City of Markham

Bird-Friendly Guidelines

Updated March 2026

MARKHAM

City of Markham
Bird-Friendly Guidelines

Document version

Version	Date	Notes
1	February 2014	First release of the Bird-Friendly Guidelines.
2	March 2026	Guidelines updated to reflect current best practices, informed by research from organizations such as the Fatal Light Awareness Program (FLAP) Canada, the American Bird Conservancy (ABC), and the Canadian Standards Association (CSA).

This document has been structured and designed to be AODA compliant to ensure that it is accessible for all readers.

Acknowledgements

The Bird-Friendly Guidelines represents a collaborative effort between the City of Markham, Fatal Light Awareness Program (FLAP) Canada, American Bird Conservancy (ABC), Toronto and Region Conservation Authority (TRCA), North-South Environmental Inc., and Wallman Architects. The leadership, expertise, and support of all contributors have been instrumental throughout the development of this document. This guide is the result of their shared commitment to creating a safer and more sustainable environment for birds in Markham.

We gratefully acknowledge the assistance, insights, and photographic contributions provided by the following sources in the development of the 2014 Markham Bird-Friendly Design Guidelines:

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Landplan

WALLMAN ARCHITECTS

Figure 1: Bird-friendly treatment applied at Markham Pan Am Centre

Preface

The City of Markham's evolving skyline, growing urban intensification areas, and extensive network of planned and protected green spaces, combined with its location along established migratory bird routes, have contributed to an increase in bird injuries and fatalities, particularly due to bird-window collisions.

In response, Markham Council has reaffirmed its commitment to becoming a bird-friendly city through a series of proactive initiatives. These include bird-friendly retrofits at the Civic Centre, Fred Varley Art Gallery, Markham Museum, and Thornhill Community Centre, as well as the application of bird-friendly design principles in the Cornell and Aaniin Community Centres.

Building on this leadership, Markham Council approved Bird-Friendly Guidelines in 2014 as a city-wide resource to promote site and building design strategies that reduce the risk of bird collisions and support the protection of avian species residing in and migrating through Markham.

Since receiving approval in 2014, the guidelines have been successfully integrated into the City's development process, reinforcing Markham's commitment to avian safety and sustainable urban planning.

To ensure the guidelines continued effectiveness, the guidelines have been updated to reflect current best practices, informed by research from organizations such as the Fatal Light Awareness Program (FLAP) Canada, the American Bird Conservancy (ABC), and the Canadian Standards Association (CSA).

Legal Protection for Birds in Canada

Canada has strong legal protections for migratory and at-risk bird species through the Migratory Birds Convention Act (MBCA), Species at Risk Act (SARA), and Ontario's Environmental Protection Act (EPA). These laws prohibit harming, disturbing, or killing birds, including their nests and eggs, whether intentionally or unintentionally. They reinforce Canada's commitment to preserving its avian populations and ensuring their protection through strict legal standards.

One of the most significant threats to birds is window collisions, particularly in urban areas where buildings incorporate glazing and other transparent or reflective surfaces. These surfaces are especially hazardous as birds often mistake it for open sky or habitat, leading to deadly collisions. Under Ontario's EPA, reflected light from windows is classified as a contaminant, meaning property owners can be held legally responsible for bird fatalities caused by untreated glass.

In response to this issue, bird-friendly guidelines, building standards, and mitigating design practices have been implemented. These initiatives hold architects, engineers, developers, and property owners accountable for incorporating measures that reduce the risk of bird collisions. By aligning with legal obligations, these guidelines emphasize that protecting bird is not only an environmental responsibility but also a legal one. This collective effort is essential to sustaining healthy bird populations and upholding Canada's ecological and legal commitments.

