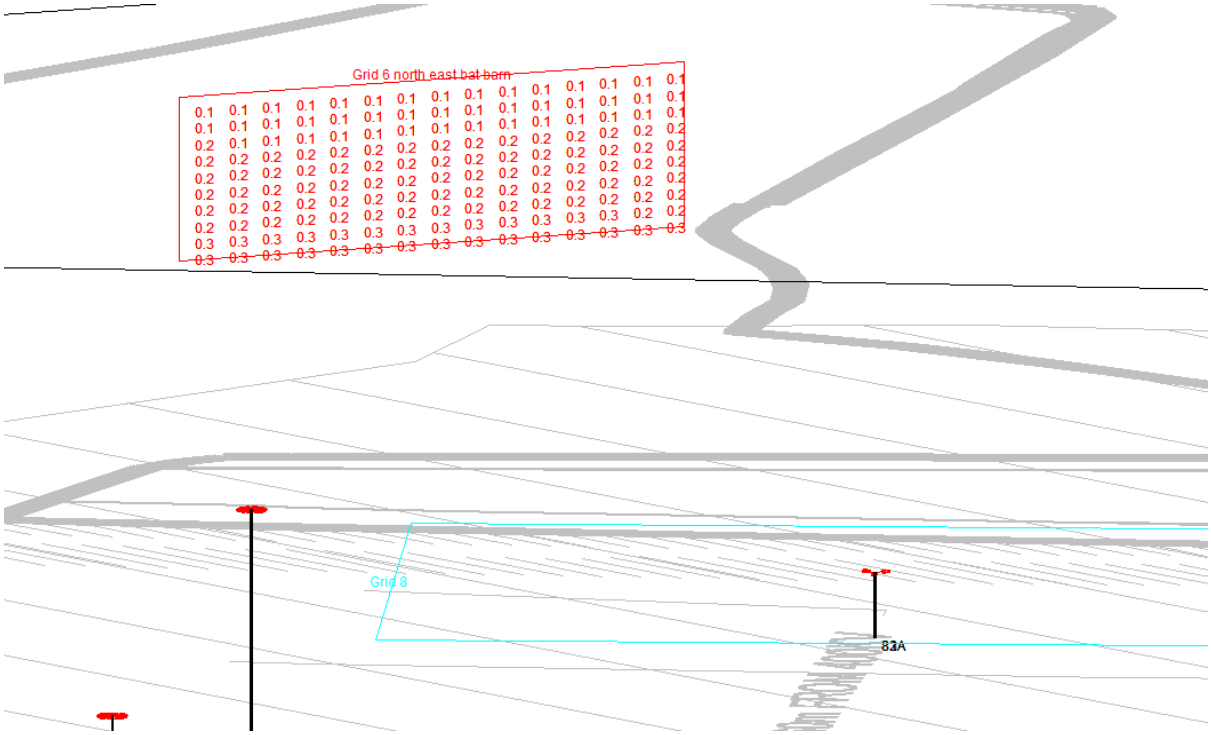
1-7.1.2 The mounting heights are 30m for the central laydown area and 6m at the east side near the village of Tregele perimeter fences with a 0-degree tilt to maintain the ULR of 0%. Luminaires are positioned so they are facing away from the Tregele and the bat barn.



Luminaire A Data

Supplier	C U Phosco
Type	FL800R-4-A8-CW-D700-610W
Lamp(s)	757P CW
Lamp Flux (klm)	200.00
File Name	FL800R-4-A8-CW-D700-610W.ies
Maintenance Factor	1.00
Imax70,80,90(cd/klm)	6656.1, 396.3, 0.0
No. in Project	230

Figure 1-44 Proposed bat barn north of Tregele, vertical illuminance results from construction



1-7.1.1 This vertical grid covers the bat barn under construction north-east of Tregele (figure 1-1). Note that there is a small hill between the bat barn and the laydown area of the main construction site which would effectively block any light trespass onto this location.

1-7.1.2 The vertical grid assumes there are no obstacles between it and the nearest light source. The grid height is set from ground level to a height of 15m, the grid is located 250m east of the 7m noise bund. The nearest lighting column from the bat barn is 260m away. The above vertical grid shows that the maximum levels near the bat barn is 0.3lux and the minimum is 0.1lux. Neutral Negligible change is predicted due to the small hill acting as a screen for this location as seen in figure 1-45.

