Light Pollution Study

for

J. Pointon and Sons, Proposed Energy Resource Centre and Community Recreational Facility,

Felthouse Lane, Cheddleton

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Executive Summary

The site is located on the outskirts of Cheddleton to the South and to the North North East of Stoke on Trent, in a rural area bounded by Cheadle Road (A520) and Felthouse Lane. The scheme as proposed comprises of two elements 1.Energy Resource Centre and 2. Recreational Facility. This report relates to the Energy Resource Centre only, as the Recreational Facility is not to be provided with external lighting. The Energy Resource Centre would have a dense perimeter of trees, (with the exception of the entrance) and a security wall / bund that clearly separates and defines the site from the surrounding area. The trees have been taken (for the purpose of this study) to be mature and 3 m tall, it is expected however that the final height of these trees will be 5 m. As can be seen from the site isolux plot, attached as appendix A, the tree, wall / bund perimeter currently provides adequate shielding, but as the trees continue to mature, this will only increase the shielding from any reflected light spillage.

Initial consultation with the local environmental health inspectors has taken place and it was agreed that the specified lighting levels would be between 5 and 20 lux average across the site.

There is no specific guidance on the control of light pollution, however light pollution may be currently regarded as a 'nuisance' under common law, but it is not listed as a statutory nuisance in the Environmental Protection Act 1990, however it is an issue that should addressed as referenced by PPG 23, annex 1. PPG 23 is superseded by PPS 23, but PPG 23 is still referenced in

the Building Regulations. So guidance is generally taken from professional bodies' guidance notes and policies refer to clause 3.4 "Environmental Considerations" for list of specific guidance that would be implemented.

The scheme has been assessed by us as E2 and this is described as a Low district brightness areas Rural or small village locations

The basis for this assessment is the guidance given by the ILE (Institution of Lighting Engineers). An extract from the document over viewing the categories in clause 2.6 "Environmental Zones" has been included for reference.

A detailed specification of both luminaire and mounting arrangements (including elevation angles) would be provided to the contractors prior to installation.

It is therefore concluded that a scheme designed in accordance with the guidance available would not be regarded as to occasion light pollution. This is demonstrated by the results obtained from the generic scheme design as appendix A.

1.0 Terms of Appointment

Clancy Consulting Ltd. was instructed by the Graham Bolton Planning Partnership on behalf of J Pointon and Sons ltd. to consider the potential effect of light pollution caused by the construction of an Energy Resource Centre and Community Recreational Facility on Felthouse lane / Cheadle Road, Cheddleton. It must be noted however, that this report is associated with the Energy Resource Centre only, as the Community Recreation Facility is not to be provided with external lighting.

The report is to consider the principles of design, including the suitability of the levels of illumination as part of an environmental statement and the means to attenuate / restrict the light spillage. The aim is to restrict lighting to that necessary and prevent or mitigate by design any potential adverse effects.

2.0 Basis of Statement

2.1 Light pollution

It impedes your view of the night sky and is a form of pollution. The pollution can be substantially reduced without detriment to the lighting task by appropriate design.

2.2 Sky glow

The brightening of the night sky above towns and cities, comprising of Glare, the uncomfortable brightness of a light source when viewed against a dark background and Light Trespass, the spilling of light beyond the boundary of the property on which the light source is located, are all forms of obtrusive light.

2.3 What causes light pollution?

The major sources of artificial light include street lighting, security lamps, advertising and display lighting, floodlights for sporting events and building illumination. Poorly fitted lights allow light to shine upwards, which causes sky glow. Some artificial light is also reflected upwards from roads, pavements and buildings.

2.4 What are the effects of light pollution?

Light pollution impacts in various ways on the surrounding area.

It can:

- Cause migrating birds to collide with illuminated buildings
- Create unnecessary and ill directed light and is a waste of energy

- Cause a false dawn that can disrupt animal and bird behaviour
- Light pollution intrudes upon the landscape and compromises the aesthetic value of architectural and natural landscapes
- Cause moth deaths as they are attracted to the light (possibly a factor in the recent decline in urban moth populations)
- Bright lights can cause human sleep disturbance, whilst unsuitable lighting can increase risks for drivers and pedestrians.
- Astronomical observation or simple enjoyment of the night sky is largely impeded.