Figure 2: The use of glass in architecture can influence a bird's per

rception of its environment

Figure 3: Reflective glass on modern buildings can confuse birds and lead to collisions

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1.0 Introduction

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1.1 Why Markham Needs Bird-Friendly Guidelines

Bird strikes on human structures are estimated to be the second largest cause of avian mortality in Canada, exceeded only by cats. Each year, millions of migratory birds navigate through the Greater Toronto Area with urban environments posing significant threats due to building collisions, habitat loss, and disorientation from artificial lighting.

An estimated 16 to 42 million birds die annually in Canada due to collisions with buildings. While high-rise buildings are often blamed, the Fatal Light Awareness Program (FLAP) Canada has documented comparable or higher mortality rates for low- to mid-rise structures. Since 1993, FLAP Canada has led efforts to address bird-window collisions by recovering injured or dead birds in the Toronto region. Approximately 67% of recovered birds are found dead and used for research and education, while over 80% of injured birds are rehabilitated and released. FLAP Canada also plays a key role in shaping policy and monitoring legislation related to bird-window collisions.

Volunteers for the FLAP Canada have documented approximately 90,000 bird-window collisions in the Greater Toronto Area (GTA) since record keeping began in 2000. Of these, over 5,000 have been documented in Markham.

Four types of birds reside in Markham:

- Birds that reside year round in the municipality;
- Birds that breed in the municipality during summer but fly south for the winter;
- Birds that are seasonal visitors; and,
- Birds that breed further north but come down to the area to spend the winter.

Markham is home to diverse bird species and lies along key migratory routes, making bird conservation a vital aspect of the City's environmental strategy.

Most collisions occur during the day, on buildings with large areas of glass. Windows with adjacent vegetation that is reflected in the glass are most commonly associated with collisions. Birds are attracted to reflected vegetation, mistaking it for habitat in which they can rest and feed during migration stopovers. Migratory birds are at greater risk of injury or death as they travel in very large numbers, and are not familiar with the urban environments that they fly through or settle in to rest and feed.

Figure 4: The Ovenbird (Seiurus aurocapilla) is one of the top 20 bird species most commonly involved in window collisions in Markham.

City lighting also contributes to bird-window collisions. While most migrating birds typically fly at altitudes well above the tallest buildings in the GTA during clear weather, artificial lighting can attract them toward urban areas. In poor weather conditions, especially when visibility is low, birds may descend and become disoriented by bright city lights. This confusion can lead them to fly into buildings and other structures, often with fatal consequences.

As Markham continues to grow and intensify through ongoing development, the risk of bird-window collisions increases driven by the expansion of glass buildings, well-lit urban areas, and denser employment and mixed-use zones. Building and residential homeowners have a responsibility under the Ontario Environmental Protection Act, Federal Species at Risk Act, and Federal Migratory Convention Act to undertake reasonable measures to protect birds from harm. Moreover, reflected light has the potential to injure Species at Risk that are protected by the Federal Species at Risk Act, Federal Migratory Birds Convention Act, or Ontario's Endangered Species Act. These policies (or acts) are taking action to address bird-window collisions by stating bird-friendly guidelines as due diligence.

The City' s implementation, continued monitoring, and regular updates of the guidelines reflect Markham's commitment to creating bird-friendly environments.

Figure 5: Birds in Markham (Selected Species)

Images

1. Yellow-bellied Sapsucker
2. White-throated Sparrow
3. Common Yellowthroat
4. Ruby-throated Hummingbird
5. Ruby-crowned Kinglet

1.2 Policy Context

Markham Council has endorsed the preparation of Bird-Friendly Guidelines, informed by key City policy documents including Greenprint, Markham's Community Sustainability Plan (2011), the City of Markham's Official Plan (2014), and the Sustainability Metrics Program (2022). Recent provincial legislative changes have also been considered in the latest update that enable municipalities to work with designers and developers through the development approvals process to promote bird-friendly buildings.

The Guidelines continue to support Federal and Provincial legislative requirements for bird-safe design and serve as an important planning tool to guide implementation. While this guideline references policies current at the time of preparation, users are responsible for ensuring compliance with the most up-to-date standards, policies and legislation.