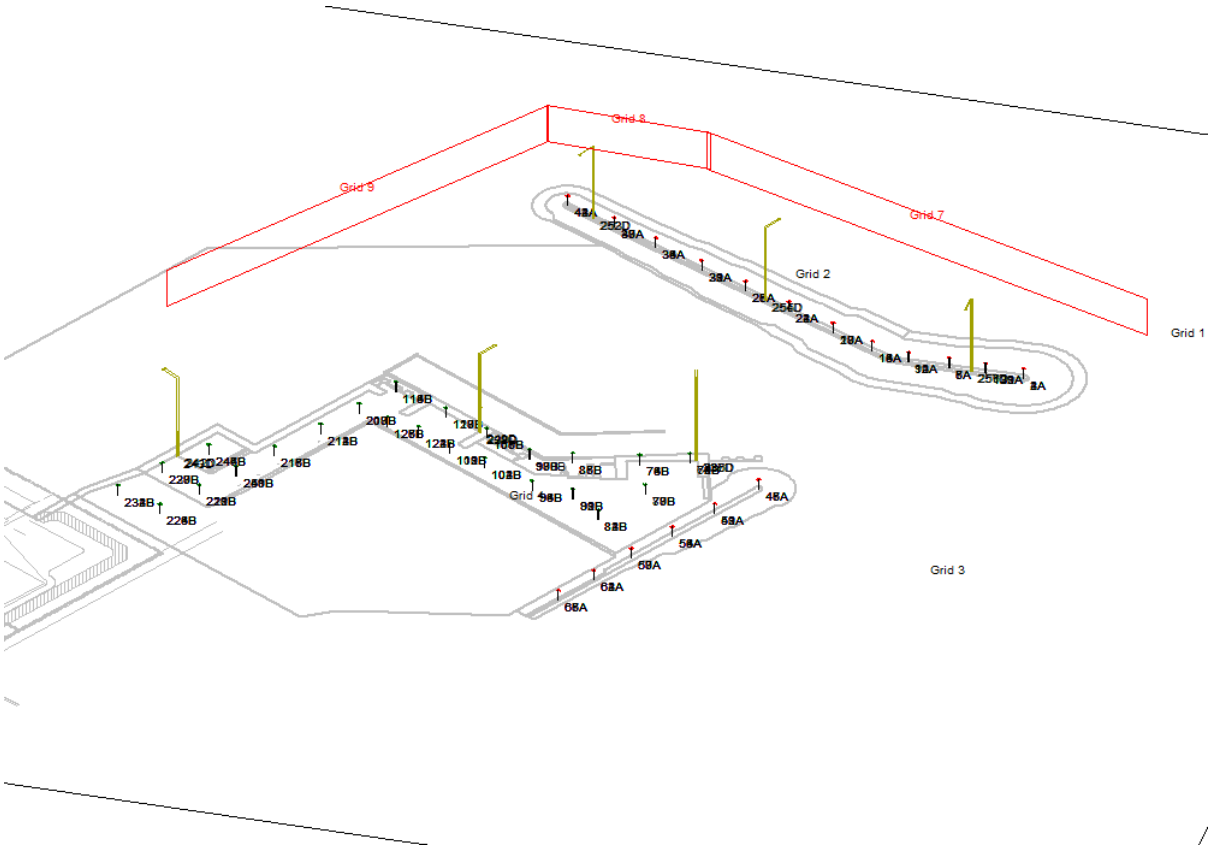
Figure 1-45 ound between Tregele bat barn location and Wylfa Newydd Development Area

[This page is intentionally blank]

Appendix 1-8Illuminance levels associated with Marine Works

1-8.1.1 Lighting calculations have been based on indicative layout to calculate potential obtrusive light (refer to Design basis and activities).

Figure 1-46 Indicative layout and position of vertical grids to assess lighting from MOLF and breakwater during construction



1-8.1.1 Vertical grids have been placed 50m from the breakwater to show light spill at this distance from the breakwater. Whilst constructing the breakwater, mobile crawler cranes at 25-30m high with a 60m boom would be in operation. The crawler cranes need to move along the breakwater placing amour units. The boom could be pointing seaward or pointing towards the MOLF. An indicative scenario has been produced as by nature these units are not static. Once the breakwater is completed the construction lighting would be removed.

1-8.1.2 The figures 1-47, 1-48, 1-49 show the vertical illuminance levels on the three vertical grids (grids 7, 8 and 9). Grid 7 has an average of 0.4lux and maximum of 6.99lux. The average results are based on the crane facing the sea. Grid 8 has an average of 0.03lux and maximum of 0.12lux. Grid 9 has an average of 0.02lux and maximum of 0.11lux. Once the breakwater has been constructed and the construction lighting removed the illuminance levels of these grids drop to 0 lux.

