



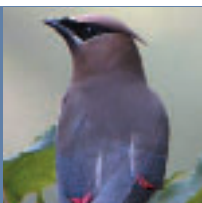
BIRD-FRIENDLY



DEVELOPMENT



GUIDELINES



## City of Toronto Green Development Standard

# BIRD-FRIENDLY DEVELOPMENT GUIDELINES

### List of Participants

The City of Toronto would like to thank the following participants for their assistance in developing the Bird-Friendly Development Guidelines:

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[www.toronto.ca/lightout](http://www.toronto.ca/lightout) [www.toronto.ca/environment/greendevlopment.htm](http://www.toronto.ca/environment/greendevlopment.htm)

March 2007



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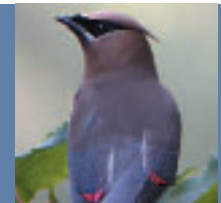




Photo: Mark K. Peck

## INTRODUCTION

- Background
- Need for Policy and Action
- Policy Context
- Relevance to New, Existing and Heritage Buildings



The goal of these Bird-Friendly Development Guidelines is to prevent the needless deaths of migratory birds by suggesting ways to mitigate the dangers buildings pose to them.



A portion of dead migratory birds collected in Toronto's Downtown Financial District by the Fatal Light Awareness Program (FLAP) during one migration season. An estimated minimum of one million migratory birds die each year in Toronto due to collision with buildings.  
Photo: Mark Thiessen, National Geographic Photographer

# Introduction

## Background

These Bird-Friendly Development Guidelines are part of the Migratory Bird Policies adopted by City Council in January 2006. They are the result of an initiative taken by City Council on April 12, 13 and 14, 2005 when it adopted Motion J(17) regarding the “Prevention of Needless Deaths of Thousands of Migratory Birds in the City of Toronto”. In addition to developing the Bird-Friendly Development Guidelines, the City of Toronto launched “Lights Out Toronto!”, a public awareness campaign aimed at drawing attention to this issue and to ways that individuals, businesses, property owners and managers can help reduce migratory bird deaths. This annual campaign will coincide with the spring and fall migratory seasons. The City is also participating in the rescue, rehabilitation and release of injured migratory birds. In City-owned buildings, a ‘lights-out’ policy for after work hours and on weekends has been in place since 2005.

Birds exist naturally in urban areas, with some species becoming particularly adept at living in cities. These year round resident birds include pigeons, gulls, cardinals, House Sparrows and European Starlings. During the two annual migration periods, the resident bird population experiences a significant influx of migratory birds.



Eastern Kingbird  
Photo: Mark K. Peck

These are birds observing their annual cycle of migration north in the spring to their summer breeding grounds and south in the fall to warmer regions where they spend the winter. Most migratory bird species are unable to adapt to living in cities. During their biannual flyovers they become confused by the combination of light pollution and the effects of glass in the urban environment. This often results in significant numbers of birds colliding with buildings.

### WHEN DO BIRDS MIGRATE?

Spring Migration: mid-March to early June

Fall Migration: mid-August to early November

Bird ‘collisions’ or ‘strikes’ are a result of a variety of causes. Daytime strikes occur because birds cannot perceive images reflected in glass as reflections, and thus will fly into windows that they think are trees or sky. Clear glass also poses a danger as birds



Black-throated Green  
Warbler  
Photo: Carol L. Edwards

(like humans) have no natural sense designed to perceive clear glass as a solid object. Birds will strike clear glass while attempting to reach habitat and sky seen through corridors, windows positioned opposite each other in a room, ground floor lobbies, glass balconies or where glass walls meet at corners. The impact of striking a reflective or clear window in full flight often results in death. While bird strikes occur throughout the year, they rise dramatically during the annual spring and fall migrations because many species of migratory birds travel at night. A combination of light from the moon and stars and geomagnetic signals from the earth provide natural cues for direction. Light pollution from urbanized areas obscures the light from the moon and stars. It is suspected that red light, commonly used on towers and other tall structures, interferes with birds' ability to track geomagnetic cues.

The light emitted from urban areas disorients migrating birds and draws them into brightly lit downtown areas, hence the term “fatal

## NEED FOR POLICY AND ACTION

Many of North America's migratory bird species are facing significant population decline.

Habitat loss, pesticide use, climate change and collisions with buildings and structures all contribute to this decline. As recorded by FLAP, of the 158 different species known to have been killed in Toronto by collision with buildings, at least 64 are classified as in decline. Millions of migratory birds are killed in North America each year as a result of collisions with buildings. Making the city safer for migratory birds will enhance the natural biodiversity with our urban environment and help reduce the decline in North American bird populations.

Birds are essential to a healthy ecology: they consume billions of insects daily, pollinate plants and disperse seeds. The beauty and diversity of birds also greatly enhance our experience of nature. They also contribute significantly to our economy as bird-watching has become the second most popular leisure activity in North America, after gardening.

One of the key ways to reduce migratory bird deaths is to reduce light pollution, which will also result in energy savings, lower building operating costs and reduced greenhouse gas emissions. By implementing bird-friendly development guidelines, Toronto's environment will be a safer and healthier place for both human and bird populations.

light attraction”. Disoriented birds will often fly around until exhausted and drop to the ground or they may strike a building or window and fall to the pavement below. If they survive the fall, they must contend with predators (such as gulls) that have learned that this is a ready food source. If not eaten, then they are trapped within the unfamiliar built environment. At this point they frequently injure themselves while trying to seek shelter by flying into the glass surfaces of brightly lit ground level lobbies decorated





Peregrine Falcon  
Photo: Canadian  
Peregrine Foundation

with large trees and or plants. Not perceiving the invisible barrier, birds will fly towards the illuminated vegetation for safety and subsequently hit the glass. In poor weather at night during rainy, overcast and/or foggy conditions, the numbers of disoriented birds colliding with buildings are at their highest as the natural cues birds use to migrate are further obscured.

Urban night lighting attracts birds and poor weather traps them, which increases the density of migratory birds in urban areas. The increased density of migratory birds in the unfamiliar urban environment results in an increased number of bird collisions in subsequent daylight hours.

## POLICY CONTEXT

### The City of Toronto Official Plan

The City's Official Plan states that 'the natural environment is complex. It does not recognize boundaries and there are limits as to the stresses resulting from human activity that it can absorb.' It also asserts that 'environmental concerns must also be part of our everyday decision-making because interaction with the environment is constant.' In keeping with this policy objective, these Bird-Friendly Development Guidelines provide strategies for reducing the stress that the urban environment exerts on migratory bird populations, thereby enhancing the natural biodiversity found within Toronto.

### The Toronto "Green Development Standard"

These Bird-Friendly Development Guidelines are part of the City of Toronto "Green Development Standard". This 'made in Toronto' Green Development Standard is intended to improve the overall quality of life in Toronto by encouraging sustainable site development to a standard that will increase energy efficiency, improve water quality, improve air quality, reduce greenhouse gas emissions, reduce waste and protect the urban forest and wildlife habitat. A 'bird-friendly' building is considered a component of a 'green development'.

### The Natural Heritage System and Inventory

The natural heritage system is an evolving policy initiative that identifies and integrates significant natural features and functions within Toronto. The City of Toronto and the Toronto and Region Conservation Authority have identified and developed an inventory of components within the natural heritage system and have provided strategic direction for improving the natural ecosystem and increasing local biodiversity. The natural heritage system is illustrated on Map 9 of the City of Toronto's Official Plan. When development is proposed on or near lands shown as part of the natural heritage system, the proposed development's effect on the system is to be evaluated and an impact study may be required. The role of migratory bird routes in the natural heritage system is an important component of this inventory.



American Robin  
Photo: Mark K. Peck



Cedar Waxwing  
Photo: Mark K. Peck

## Relevance to New, Existing, and Heritage Buildings

These guidelines are intended to provide a list of design-based development strategies available to developers, building managers and owners, architects, landscape architects, urban designers and professional planners wishing to make new and existing buildings less dangerous to migratory birds. The specific context of each development will influence the strategies selected. These strategies may be applied to any type of development including high and low-rise residential, commercial, industrial and institutional projects.