Greenprint, Markham's Community Sustainability Plan (2011)

The Greenprint, Markham's Community Sustainability Plan (2011), is a long-term plan to address environmental health, economic vitality, and social and cultural well-being. The Greenprint is a comprehensive strategy to make Markham one of the most livable and sustainable communities in North America. Within the plan are 12 integrated sustainability priorities that reflect Markham's unique context.

The Bird-Friendly Guidelines support the Ecosystem Integrity within the Greenprint priorities with the objective to develop and support wildlife habitat and to increase biodiversity. Recommendations from the priority are integrated into the Bird-Friendly Guidelines including: adopt Bird-Friendly Guidelines for all new and high-risk existing buildings; establishes a dark sky policy; and, work with local partners and the community to establish wildlife stewardship and education programs.

City of Markham's Official Plan (2014)

The City of Markham's Official Plan (2014), as amended, includes policies that promote the principles of sustainable community development. New growth will be concentrated in centres and corridors in the urban areas with emphasis on compact higher density development. The Official Plan (2014) contains policies to protect and enhance key natural heritage features and their functions, both within the local and provincial context, as well as, significant features such as the Oak Ridges Moraine and the Rouge National Urban Park.

The urban design policies in the Official Plan (2014) provide direction for the inclusion of Bird-Friendly Guidelines under section 6.2.2.7 to reduce occurrence of bird collisions with buildings for use as part of the development approval process. Section 6.2.3.1 of the Sustainable Buildings and Site Design section also states that it is the policy of Council to apply innovative sustainable design practices and technologies in site planning and building design through the development approval process. The list of sustainable design practices includes considerations for the use of window applications, visual markers, and external coverings to reduce the risk of bird collisions with building façades, and minimizing the impact of lighting from development on the nocturnal environment and night sky. These policies have been considered in the development of the guidelines.

City of Markham's Sustainability Metrics Program (2022)

The City of Markham's Sustainability Metrics Program (2022) is a performance-based framework that evaluates and promotes the sustainability of new developments. The program supports the creation of complete, resilient communities through the integration of environmental, social, and economic sustainability measures.

A key feature of the program is its emphasis on bird-friendly design. Developers are encouraged to incorporate strategies that reduce bird-window collisions through glazing treatments and light mitigation strategies. Administered through the development approvals process, these measures align with the City's broader environmental priorities, which include enhancing biodiversity and protecting ecological integrity.

Figure 6: Residential towers with large areas of glazing can significantly increase the risk of bird collisions if bird-friendly measures are not implemented

1.3 How to use the Guidelines

Purpose and Scope

The purpose of the guidelines is to support federal and provincial legislative requirements and align with current best practices for bird conservation. The guidelines provide a framework for enhancing bird safety in the built environment. They are intended to encourage and promote the integration of design-based solutions that improve building visibility for birds and actively reduce the risk of bird-window collisions within the City of Markham. The guidelines also provide technical guidance for bird-friendly site and building design and includes recommendations for municipal implementation.

The guidelines are the result of extensive consultation and integrates valuable input from both internal and external stakeholders, including developers, architects, and industry associations such as Ontario Association of Architects (OAA), Building Owners and Managers Association (BOMA), Building Industry and Land Development Association (BILD), and the Markham Developers Round Table.

The guidelines serve as a practical resource for planners, designers, and the development industry to inform both new construction and redevelopment in the built environment. The guidelines will be primarily used by City staff to evaluate proposals through the development application review process to ensure that bird safety is integrated as a core consideration throughout the design and planning stages of development.

The guidelines focus on two main areas:

1. Collision Prevention: Recommending the use of bird-friendly glazing, visual markers, external coverings, and architectural design strategies that reduce the risk of birds collision with reflective or transparent surfaces.

2. Lighting Management: Promoting responsible lighting strategies to reduce light pollution, particularly during peak migration periods.