Figure 1-47 Vertical Illuminance levels- Grid 7

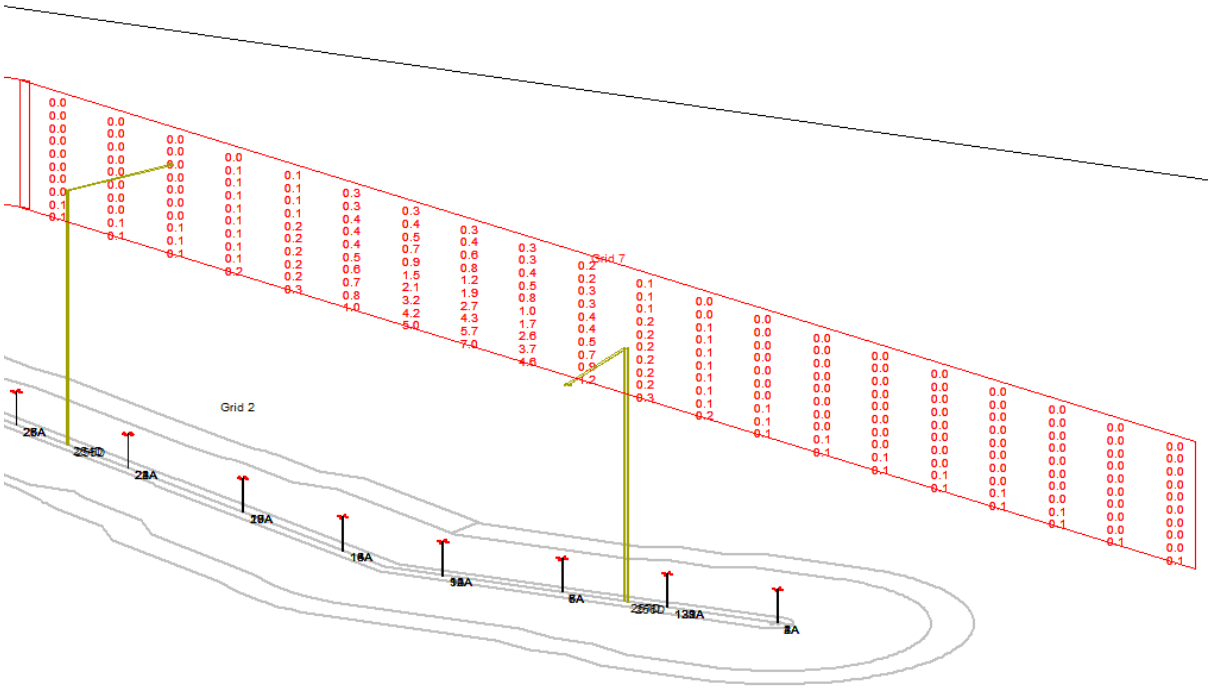


Figure 1-48 Vertical Illuminance