For new developments, the developer will choose to incorporate some or all of the possible strategies. Consideration of bird-friendly features should be incorporated into the design process, beginning

with the initial design concept and ultimately carrying through to the Site Plan.

For existing buildings, the viability of options will depend on the design of the existing building and site. Some options will be easier to implement than others.

These guidelines can also apply to heritage buildings in the City. Heritage buildings pose a particular challenge as the historical integrity of the building's design must be maintained. The strategies available to building owners and managers of existing heritage buildings wishing to implement bird-friendly options may be somewhat limited by these factors. Nevertheless, they are still strongly encouraged to participate wherever possible.

Photo: Carol L. Edwards

## DESIGN-BASED DEVELOPMENT STRATEGIES FOR BIRD-FRIENDLY BUILDINGS

- Glass
- Visual Markers
- Strategies for Creating Visual Markers
- Strategies for Muting Reflections



Appropriate window applications for the first 12 metres above grade are essential for a building to be considered bird-friendly.



**Hazard:** Habitat reflected in untreated reflective glass is an extreme hazard. Treatment of these windows would make them bird-friendly.  
Photo: FLAP

# Design-based Development Strategies for Bird-Friendly Buildings

## Glass

### Creating Visual Markers and Muting Reflections

Natural features in the wild do not reflect images in the way glass does, rather they project 'visual markers' to birds, indicating to them that they are solid objects to be avoided.

There are two means of mitigating the danger glass poses to birds. The first and far more effective approach is to create visual markers. The second and less effective strategy is to mute reflections in glass.

These Bird-Friendly Development Guidelines offer examples and strategies to create visual markers and mute reflections in glass features of buildings. Applying these solutions to an entire building is ideal. However, the key critical area is the first 12 metres above grade. Window applications to the first 12 metres are essential for a building to be considered bird-friendly (these dimensions relate to the typical city tree heights).

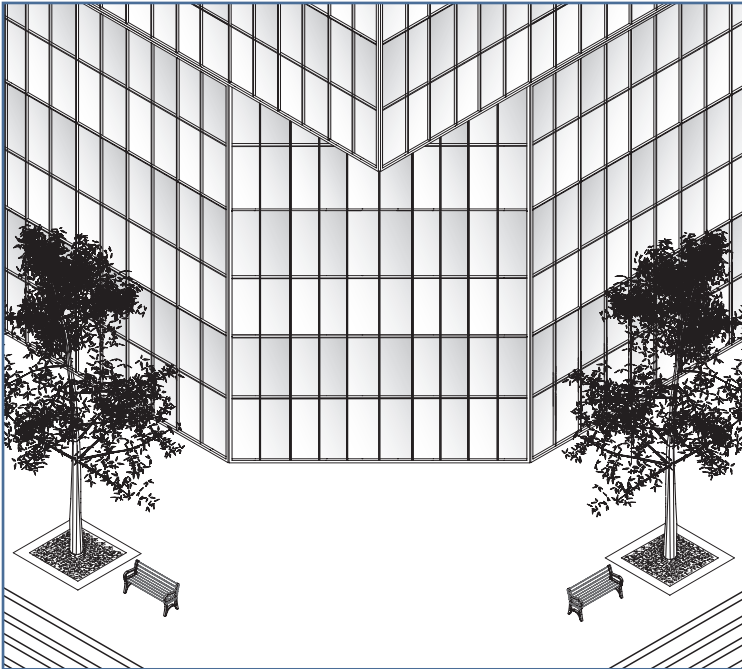


White-throated Sparrow  
Photo: Carol L. Edwards

This will be subject to the specific building design and site condition. For instance, if the site is close to a natural area such as a ravine or woodlot or other natural feature where the majority of the vegetation is generally higher than 12 metres, glass treatments in these areas should be applied to the height of the top of the surrounding tree canopy or the anticipated height of the surrounding vegetation at maturity. Similarly, for elevated landscapes such as podium gardens and green roofs, glass adjacent to or in the vicinity of these elements should be made bird-friendly.

## Visual Markers

Birds begin to perceive buildings as objects to be avoided when the distances between features or patterns on glass is at approximately 28 cm, with the most effective pattern distance at 10 cm or less. Essentially, the denser the pattern the more effective it becomes in projecting itself as a solid object to birds.



Visual Markers – The denser the pattern in the design of the exterior, the more effective a building becomes in projecting itself as a solid object to birds.



This is a good example of a building that projects sufficient visual markers for birds to perceive as a solid object. Very few dead and injured birds are found at this facade.

Photo: FLAP

## Strategies for Creating Visual Markers

### Patterned or 'Fritted' glass

Patterned or 'fritted' glass has an image or abstract pattern embedded in it. By using dots of various sizes and densities, manufacturers can create any kind of image, translucent or opaque. The image in the glass then projects enough visual markers to be perceived by birds. Only non-reflective glass should be used in combination with fritted patterns.



**Hazard:** Linkways are especially dangerous to birds as they will attempt to reach the habitat located beyond the glass. Glass treatments are strongly encouraged for these elements.  
Photo: FLAP



Patterned glass with an embedded, decorative image.  
Photo: Kelly Snow

## Film

Patterns can also be applied to existing glass through the use of film products. Applied to external surfaces, including windows, film products can be designed with any image or pattern. Film laminates are often applied to downtown buildings for other purposes, such as security or advertising. Often these products are applied to transit vehicles for advertising purposes. On buildings, the film need not advertise particular products and could be integrated with the architectural design of the building.



Exterior view of film  
Photo: FLAP



Interior view of film (same window)  
Photo: FLAP



## Decals

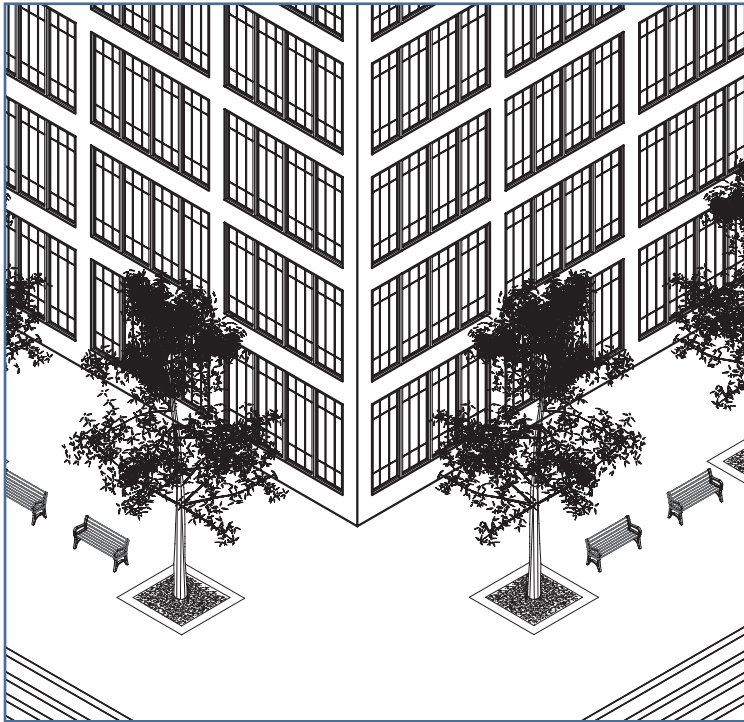
A pattern of decals applied externally can also create enough visual markers. However, if decals are used, a pattern with clear spaces of no more than 28 cm is required in order for the use of decals to be considered bird-friendly.