2.5 Reduction methods to reduce light pollution?

Uncontrolled artificial light can be a nuisance, however, artificial light is needed to safeguard and enhance our night-time environment.

The effects of light pollution can be mitigated with a number of simple measures:

- Designing of light fittings that reduce / omit direct light emitted upwards
- Positioning lighting properly and directing it downwards
- Using only the necessary amount of lighting
- Switching off unnecessary lighting, particularly decorative floodlighting and advertising lighting, late at night and in the early morning.

2.6 Environmental Zones

It is recommended that in the basis of the design is based upon agreed principles; the following environmental zones for exterior lighting control are recognised as accepted standards.

Category Examples

E1: Intrinsically dark areas National Parks, Areas of Outstanding Natural Beauty, etc

E2: Low district brightness areas Rural or small village locations

E3: Medium district brightness areas Small town centres or urban locations

E4: High district brightness areas Town/city centres with high levels of night-time activity

Where an area to be lit lies on the boundary of two zones or can be observed from another zone, the obtrusive light limitation values used should be those applicable to the most rigorous zone. However, effective separation from the adjacent zone has been achieved by means of the tree and wall / bund line to maintain the E2 rating for the adjacent site.

Obtrusive Light Limitations for Exterior Lighting Installations (Table 1)

Environmental Zone	Sky Glow ULR [Max %]	Light into Windows E_v [Lux] (1)		Source Intensity I [kcd] (2)		Building Luminance Before curfew (3)	
		Before curfew	After curfew	Before curfew	After curfew	Average, L [cd/m^2]	Maximum L [cd/m^2]
E1	0	2	1*	0	0	0	0
E2	2.5	5	1	20	0.5	5	10
E3	5.0	10	2	30	1	10	60
E4	15	25	5	30	2.5	25	150

(Table and notes reproduced from the ILE – Guidance Notes for the Reduction of Light Pollution 2005)

ULR = Upward Light Ratio of the Installation is the maximum permitted percentage of luminaire flux for the total installation that goes directly into the sky.
Ev = Vertical Illuminance in Lux and is measured flat on the glazing at the centre of the window

I = Light Intensity in Cd

L = Luminance in Cd/m2

Curfew = The time after which stricter requirements (for the control of obtrusive light) will apply; often a condition of use of lighting applied by the local planning authority. If not otherwise stated -23.00hrs is suggested.

* = From Public road lighting installations only

(1) Upward Light Ratio – Some lighting schemes will require the deliberate and careful use of upward light – e.g. ground recessed luminaires, ground mounted floodlights, festive lighting – to which these limits cannot apply. However, care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and light controlling attachments.

(2) Light Trespass (into Windows) – These values are suggested maxima and need to take account of existing light trespass at the point of measurement. In the case of road lighting on public highways where building facades are adjacent to the lit highway, these levels may not be obtainable. In such cases where a specific complaint has been received, the Highway Authority should endeavour to reduce the light trespass into the
window down to the after curfew value by fitting a shield, replacing the luminaire, or by varying the lighting level.

(3) Source Intensity – This applies to each source in the potentially obtrusive direction, outside of the area being lit. The figures given are for general guidance only and for some sports lighting applications with limited mounting heights, may be difficult to achieve.

(4) Building Luminance – This should be limited to avoid over lighting, and related to the general district brightness. In this reference building luminance is applicable to buildings directly illuminated as a night - time feature as against the illumination of a building caused by spill light from adjacent luminaires or luminaires fixed to the building but used to light an adjacent area.

(Table 2)

Maximum Values of Threshold Increment from Non - Road Lighting Installations				
Light Technical Parameter TI	Road Classification			
	No road lighting	ME5	ME4/ME3	ME2 / ME1
	15% based on adaptation luminance of 0.1cd/m2	15% based on adaptation luminance of 1cd/m2	15% based on adaptation luminance of 2 cd/m2	15% based on adaptation luminance of 5 cd/m2

3.0 Design Methodology

3.1 Good Practice

As a result of the “basis of statement” above and the effects caused, there are increasing demands for action to prevent and control lighting impacts; the decision-making process would be managed to define where and how lighting is installed and by improving the overall lighting design.