levels- Grid 8

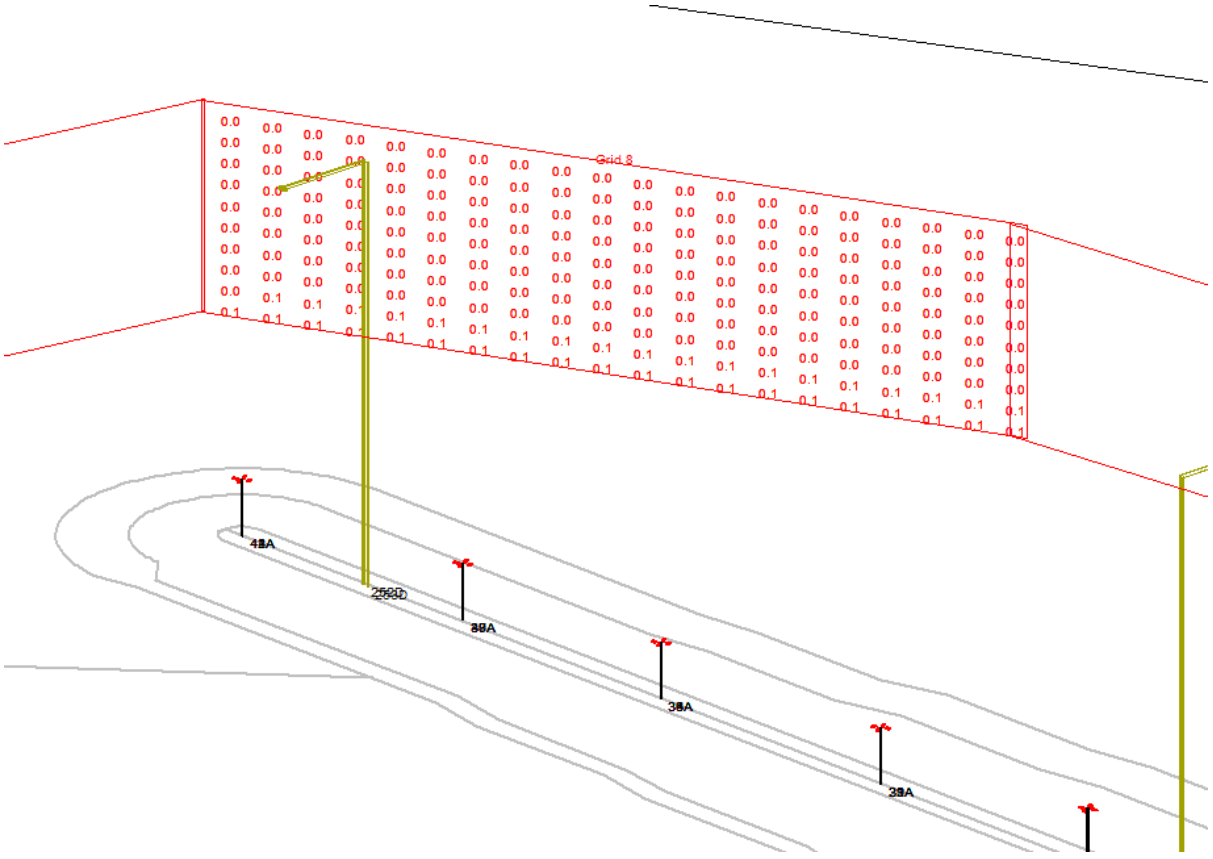


Figure 1-49 Vertical Illuminance levels- Vertical Grid 9