Externally-applied patterned decals can create sufficient visual markers for the glass to be perceived by birds  
Photo: Allan Turner

## Fenestration Patterns

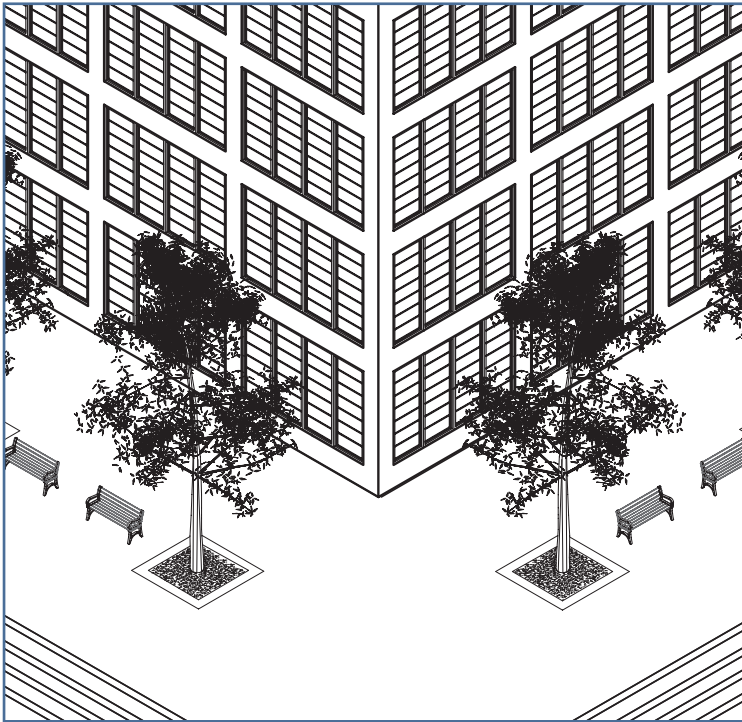
Multiple paned glass is an effective source of visual markers. The vertical and horizontal mullions create an image that is visible to birds, as long as the panes conform to the optimal range of 28 cm to 10 cm or less, with the smaller distances being more effective.



Fenestration patterns within glass  
Photo: FLAP

## Decorative Grilles and Louvres

Exterior decorative grilles are another means of projecting visual markers to birds. Exterior decorative grilles can serve as a bird-friendly development feature as long as they are within the optimal range of 28 cm to 10 cm or less, with the smaller distances being more effective.



Decorative Exterior Grille  
Photo: FLAP

## Artwork

Similarly, artwork installed on the interior or exterior of windows may provide enough visual markers for birds to perceive the glass as a solid object while allowing enough natural light into the interior space.



Exterior artwork  
Photo: FLAP

## Creative Design Solutions and Opportunities

Opportunities may exist for developments to explore design solutions for glass that address these Bird-Friendly Development Guidelines and the City's Percent for Public Art Guidelines. By thinking about these guidelines in combination at the conceptual stage, a development may successfully address, in part, some objectives of City Planning's Public Art Program and the goal of the Bird-Friendly Development Guidelines.

## Emerging Technologies

Birds are able to perceive ultraviolet (UVA-A) light. Currently, there are glass products under development that either reflect or absorb UV wavelengths (ranging from 300 - 400 nanometers), that birds can see but humans cannot, which would enable a window to be clear and/or reflective to the human eye but appear solid to a bird's.

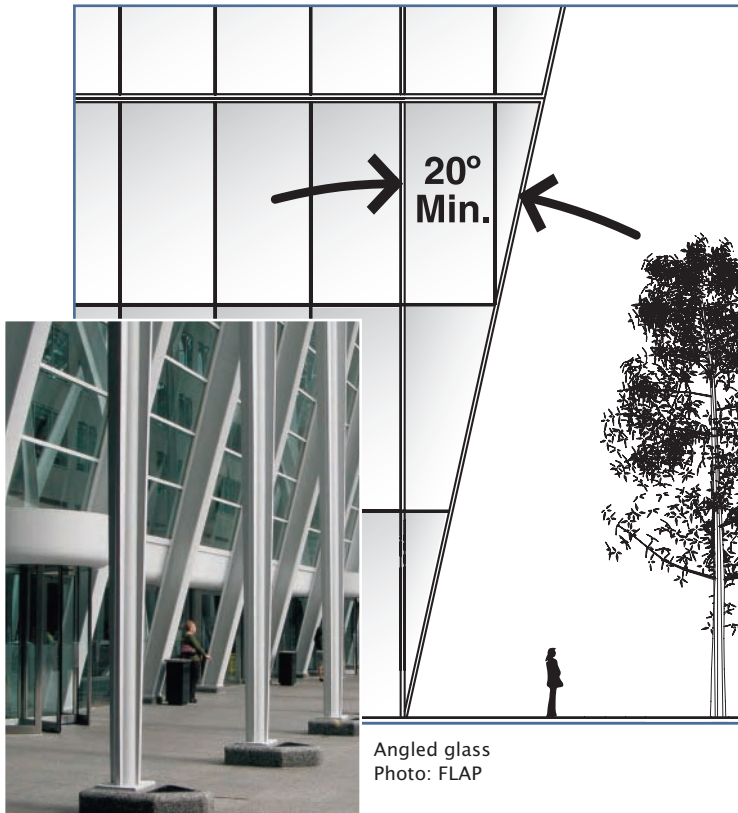
Also, photovoltaic panels can be incorporated into windows where photovoltaic vision glass substitutes a thin-film, semi-transparent photovoltaic panel for the exterior glass panel in an otherwise traditional double-pane glass window or skylight. These panels can be designed in such a way as to generate enough visual markers for birds to perceive windows as solid objects while also producing renewable energy.

The research of such technologies is supported in principle by the City of Toronto. If such products were to come to market, the City would consider them as acceptable bird-friendly design options.

## Strategies for Muting Reflections

### Angled glass

Angling glass panes in such a way as to project reflected images downward is a fairly effective way of reducing bird strikes, especially at ground level. Angles become effective at a minimum angle of 20 degrees with 40 degrees known to be more effective.



### Internal Screens

Installation of internal screens may provide enough visual markers through non-reflective glass for birds to perceive windows as solid objects. To be most effective, they must be installed as close to the glass as possible so as to maximize the visual markers projected through the window.



## Awnings and Overhangs

Awnings and overhangs will cover windows in ground floor lobbies and mute image reflections in them. They can take on a variety of creative forms.



## Sunshades

Sunshades are external features designed to reduce direct sunlight into a room while allowing indirect light, thus reducing the demands on cooling systems. They have many variations and can be incorporated into the design of a building in many interesting and creative ways. Sunshades mute the reflections in glass windows thereby reducing the likelihood of birds flying into them.



Detail of ceramic fritted glass sunshades  
Photo: Teri Meyer Boake



### LIGHT POLLUTION

- External Lighting Fixtures
- Types of Lighting
- Preferred Lighting
- Discouraged Lighting



Photo: Mark K. Peck





A “bird’s eye view” of Toronto at night.



Toronto at night  
Photo: Vince Pietropaolo



# Light Pollution

Light pollution creates “artificial sky glow”, which is an issue not just for migratory birds, but for people as well.

Reducing light pollution will not only reduce the needless deaths of hundreds of thousands of migratory birds each year, it will save energy, enhance the visibility of the night sky’s stars, and improve security and safety for people and property through the use of efficient, properly designed lighting fixtures.

Artificial sky glow is the unnatural brightening of the night sky through excessive and unnecessary light, which is wasted energy, hence the term “light pollution”. Light pollution is caused by inefficient and poorly designed lighting fixtures that project light upward. It is also a result of lights left on unnecessarily in and around buildings, excessive use of vanity lighting, excessively-lit advertising fixtures and festival lighting.