However, there is no existing guidance that is comprehensive, relevant and accessible, and the topic is a complex one both procedurally and technically.

The purpose of this design methodology statement is to advise upon how the lighting provision impact is mitigated through appropriate action by all those involved

Specific objectives are to: identify good practice in the planning and design of lighting and define how this can be achieved and implement this by managing the specification output.

Under pin the specification output by utilising advice provided in the Chartered Institution of Building Services Engineers (CIBSE) and the Institution of Lighting Engineers (ILE) in 1995 published Lighting and the Environment: A Guide to Good Urban Lighting in the specification output.

3.2 Initial Scheme Appraisal

Having established that lighting is needed, an initial assessment of the specific lighting requirements of the task in hand would be made and an outline scheme design

prepared. This would include a number of options such as different luminaire locations and types of lighting provision, but detailed consideration of lamp and luminaries would not be anticipated at this stage.

The main purpose of the initial appraisal would be to identify a viable outline scheme that has the potential to be successfully integrated with its surroundings and that can be taken forward for more detailed assessment. At this stage, the environmental and cost issues would be reviewed in a broad-brush way and initial contact / involve third parties such as planners would occur. It is intended that the design process would be an iterative one, with constant feedback, review and refinement of the emerging proposals.

An illumination level of between 5 and 20 lux average has been selected, as between these levels of illumination a wide array of lighting conditions can be obtained whilst mitigating light pollution effects and wasting energy i.e. road way lighting, building and general amenity lighting.

To understand the light distribution by selecting an average lighting level of between 5 – 20 lux, the area can be modelled and an isolux plot prepared, as the attachment in appendix A

3.3 Planning Considerations

During early consultation with the Planning Department, the Planning Department asked for this Light Pollution Report. The report sets out to prescribe amelioration methods for light pollution. Light pollution as a specific issue would be addressed in parallel with the initial scheme appraisal. An initial approach to the local planners has been made through informal contact. This was to

determine any questions that would be raised stage i.e. any relevant structure and local plan policies on lighting, as well as policies on development generally; supplementary planning guidance on lighting (such guidance, where it exists, sets out the detailed planning and technical requirements that apply to new lighting schemes); and planning application procedures and information requirements.

3.4 Environmental Considerations

The principles referred to in this report are those that would be adopted as an integral part of the measures to reduce the light pollution impact.

Among the issues to be examined and further developed would be the effects of night lighting on dark landscapes, the appearance of lighting structures in daytime, potential impacts on the visual amenity of residents and special interest groups such as astronomers, and effects on the safety of transport users. The results of the assessment would feed into the lighting and landscape design of the scheme as a whole.

Reference to the following lighting guidance would also be made

PPS 1 – Delivering Sustainable Development
PPS 6 - Archaeology and the Built Heritage
PPS 7 – Sustainable Development in Rural Areas
PPS 9 - Biodiversity and Geological Conservation
PPS 22 –Renewable Energy
PPS 23- Planning and Pollution Control
PPG 15- Planning and the Historic Environment
PPG 17 –Planning for Open Space, Sport and Recreation
PPG 23 -Planning and Pollution Control

British Standards: BS 5489_1: 2003 Code of practice for the design of road lighting – Part 1: Lighting of roads and www.bsi.org.uk public amenity areas

BS EN 13201_2:2003 Road lighting – Part 2: Performance requirements

BS EN 13201_3:2003 Road lighting – Part 3: Calculation of performance

BS EN 13201_4:2003 Road lighting – Part 4: Methods of measuring lighting performance.

BS EN 12193: 2003 Light and lighting – Sports lighting

Countryside Commission/DOE Lighting in the Countryside: Towards good practice (1997) *(Out of Print)*

www.odpm.gov.uk

CIBSE/SLL Publications: CoL Code for Lighting (2002)

www.cibse.org LG1 The Industrial Environment (1989)

LG4 Sports (1990+Addendum 2000)

LG6 The Exterior Environment (1992)

FF7 Environmental Considerations for Exterior Lighting (2003)

CIE Publications: 01 Guide lines for minimizing Urban Sky Glow near Astronomical Observatories (1980)

www.cie.co.at 83 Guide for the lighting of sports events for colour television and film systems (1989)