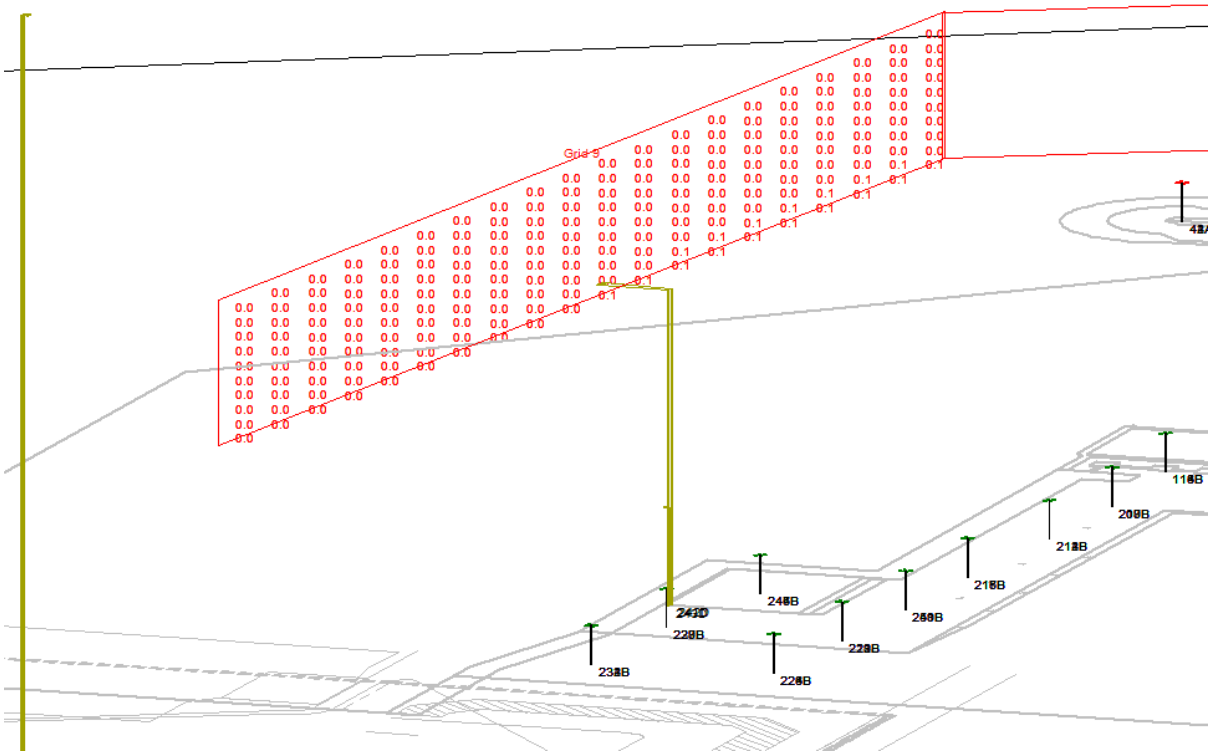
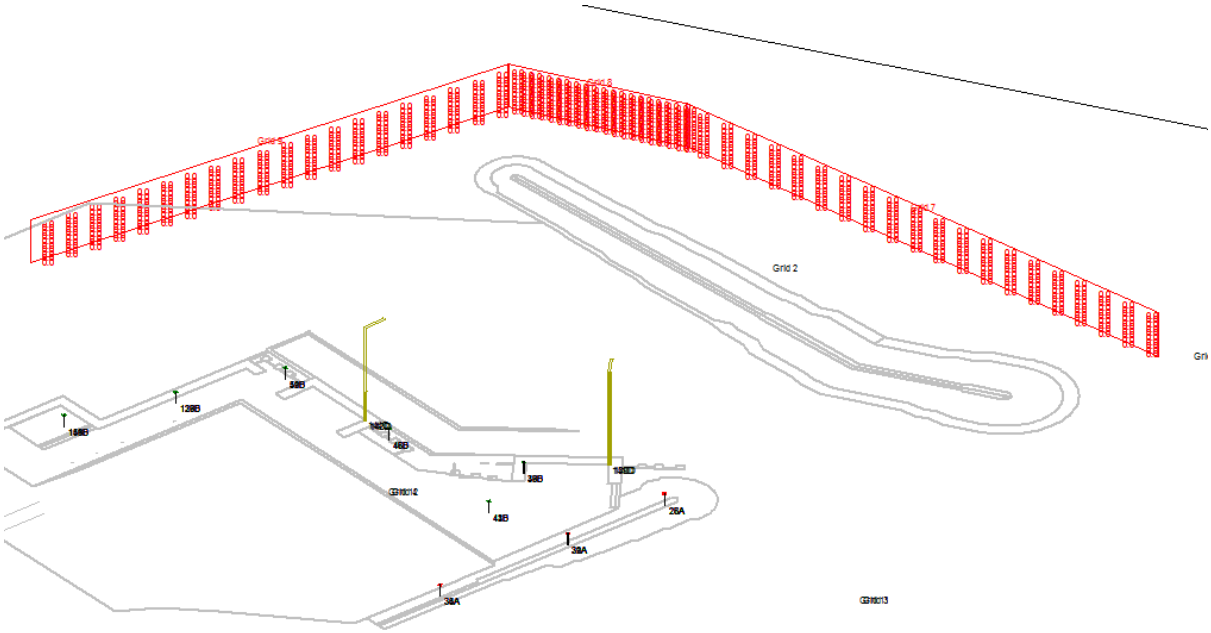
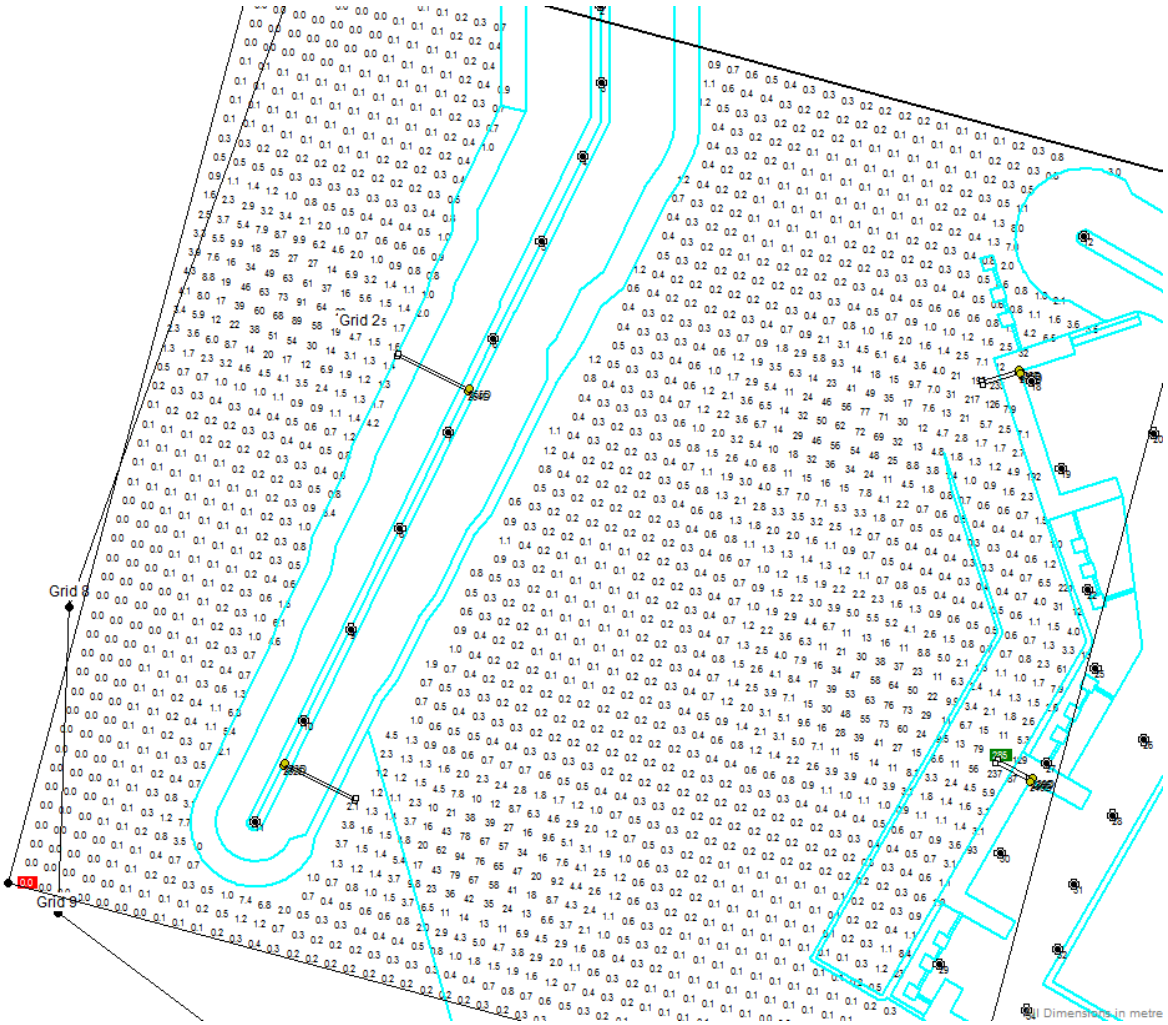