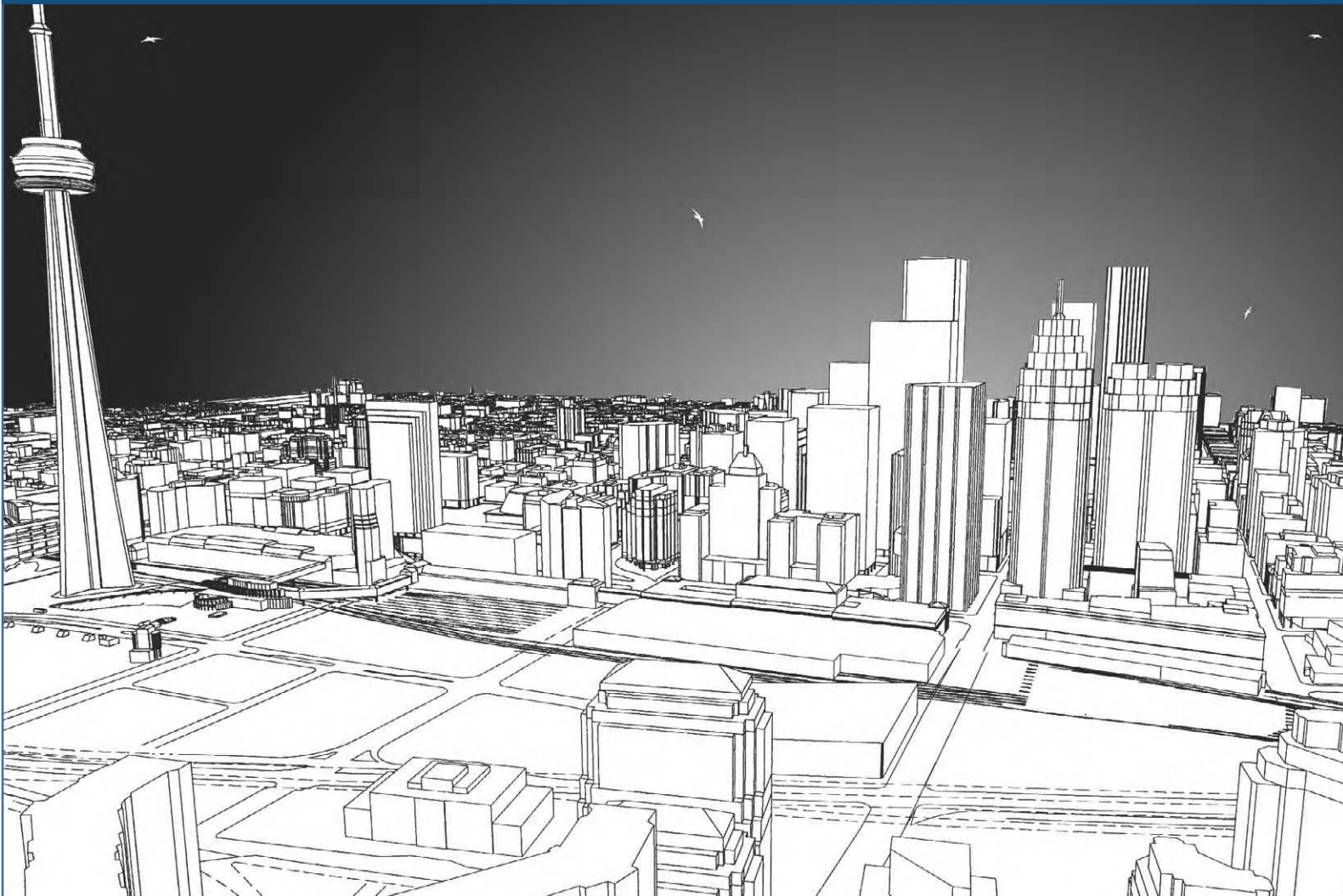


Yellow Warbler  
Photo: Mark K. Peck



Light pollution in North America

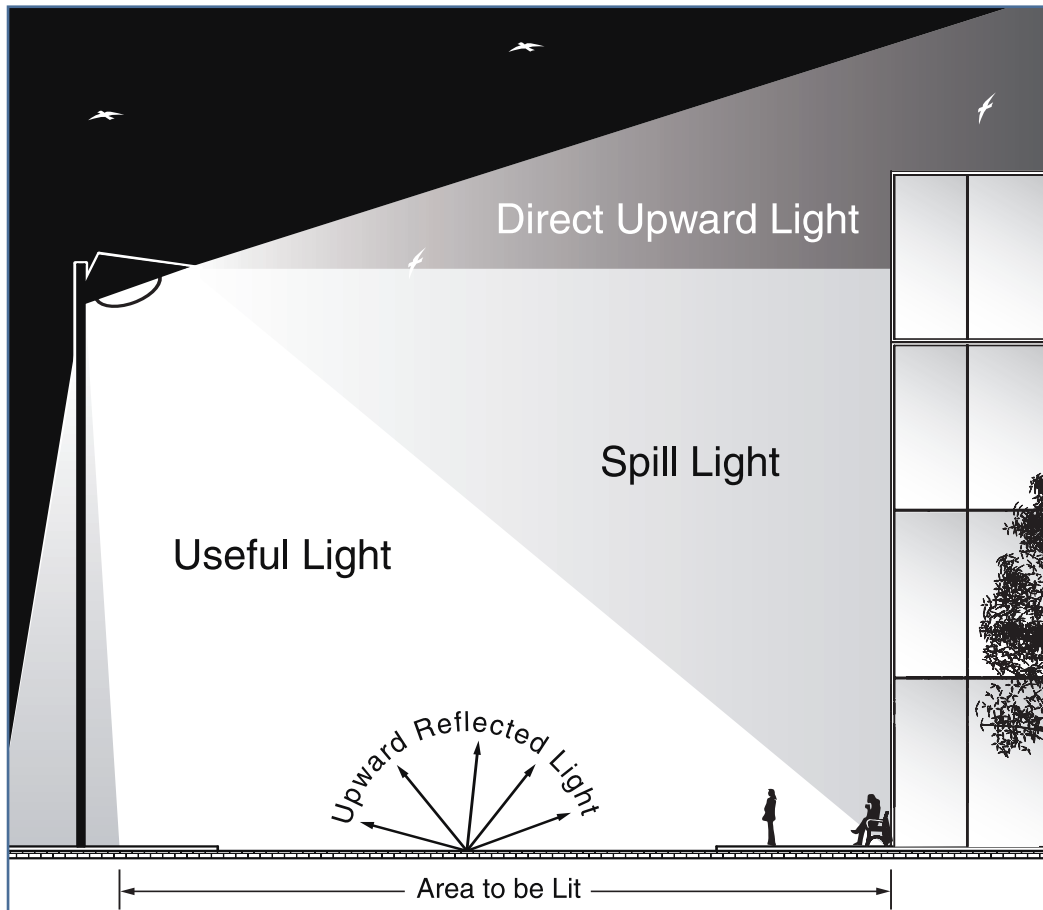
Artificial sky glow is the unnatural brightening of the night sky through excessive and unnecessary light, which is wasted energy, hence the term “light pollution”.



## External Lighting Fixtures

Inefficient external lighting is a significant source of light pollution.

For a building to be bird-friendly, light pollution from external lighting must be minimized. This can be achieved by implementing several design features and operational practices related to vanity and architectural lighting, site lighting, lighting for advertising, event and festival lighting.



### THE OBJECTIVES ARE TO:

- **Eliminate direct upward light**  
Direct upward light is projected directly upward by inefficient lighting fixtures.
- **Reduce spill light**  
Spill light spills beyond areas that need to be lit for safety and security reasons but is not projected directly upward.
- **Optimize useful light**  
Useful light is used to illuminate urban areas that need to be lit for safety.

## Types of Lighting

External lighting used to illuminate the surrounding site of a building should be efficient while providing enough illumination to effectively make the site safe and secure at night. Light fixtures should project light downward to minimize direct upward light, spill light, glare and artificial sky glow.

Several conceptual examples are provided to indicate bird-friendly types of light fixture designs. Likewise, examples of undesirable light fixture design are also provided. Site lighting is also addressed in the section “Site Design Strategies.”