92 Guide for floodlighting (1992)

115 Recommendations for the lighting of roads for motor and pedestrian traffic (1995)

126 Guidelines for minimizing Sky glow (1997)

129 Guide for lighting exterior work areas (1998)

136 Guide to the lighting of urban areas (2000)

150 Guide on the limitations of the effect of obtrusive light from outdoor lighting installations (2003)

154 The Maintenance of outdoor lighting systems (2003)

Department of Transport Road Lighting and the Environment (1993) (Out of Print)

www.defra.gov.uk

ILE Publications: TR 5 Brightness of Illuminated Advertisements (2001)

www.ile.org TR24 A Practical Guide to the Development of a Public Lighting Policy for Local Authorities (1999)

GN02 Domestic Security Lighting, Friend or Foe

ILE/CIBSE Joint Publications Lighting the Environment _ A guide to good urban lighting (1995)

ILE/CSS Joint Publications Seasonal Decorations – Code of Practice (2005)

Campaign for Dark Skies (CfDS)

3.5 Impact Prediction

The attached isolux lighting plot has been created by taking the master site plan and imposing the external tree barrier, buildings and a generic lighting scheme in three dimensions to provide a predicted outcome of the lighting effect.

As previously stated the lighting scheme and luminaire selection is generic. However, the luminaires selected are in compliance with a category 2 site i.e. providing for a limiting upward light ratio of 5 % or less.

As defined by the attached isolux lighting plot (s), a quantitative prediction of the impact of lighting on different potential receptors of landscape, visual and other forms of impact has been prepared.

The introduction of the tree barrier provides for limited external impact of the scheme and provides effective separation between lighting zones.

The cumulative effect of all the mitigation measures that would be taken provides for a limited impact upon any

local residents on Cheadle Road, Felthouse Lane, Folly Fields / Lane and Woodland Ave.

The above mitigation measures are those that effect and limit sky glow as table 1 / 2

3.6 Measures of Lighting Impact on Different Receptors

Receptor	Possible Measures
Historical or Wildlife Features	*Importance or rarity of affected resource and nature of change that it would suffer.*

Receptor	Possible Measures
	Impacts upon these resources would be difficult to predict quantitatively, and there would be a need to rely on professional judgment of the likely effects of change, which may be beneficial in some instances.
Dark Landscapes	*Surface luminance in cd/m2 of the building facade or sign*. The limits for building luminance as defined in the ILE Guidance Notes would be followed. *Prominence and visibility of the light source*. In addition to the attached generic isolux plot, actual values be predicted using computer modelling, or by preparing isolux contours (lines of equal illuminance), and examining the screening effects of topography, vegetation and other features.
Appearance of the Landscape by Day	*Effects on skylines, key views and on landscape character generally*. Guidance would be sought from the published document - *Guidelines for Landscape and Visual Impact Assessment*.
Local Residents	*Luminous intensity of the light source (ie source intensity) in cd.* The ILE Guidance Notes would be used to specify the source intensity limits for control of glare. Illuminance in the vertical plane in lux. The ILE Guidance Notes would be used

	to specify the limits for illuminance in the vertical plane, for control of light trespass. *UWLR of the lighting installation*.
Astronomers	This gives an indication of the sky glow produced. The Sky glow limits are as defined in section 2 of this study would be specified.
Motorists, Cyclists and Pedestrians	Ensure the threshold increment in %. Is within specified guidelines

3.7 Mitigation

This study and the environmental assessment as a whole should evaluate and determine how a lighting scheme should be specified.

It is an intention of this study to confirm that the design and location of the site lighting equipment would be such to minimise its impact on the landscape and people, both at night and in the daytime.