Figure 1-50 Illuminance levels once breakwater has been completed and MOLF is operational



1-8.1.1 Figure 1-51 shows the horizontal illuminance levels between the vertical grid locations, breakwater and the MOLF.

Figure 1-51 Horizontal illuminance levels between breakwater and MOLF during construction



1-8.1.1 The water between the MOLF and the breakwater during construction would be the most affected by light spill. Once the construction of the Marine Works is complete the lighting around the MOLF area would be less than half the levels, as shown in figure 1-52.

Figure 1-52 Horizontal illuminance levels between breakwater and MOLF during operation of MOLF

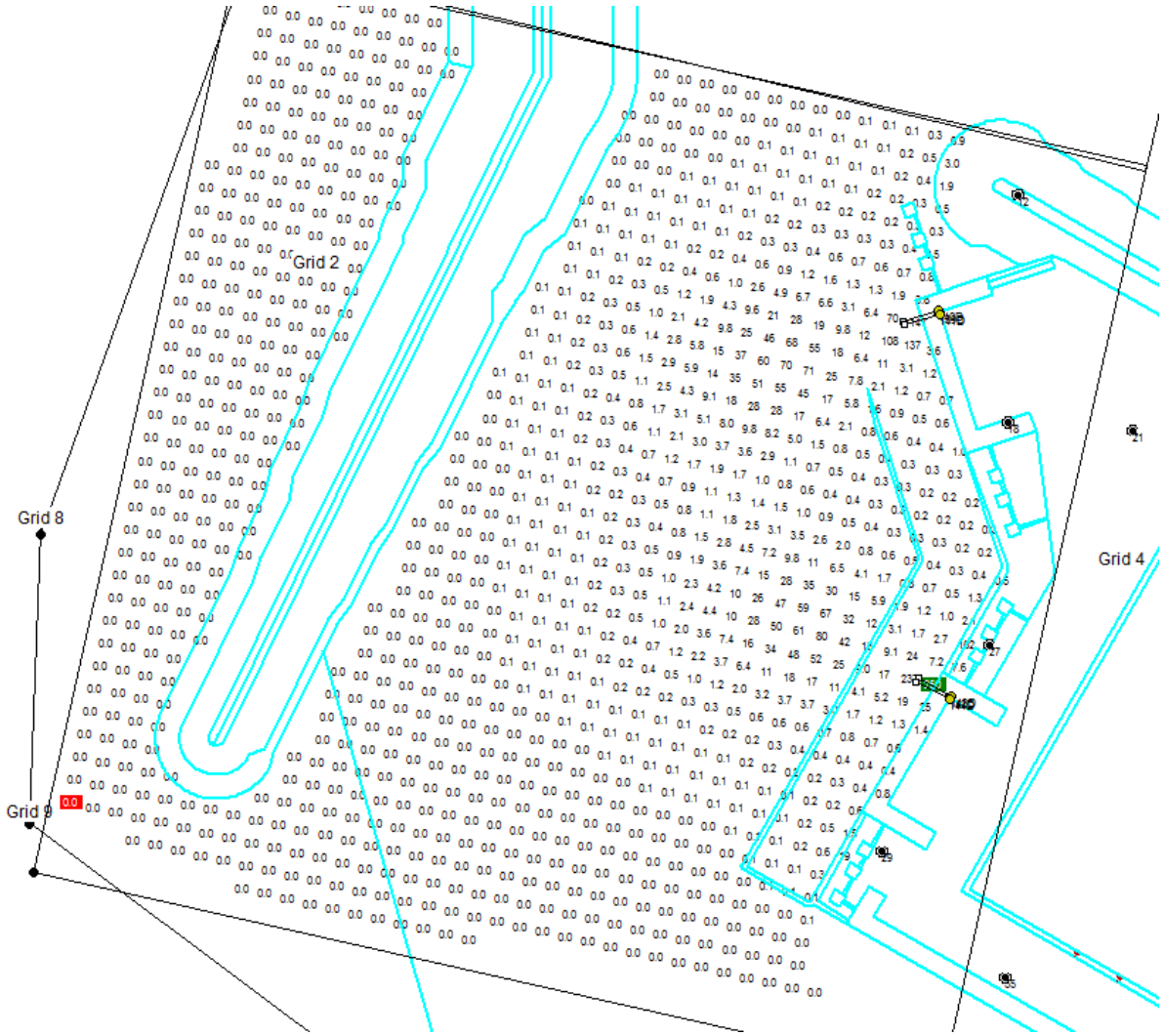


Figure 1-53 Off-loading facility showing horizontal illuminance of 50lux

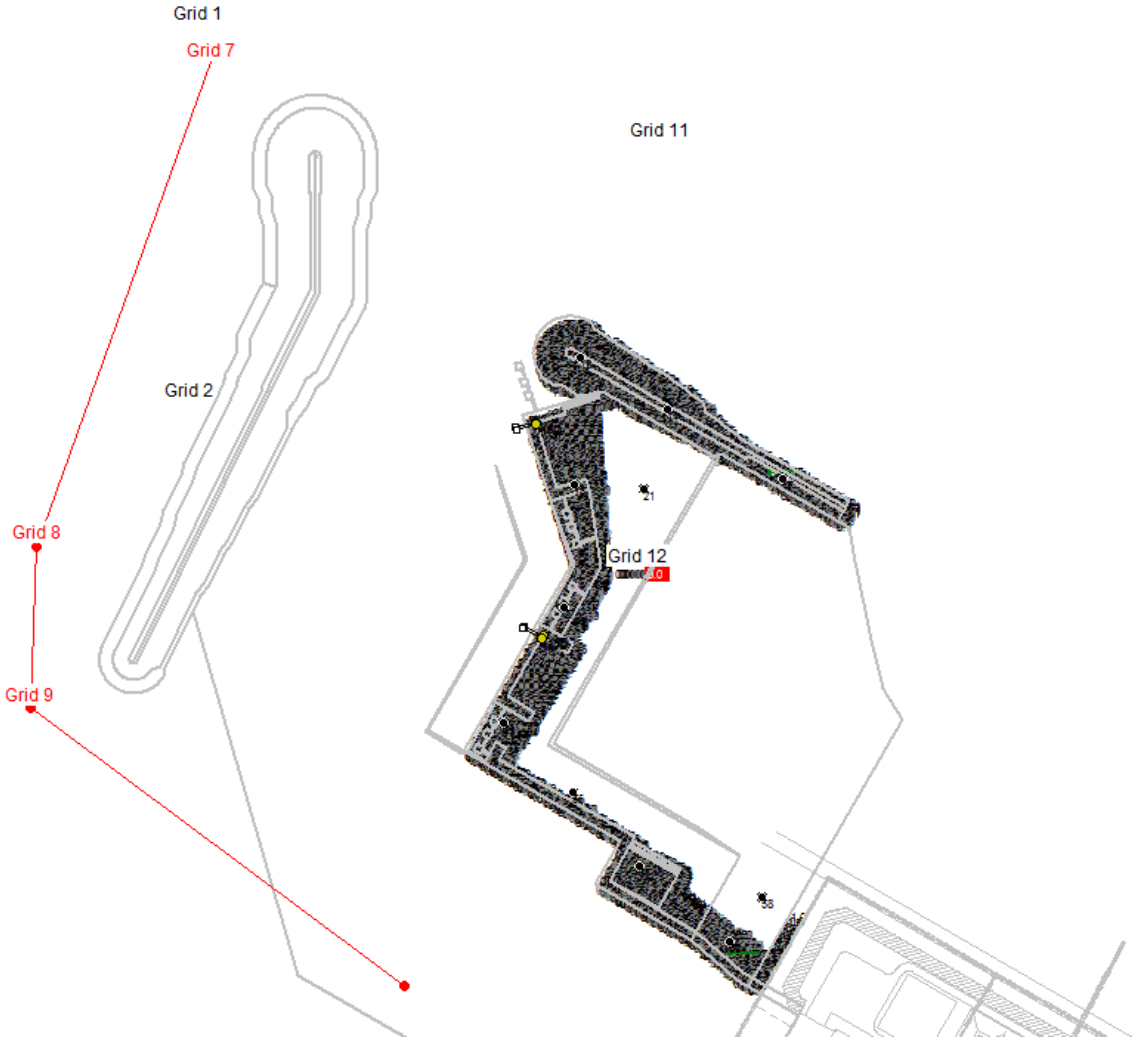
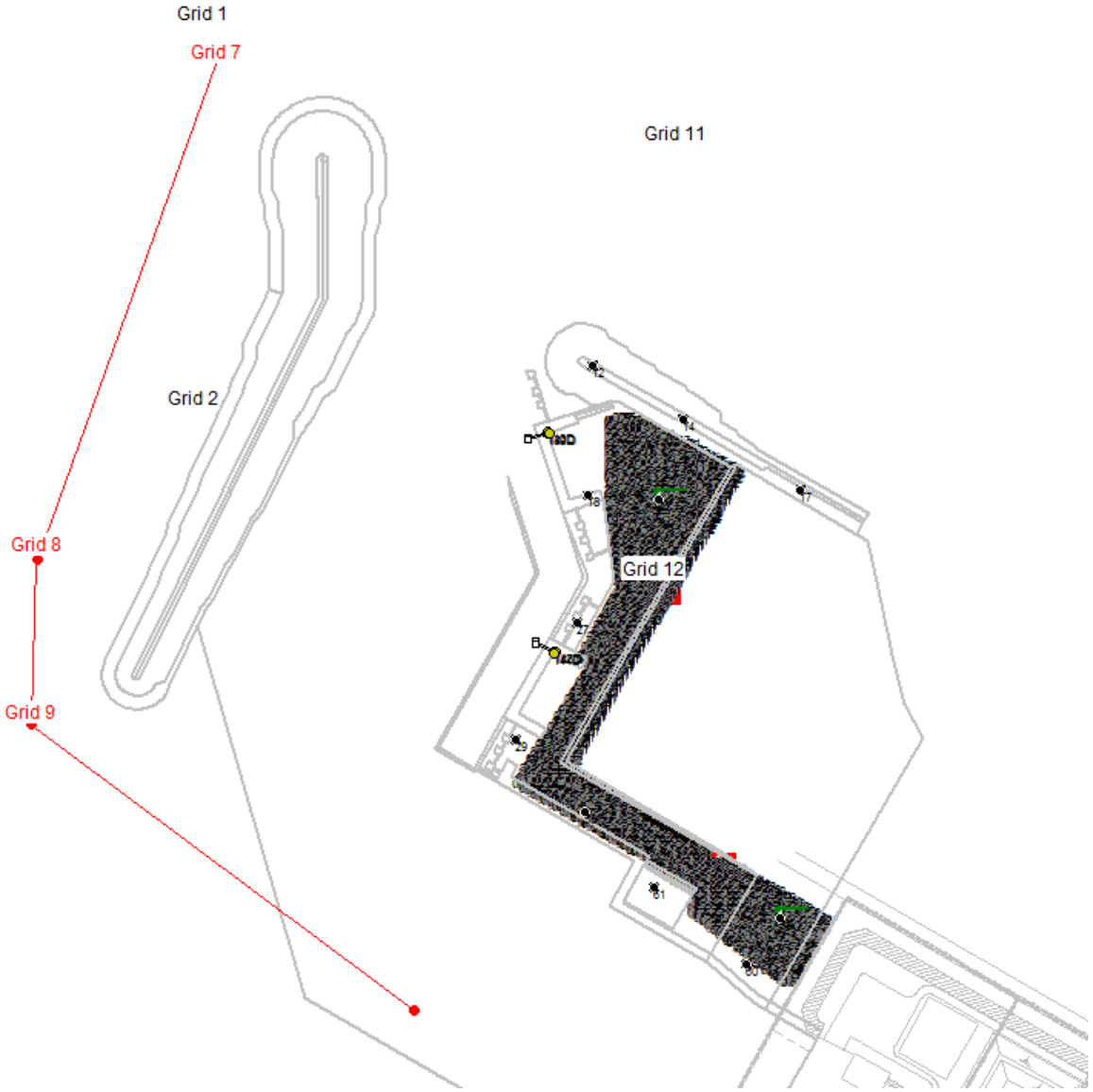