### Decorative Lighting

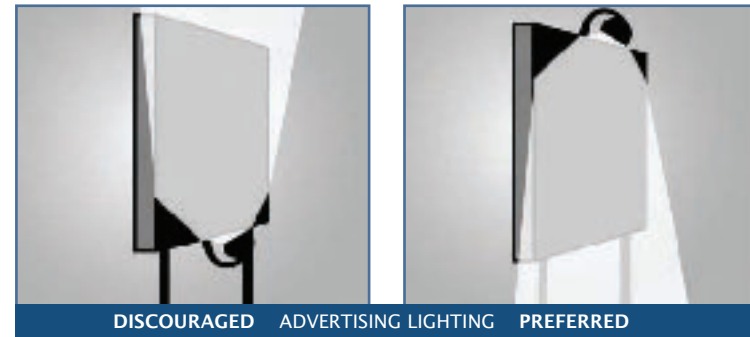
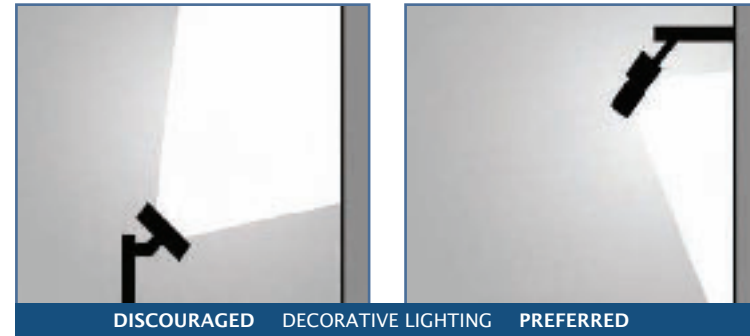
The external lighting of building features, known as ‘vanity’ or ‘architectural’ lighting, should be eliminated at best or projected downwards. For existing buildings, vanity and architectural lighting should be turned off during the migratory seasons. In cases where architectural lighting is used for aeronautical navigation purposes, the use of strobe lights is preferred as a suitable option.

### Advertising Lighting

Advertising can be designed to produce less light pollution by ensuring that the illuminated area is lit from above to minimize the amount of light unnecessarily being projected into the night sky.

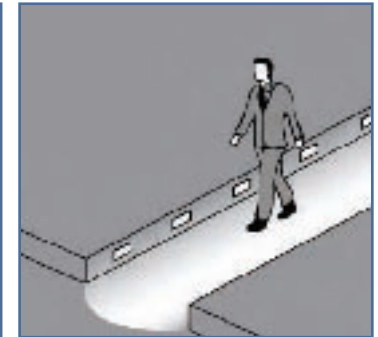
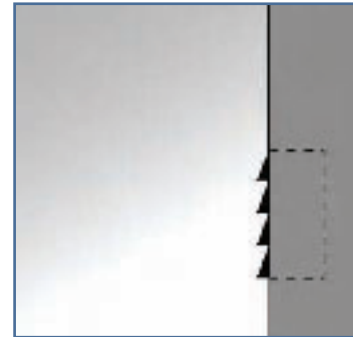
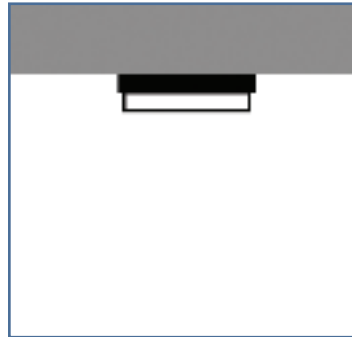
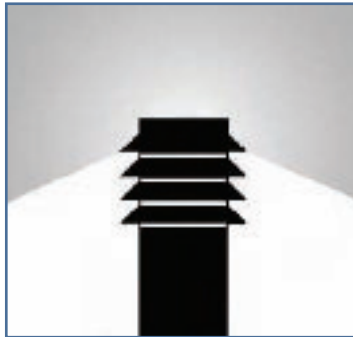
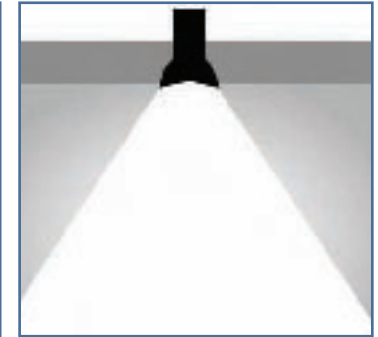
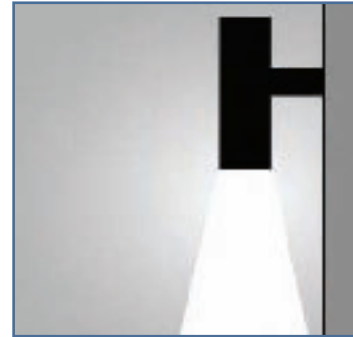
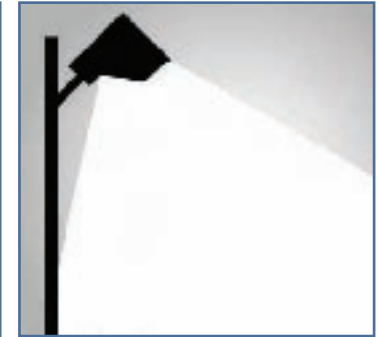
### Event and Festival Lighting

Event lighting, such as spotlights and searchlights should be prohibited during the migratory seasons.



## Preferred Lighting

Examples of lighting fixtures that effectively project light downwards, minimizing direct upward light, spill light, glare and artificial sky glow. Use of these types of lighting fixtures is **encouraged** for external site lighting.



## Discouraged Lighting

Examples of inefficient lighting fixtures that project light upwards, increasing spill light, glare and artificial sky glow. Use of these types of lighting fixtures is **discouraged** for external site lighting.

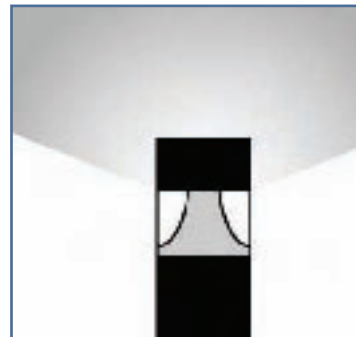
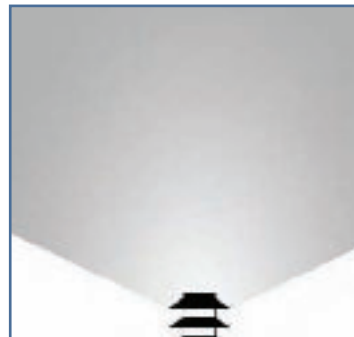
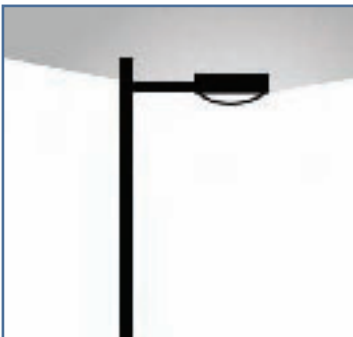
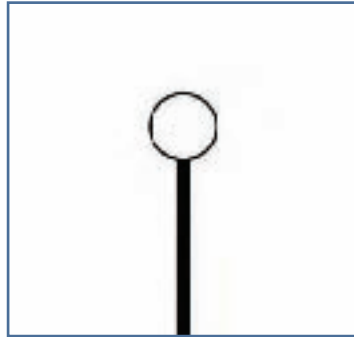