Applicability

Markham's Bird-Friendly Guidelines applies city-wide, implemented primarily through the development application review process. The guidelines apply to a broad range of building types including:

- Low-rise, mid-rise, and high-rise residential buildings;
- Industrial developments;
- Commercial developments; and,
- Institutional developments.

Although retrofitting existing buildings falls outside the scope of the development application review process, the City strongly encourages building owners, homeowners, and property managers to implement bird-friendly measures on high-risk buildings. Retrofitting strategies such as applying visual markers to glass or modifying lighting can significantly reduce bird-window collisions and contribute to a safer urban environment for both migratory and resident bird species. These measures are advocated as part of responsible building maintenance and ongoing environmental stewardship.

By adopting and applying these guidelines, the City of Markham reaffirms its leadership in sustainable urban development and contributes to a healthier, more resilient ecosystem that benefits both local wildlife and the broader community.

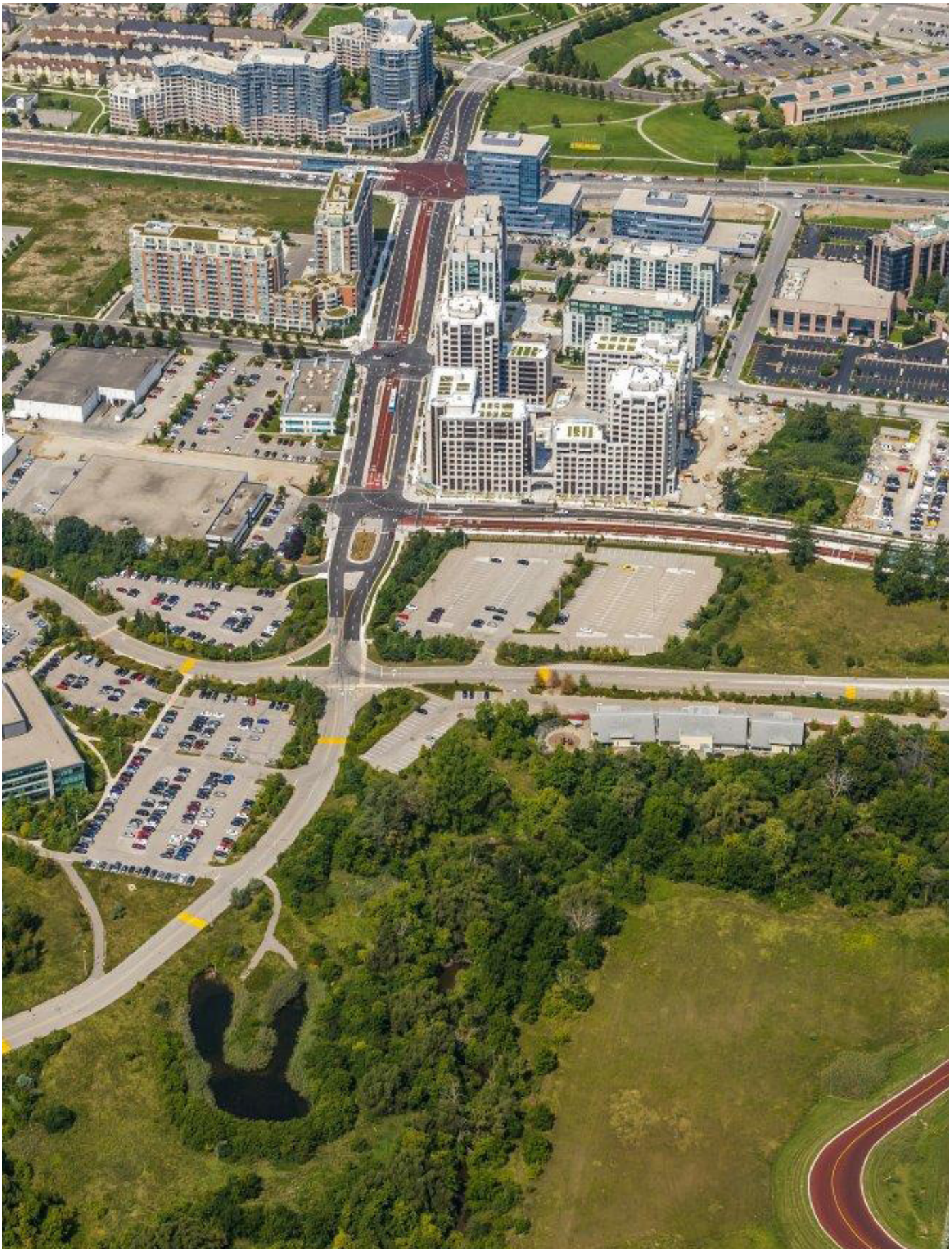

Figure 7: Bird-friendly measures apply city-wide, including intensification areas such as Markham Centre

2.0 Surface Treatment Guidelines

2.0 Surface Treatment Guidelines

Research has shown that the most effective way to prevent bird-window collisions is by making the glass visible to birds, primarily by reducing reflection and transparency. The guidelines offer a range of solutions to support this goal. These specifications are based on empirical research and practical experience from the Greater Toronto Area (GTA), and have been demonstrated to significantly reduce bird strikes by at least 80%.

This following section of the document provides guidance on mitigating bird window collisions using surface treatments.