Figure 1-54 General operational area with Horizontal Illuminance of 20lux (shaded area)



Appendix 1-9Examples of additional lighting mitigation

1-9.1.1 There are a number of adaptations that can be used to further limit light spill and/or glare from luminaires. These include:

- cowls/hoods;
- louvres (internal or external); and
- shields.

1-9.1.2 Figures 1-55 shows a luminaire with cowl, and figure 1-56 shows a luminaire with hood. Cowls and hoods help direct light spill downwards, reducing light spill and glare.

Figure 1-55 Symmetrical variable aim luminaire with cowl [RD3]

Figure 1-56 Double asymmetric luminaire with hood [RD3]

1-9.1.1 Louvres are another method of minimising light spill. They can be fitted to luminaires either internally (as shown in plates a and b of figure 1-57) or externally (as shown in plates d and e of figure 1-57). Internal louvres can also be combined with a hood or cowl as shown in plate c of figure 1-57.

Figure 1-57 Internal and external louvres [RD3]

1-9.1.1 Similar to cowls and hoods, shields help control the direction of light and reduce glare. Figures 1-58 and 1-59 show two different types of shield used on fixed position and variable position luminaires respectively.

Figure 1-58 Fixed position luminaire with shield [RD3]

Figure 1-59 Symmetrical variable aim luminaire with 'barn door' shields [RD3]