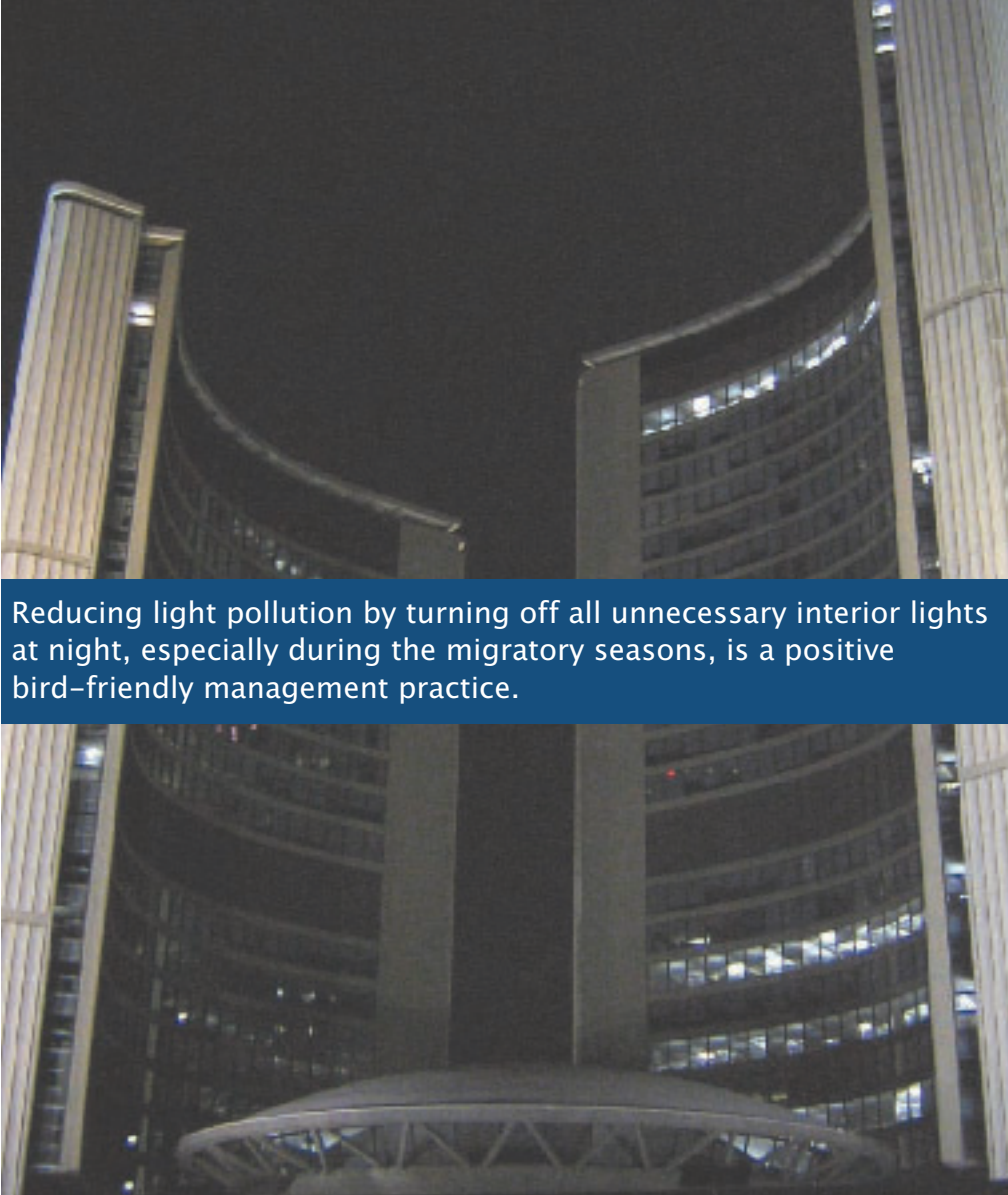


Photo: Jim Flynn

#### **BUILDING MANAGEMENT OPERATIONS**

- Reducing Light Pollution from Interior Lights
- Cleaning During the Day
- Internal Location of Greenery



A photograph of Toronto City Hall at night, showing its distinctive curved architecture and illuminated windows. The building is lit up, with many windows glowing from interior lights. The sky is dark, and the building's structure is highlighted by the lights.

Reducing light pollution by turning off all unnecessary interior lights at night, especially during the migratory seasons, is a positive bird-friendly management practice.

Toronto City Hall, April 2006, 12:00 a.m.  
Photo: Kelly Snow



# Building Management Operations

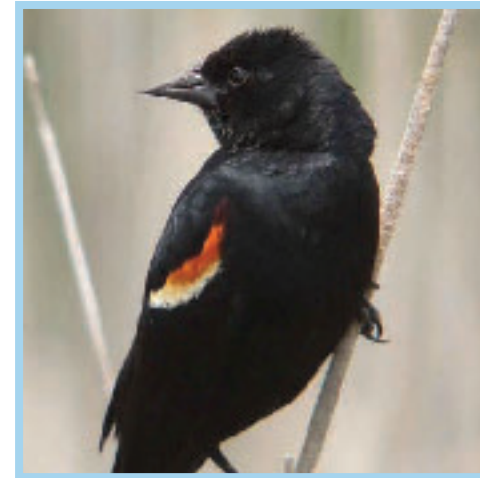
In addition to implementing design and lighting elements to make a building bird-friendly, developers, building owners, managers and tenants can incorporate operational practices and systems that will help reduce migratory bird deaths.

## Reducing Light Pollution from Interior Lights

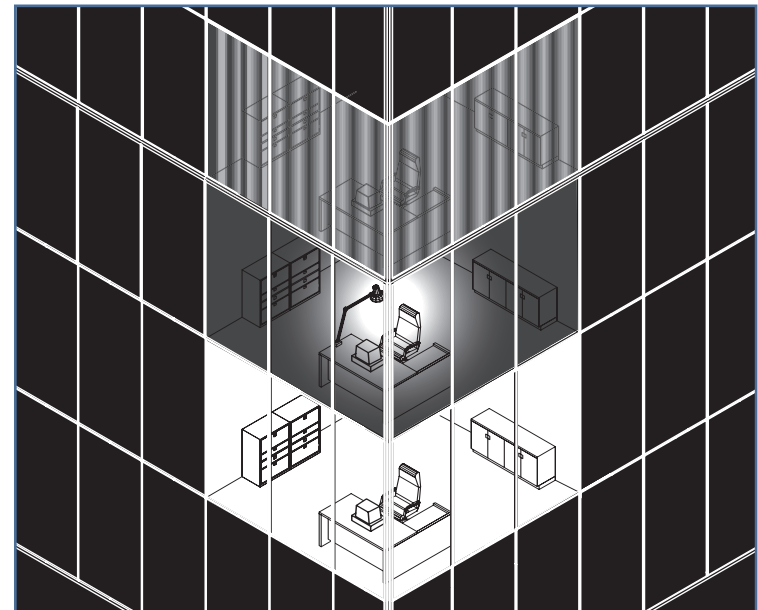
As birds migrate, they are disoriented by and drawn towards light pollution escaping from urban areas, which often leads to their collision with buildings resulting in injury or death.

Reducing light pollution by turning off all unnecessary interior lights at night, especially during the migratory seasons, is a positive bird-friendly management practice that is cost effective for existing buildings. Installation of motion-sensitive lighting in lobbies, walkways and corridors and retro-fitting operational systems that automatically turn lights off during after-work hours are other ways to reduce light pollution and fatal light attraction.

For tenants of existing buildings, using task lighting at one's workstation and drawing office blinds or curtains at night are ways that individuals can help to reduce migratory bird deaths.



Red-winged Blackbird  
Photo: Mark K. Peck



Light pollution can be drastically reduced by drawing office blinds or curtains (top), or using task lighting at work stations (middle). Doing neither (bottom) is energy inefficient and dangerous for migrating birds.

Building managers and owners can assist in raising awareness of these helpful individual practices by notifying and reminding their tenants of these 'best practices' throughout the migratory seasons.

For new developments, the process is straightforward. The developer's responsibility is to ensure that bird-friendly options are provided in the design of the building, while the building manager and tenants are ultimately responsible for operating the bird-friendly features appropriately. In open concept offices, lighting systems that automatically adjust lighting levels and turn off unnecessary lights can be installed. Blinds should also be installed along with the task lighting so that tenants can also help reduce light pollution.

## Cleaning During the Day

Commercial office cleaning has traditionally been done during the evening, after normal work hours when most tenants have left for the day. This system requires office lighting to be on while cleaning staff are working in the building at night, resulting in increased light pollution, which negatively impacts migratory birds.

Cleaning during the day is becoming a popular operational option to traditional evening cleaning as it reduces energy consumption and subsequently results in cost savings. It also reduces greenhouse gas emissions and enhances building security. Buildings are encouraged to institute the practice of cleaning during the day as a bird-friendly building management operation.