Principal Standards and Guides	**Synopsis**
International Commission on Illumination (CIE) Publications	
No 1: Guidelines for minimising urban sky glow near astronomical observatories 1980	Describes sky glow; provides a methodology for estimating sky glow in relation to its impacts on observatories; suggests mitigation measures to minimise the problem with specific reference to needs of astronomers.
No.92: Guide to the lighting of urban areas 1992	Recommends lighting standards for roads and public areas, such as paths, community areas, industrial roads, access points; discusses effect of light on crime; considers the suitability of light sources for different sites; explores the effects of lighting on the environment; discusses general aesthetics of lighting equipment. Gives general guidance on how to reduce or avoid impacts of sky glow on astronomical observatories;

	provides methods for surveying and measuring sky glow as a basis for classification of zones; recommends sky glow limits for these zones and covers restrictions for lighting equipment and installations.
	Sets out guidelines for assessing the environmental impacts of exterior lighting and gives recommended limits for tolerable levels of light; gives guidance for limiting: ▪ illumination falling on surrounding roads and properties; ▪ bright luminaires in the field of view; ▪ the effects on transport systems;sky glow; ▪ the effects of over lit building facades and signs.
Guide on the limitation of the effects of obtrusive light from outdoor lighting installations Chartered Institution of Building Services Engineers (CIBSE) Publications No. LG6: The Outdoor Environment Lighting the Environment - A Guide to Good Urban Lighting 1995 (with ILE)	Provides advice on lighting a wide range of situations in the outdoor environment, but contains little information on reduction of light pollution. Recommends a strategic, integrated approach to lighting design, integrating the recommendations from the range of existing guides and codes of practice; advises on energy conservation, appropriate lighting for different situations and activities and suggests measures for mitigating and avoiding light pollution; provides design guidance and recommends good practice; suggests lighting may increase the vibrancy and use of the urban environment, particularly for pedestrians; many of the general principles are applicable to rural as well as urban situations.
Principal Standards and Guides – (Cont)	**Synopsis– (Cont)**
Institution of Lighting	Provides simple advice on

Engineers (ILE) Publications Guidance Notes for the Reduction of Light Pollution 1994	minimising intrusive light; details some useful technical parameters for measuring and monitoring levels of light, including the upward waste light ratio, vertical illuminance, intensity and luminance and applies them to the problems of sky glow, light spill onto windows, over-bright light sources and building luminance.
Lighting and Crime	Describes problem of crime and the role of lighting in its prevention; provides relevant references and case studies; provides details on financing and specifying lighting to minimise crime.
Royal Fine Art Commission Lighten Our Darkness: Lighting Our Cities - Successes, Failures and Opportunities 1994	Provides technical and design guidance on improving design of urban lighting - many of the principles are applicable to lighting in the countryside; describes the scale and extent of light pollution; promotes an approach to lighting which combines functional security with opportunities for aesthetic enhancement and provides case studies of good practice in urban situations; advises on design of floodlighting to enhance rather than overwhelm architectural detail.

3.7 Luminaires

The selection and specification of the luminare would be closely controlled, as it is the luminaire that controls the direction and intensity of the light beam, and thus its environmental impact.

The UWLR (Upward light ratio) of luminaires would be assessed to ensure the ratio of light emitted at and above the horizontal to the total light emitted is within the guidelines in section 2. The UWLR for variable-angle luminaires would be modelled to enable the correct settings to be chosen to mitigate the light pollution and the elevation angles of the luminaires recorded for inclusion into the design specification.

3.8 Commercial Developments

Issues and Good Practice for Lighting Commercial Developments

Design statement	Mitigation
Component Lighting Elements	**Principles for Good Practice**
Promotional Lighting - lights may be associated with signage and a corporate image. They are usually placed at the entrance to the complex, which may be in a rural setting, and are often part of a road lighting scheme to guide people into car parks etc. They are also placed at the entrance to the public buildings;	All lighting should have a clear purpose - avoid use of lights simply to create a `presence' at night; concentrate lights where they are needed and establish a clear hierarchy, with minimum lighting around the outer, more rural, perimeter of the complex; reduce the scale of street/road lighting (from usual standards for roads) and consider height and spacing of lights in relation to buildings; direct all floodlights carefully to where they are most needed and design equipment to minimise light pollution; encourage a `rural' image, with low key lighting in small developments
Road Lighting - this is found particularly in business parks or retail parks, where there is an internal road system. Usually there is a unified lighting scheme throughout the area. Road lighting is often supplemented by lighted bollards along pavements and the scheme tends to be designed to create a relatively `urban' environment.	and on the edges of larger sites and design lighting to be in harmony with the building styles; use a unified lighting scheme, so that the different types of lighting are not intrusive in daytime; position promotional lighting/signs so that they are not visible from open countryside i.e. concentrate at public entrance to buildings; consider timing of lights - avoid any lights being left on during daytime and turn off all lights after working hours; and consider design of overall site to minimise use of lighting eg segregate pedestrian and vehicular traffic and introduce traffic calming
Car Park Lighting - this is rarely designed to minimise light pollution. Its impact may be reduced a little by planting. Loading bays, or areas where work often continues after normal hours, are usually lit by taller, directional floodlights.	
Security Lighting - this is typically extensive and often carefully located and directed to light areas most at risk. Security floodlights may be mounted on columns and on buildings and are often designed as part of a sophisticated security system, which includes cameras.	
Working Lights - these are generally concentrated in the loading bays or storage areas of commercial developments and are particularly significant in those which include warehouses. They may be mounted on the buildings, or on tall columns within the working/loading areas of the development.	