Dark-eyed Junco  
Photo: Carol L. Edwards

### Example of Potential Energy and Money Savings

Building surface area: 22,000 m<sup>2</sup>

Illumination strength: 9 W / m<sup>2</sup>, lights on 24 hours,  
365 days/year

$22,000 \text{ m}^2 \times 9 \text{ W/m}^2 \times 24 \text{ hours} \times 365 \text{ days} \times 1/1000 =$   
1,734,480 kWh power used annually

At 5 cents per kWh = \$86,724 annual energy costs

By turning off lights from 11 pm to 5 am = savings of  
\$21,681 in annual energy costs

By turning off lights from 7 pm to 7 am = savings of  
\$43,362 in annual energy costs

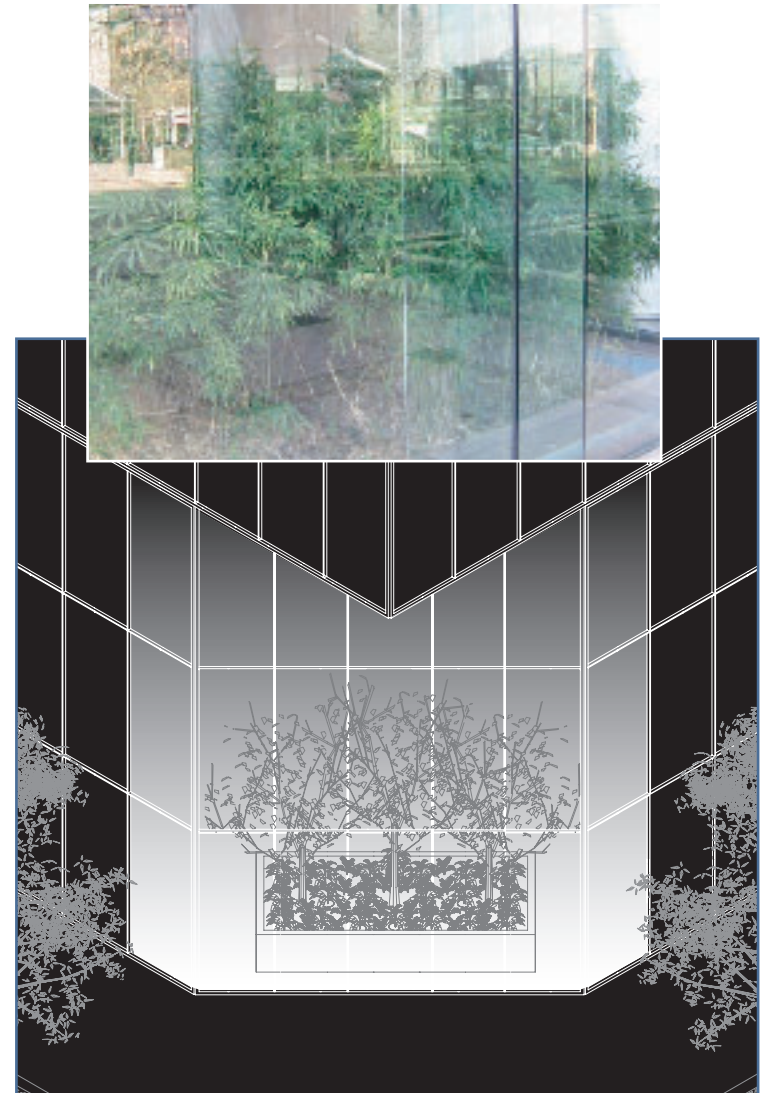
## Internal Location of Greenery

The location of interior plants, large and small, on the ground floor levels of buildings can also have a negative impact on birds.

Ground floor lobbies and walkways are often decorated with trees and shrubs and designed with clear glass fenestration. These lobbies are often brightly lit at night, dramatically highlighting any greenery that may be inside.

Brightly lit lobbies with greenery features are extremely dangerous to a migratory bird that has been drawn into the city by light pollution and become trapped in the unfamiliar urban environment. Birds, like humans, cannot perceive clear glass and thus will attempt to fly towards the greenery that is perceived as safe habitat. This often results in injury and death as they crash into the window.

To minimize bird collisions, building managers and owners are encouraged to locate any greenery away from clear glass. They are also encouraged to minimize lighting levels through motion-sensitive lighting systems in ground floor lobbies, walkways and corridors, and to retrofit clear glass wherever possible with translucent, 'fritted' glass, or to apply window film. These retrofit and application options will produce 'visual markers' to enable birds to perceive the glass as a solid object.



Discouraged  
Photo: Kelly Snow

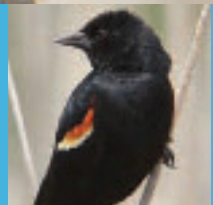




Photo: Mark K. Peck

#### SITE DESIGN STRATEGIES

- Lighting
- Other Site Features
- Comprehensive Bird-Friendly Site Strategy





# Site Design Strategies

Site design strategies should always be implemented in conjunction with glass treatment at lower levels.

The overall site strategy of a bird-friendly building can influence migratory bird deaths through the placement of bird-friendly exterior lighting fixtures, design of glass elements on site and type of ventilation grates used on site. Bird-friendly site strategies are developed as a result of understanding and anticipating where birds will be in relation to the glass in the structures located on a particular site. Ideally, migratory birds are less likely to be drawn into a building site within an urban area once light pollution levels are minimized.

## Lighting

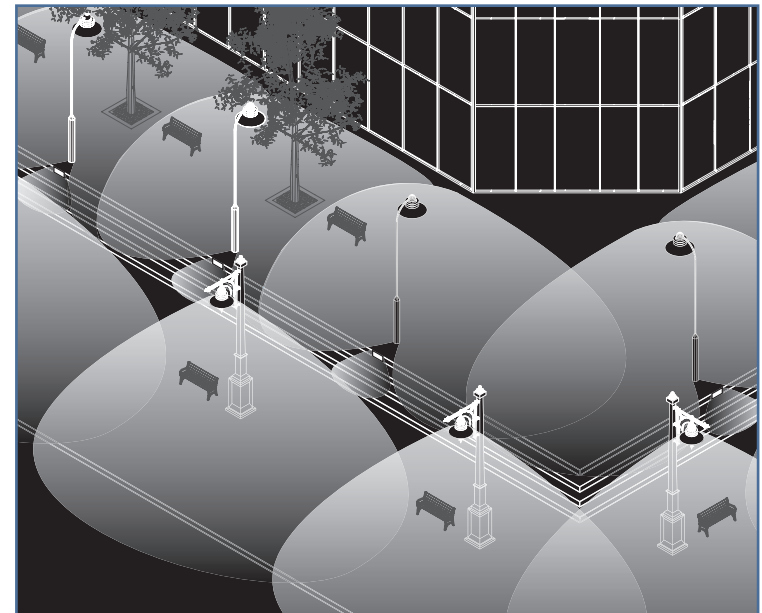
Lighting fixtures on a building site must conform to proper building and safety codes. Within the parameters of these codes, exterior site lighting fixtures should be directed downward, oriented and placed in such a way as to project light only on non-reflective surfaces on the site. This will help reduce light pollution from reflections and glare off glass within the site.

## Other Site Features

Glass design features on a site such as windbreaks, solariums and greenhouses should be treated in a way that creates enough visual



Ruby-throated  
Hummingbird  
Photo: Terry Flynn



Example of preferred site lighting design

markers for birds to perceive them. Such treatments would entail the same treatments for glass described in the section “Design-Based Development Strategies for Bird-Friendly Buildings”.



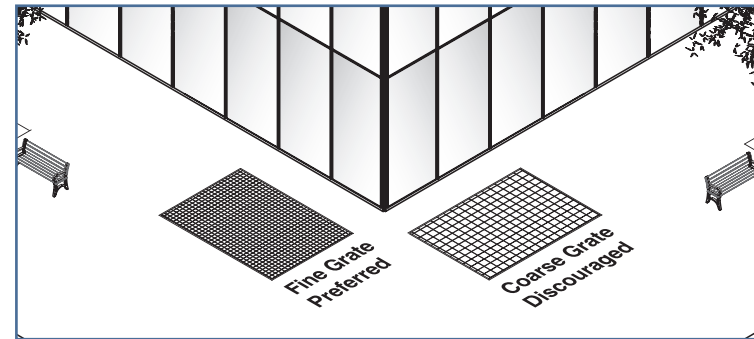
Glass windbreaks treated in a way that creates visual markers  
Photo: Kelly Snow

### Use of Mirrors in Gardens

Increasingly, landscape architects and garden designers are specifying mirrors (large and small) in their designs, with the intent to create a reflection and, at times, an infinite repetition, of their design; and in small gardens, to create an illusion of a larger space. Unfortunately, these surfaces kill and maim birds, as birds cannot distinguish the reflected habitat from real habitat. Mirrors should be avoided in landscape design.

### Site Ventilation

Ventilation grates on a site also present a deadly hazard for birds. An injured and helpless bird that falls onto a ventilation grate with a porosity large enough for the bird to fall through will find itself trapped when it recovers enough to attempt flight. Ventilation grates should have a porosity no larger than 2 cm x 2 cm or should be covered with netting in order to prevent birds from falling through. Also, ventilation grates should never be up-lit for this would produce light pollution.



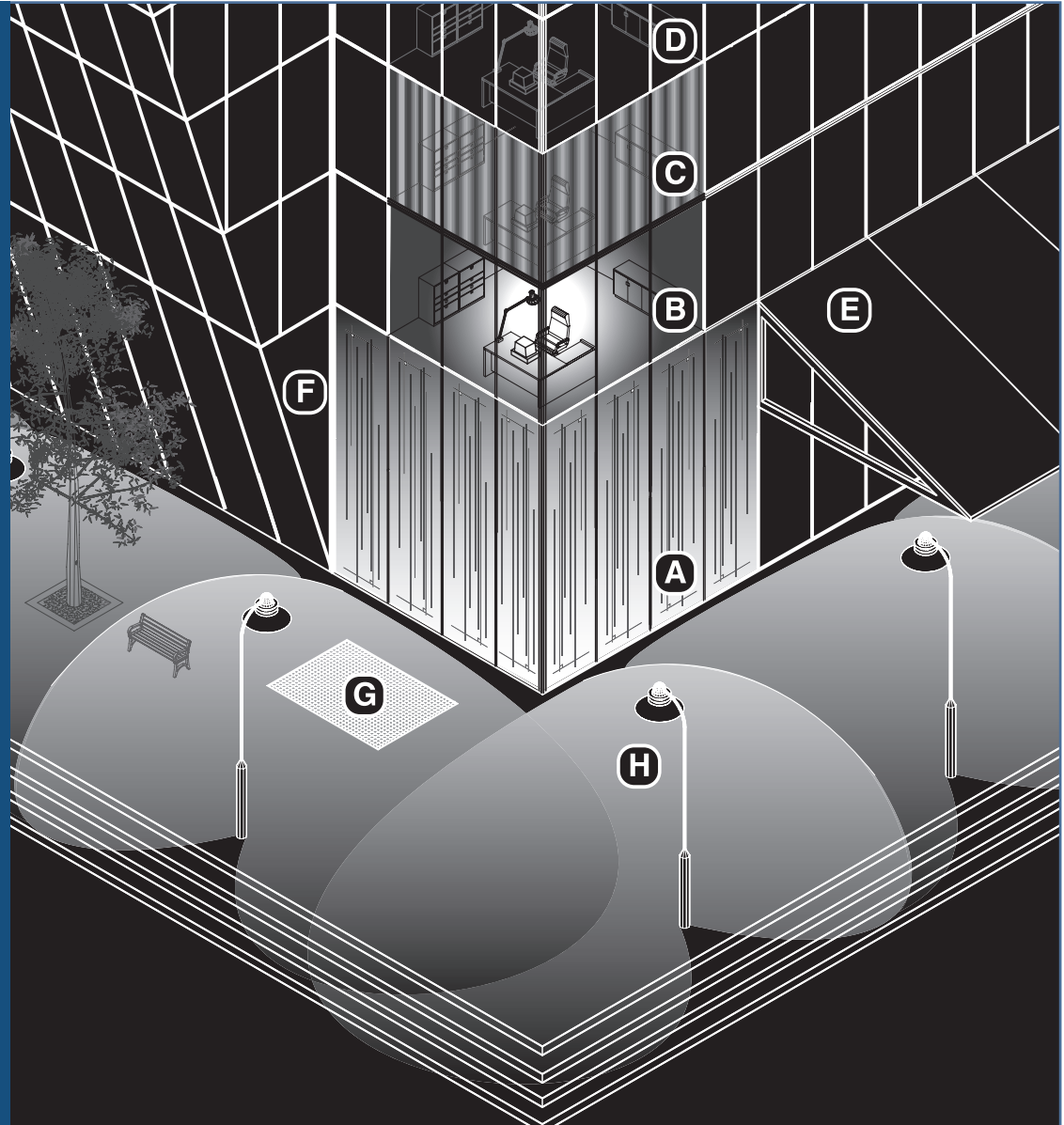
### Use of Transparent Noise Barriers

Noise barriers erected at highways and railway rights-of-way to protect adjacent communities from noise present similar problems if portions of the barriers are transparent. Increasingly, portions of noise barriers are constructed with clear polymethyl methacrylate (PMMA) panels. These transparent panels are perceived by birds as non-existent and hence the birds fly into them and are killed or seriously injured. These panels present the same dangers to birds as do the glass panels of buildings. Use of glass or methacrylate panels in noise barriers should be avoided. When transparent barriers are present, they should be treated in a way so as to create enough visual markers for birds to perceive them.



## COMPREHENSIVE BIRD-FRIENDLY SITE STRATEGY

- A: Treatment applied to glass projecting enough visual markers to make it visible to birds
- B: Task lighting in use after dark
- C: Blinds drawn after dark
- D: Lights turned off after work hours
- E: Awning for muting reflections on lobby windows
- F: Glass effectively angled to project reflections downward
- G: Bird-friendly site ventilation grates
- H: Use of lighting fixtures effectively projecting light downward

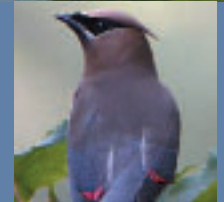






## CONCLUSION

- Glossary





The City of Toronto strongly encourages the creative and innovative implementation of these Bird-Friendly Development Guidelines wherever possible.

Northern Flicker  
Photo: Mark K. Peck

# Conclusion

Birds have been migrating through this region for thousands of years. The dangers posed to migratory birds by today's urban landscapes are relatively new in evolutionary time scales and birds have been unable to alter their instinctive behaviour in response to this recent product of human activity. Bird populations are depleting rapidly throughout North and South America and it is inconceivable that they can evolve quickly enough to adjust to massive urbanization, deforestation and other factors threatening them. Cities are the key places that the changes in human behaviour necessary for bird conservation can occur. Education and involvement of individuals will help to reconcile the needs of the human and non-human worlds and help mitigate the negative impact of the built environment on the natural environment.

The City of Toronto has worked in partnership with the private sector, bird advocacy organizations and other levels of government to develop these Bird-Friendly Development Guidelines. Residents of Toronto can all play a role in reducing migratory bird deaths and together architects, developers, urban designers, planners, building owners, managers and tenants can make a positive difference to our city's natural environment and help to ensure the survival of migratory bird populations for future generations.



Eastern Bluebird  
Photo: Jim Flynn



Golden-winged Warbler  
Photo: Mark K. Peck

## Glossary

**Artificial sky glow:** the artificial brightening of the night sky caused in large part by inefficient lighting fixtures that project light upward.

**Direct upward light:** light that is projected directly upward by inefficient lighting fixtures. Direct upward light contributes greatly to artificial sky glow.

**Fatal light attraction:** the instinctive reaction of birds to fly toward artificial bright light that often results in death by collision with buildings.

**Fenestration:** the arrangement of glass panels and/or windows in a wall.

**“Fritted” glass:** glass that is manufactured with a visible embedded pattern.

**Heritage buildings:** buildings that are listed on the Inventory of Heritage Properties for their historical and architectural significance.

**Migration:** animal species’ long distance movement from one habitat to another, according to the seasons and on an annual cycle.

**Mullions:** the bars between panes of glass in a window.

**Resident bird:** non-migrating birds that reside year-round in the urban environment.

**Spill light:** artificial light that is projected indirectly by lighting fixtures.

**Useful light:** artificial light that is efficiently and directly projected by lighting fixtures, which has a necessary purpose and use in the urban environment.

**Visual markers:** a term used to describe birds’ visual perception created by solid/opaque surfaces.