4.0 Conclusion

Discussion with the local environmental health officer indicated a site lighting level of 5 – 20 lux (average) would be the prescribed illumination level for the site.

From the modelling carried out and our intention to comply with ILE category 2, the scheme is deemed to have satisfied the criteria that a scheme can be provided on the site and that it would provide both its function, whilst fulfilling the need to comply with specific guidance on light pollution contained in clause 3.4 “Environmental Considerations”.

It can be seen from the sky glow calculation that some of the isolux plots are above those permitted in an E2 area. However, we have taken for all worst case elements in the calculation and upon the agreement of the construction materials anticipate the figure to be below the 2.5 % limit.

Appendix A

Explanation of the Isolux Plots

The isolux plots are arranged to provide 3 elements of information.

1. Reference of the luminaires, this is shown by the no. adjacent to the column position.

2. The luminaire type, this too is indicated by a reference number adjacent to the column position.

3. The isolux level is indicated by the continuous line with the number indicated along the line.

Appendix A

Proposed Energy Resource Centre and Community Recreational Facility

Installation: Exterior Lighting - Light Spill

Project number : 7/2125

Processed by : Stephen Howe

Date : 24.05.2007

Project description:

All luminaires are dark sky compliant utilising metal halide white light lamps.

Maintenance factor calculated at 6,000 hours.

Sky glow calculation based upon a concrete forecourt with an assumed reflectance of 30%.

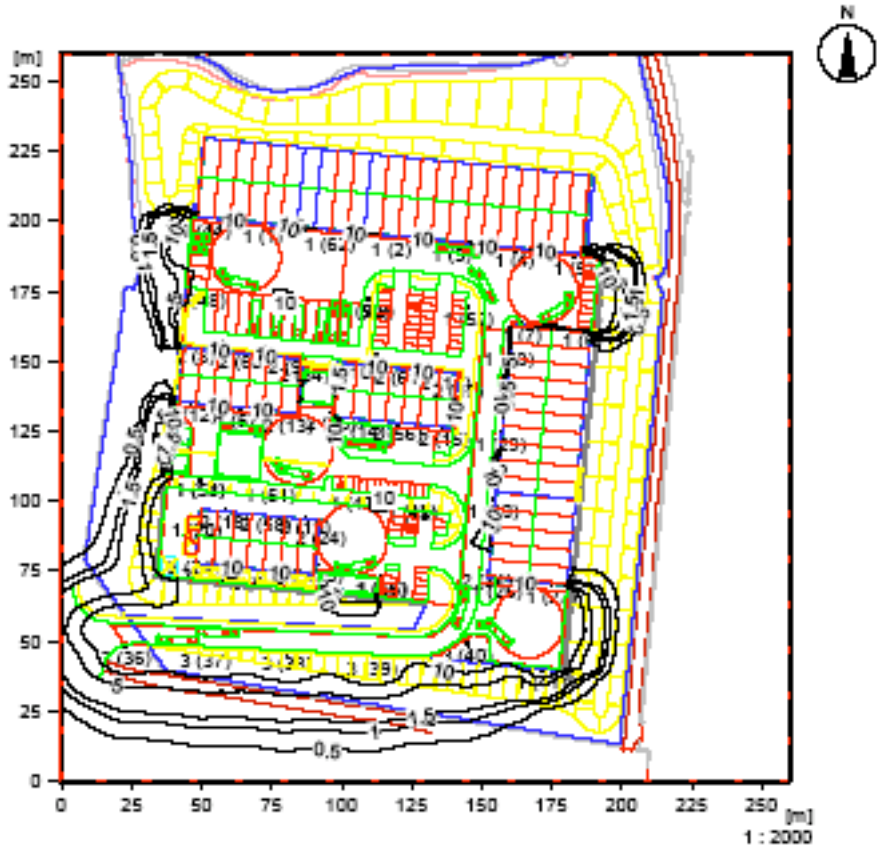
The following values are based on exact calculations on calibrated lamps, luminaires and their arrangement. In practice, gradual divergences can occur.

Exterior
Description, Exterior
Floor Plan

Object : Proposed Energy Resource Centre and Community Recreational Facility
Installation : Exterior Lighting - Light Spill
Project number : 7/2125
Date :24.05.2007

Exterior

Calculation Results, Exterior
Isolines representation, Spill Light (E)



Illuminance [lx]

Height of the reference plane		: 0.00 m
Average illuminance	Eav	: 10 lx
Minimum illuminance	Emin	: 0 lx
Maximum illuminance	Emax	: 138 lx
Uniformity g1	Emin/Eav	: ---
Uniformity g2	Emin/Emax	: ---

Object	: Proposed Energy Resource Centre and Community Recreational Facility
Installation	: Exterior Lighting - Light Spill
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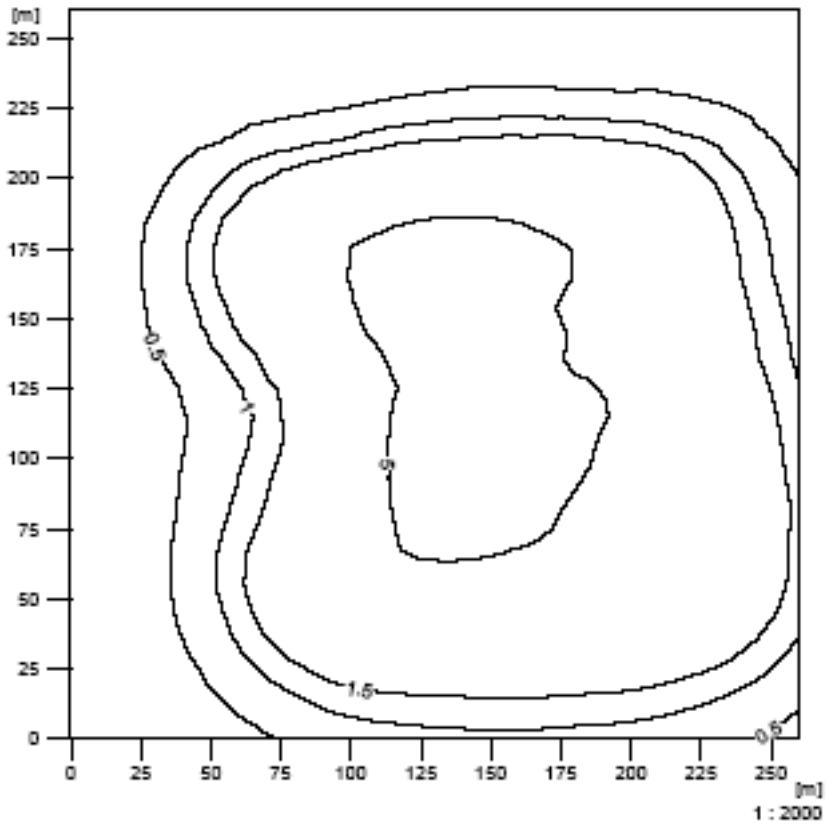
Isolines representation, Sky Glow (E)

Illuminance



Average illuminance	Eav	: 2.2 lx
Minimum illuminance	Emin	: 0.05 lx
Maximum illuminance	Emax	: 6.14 lx
Uniformity g1	Emin/Eav	: 1 : 45.50 (0.02)
Uniformity g2	Emin/Emax	: 1 : 126.82 (0.01)

Object	: Proposed Energy Resource Centre and Community Recreational Facility
Installation	: Exterior Lighting - Light Spill
Project number	: 7/2125
Date	:24.05.2007