While canopies, awnings, and overhangs that provide external shading have been suggested as a viable treatment in some jurisdictions, as noted within **Part 2: Appendix A** - Best Practices Summary, FLAP Canada has found them to be ineffective. As a result, they are not included as recommended options for mitigating bird window collisions in the City of Markham.

The treatment of windows to reduce the risk of bird-window collisions may also be a consideration taken by the development industry to obtain LEED credits.

Best Practices

FLAP Canada recommends the following best practices:

1. Exterior window treatments should be selected to withstand exposure to the elements and regular window cleaning.
2. Selected products should come with a reasonable warranty.
3. Dual-purpose products, such as those offering privacy, artwork, branding, advertising, or energy savings (e.g., solar reflective films with bird-safe markers), should be explored to offer cost-neutral solutions.

Figure 8: Buildings designed to prevent fly-through conditions

2.1 Treatment Zones

The application of bird-friendly treatments requires a balanced approach that addresses both bird safety and user needs. To reflect this balance, new developments incorporating glass should consider the following key factors:

- Height of treatment zone;
- Coverage area within treatment zone.

These considerations are based on best practices supported by research (see **Part 2: Appendix A - Best Practices Summary**) and are further described below.

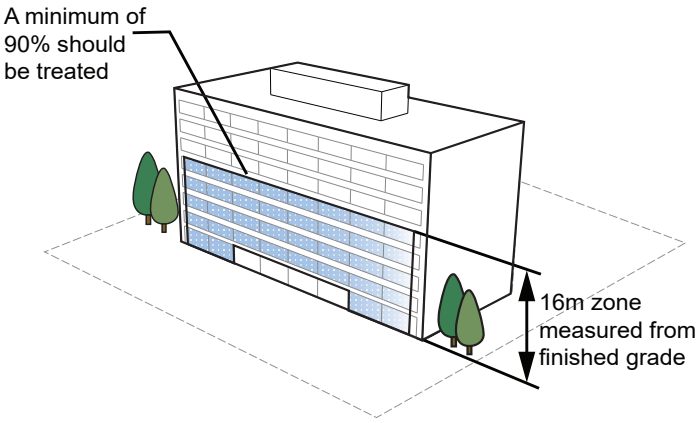

Figure 9: Illustration of treatment area based on the 16 metres zone and 90% rule. All exterior glazing and other transparent or reflective surfaces within the first 16 metres from finished grade should have a minimum of 90% bird-friendly treatment, where as 100% is encouraged

16m Zone of Protection

Several factors play a key role in determining the zone of protection. First, research has found that the largest number of bird-window collisions occur next to the tallest vegetation. Secondly, the average size of mature trees in the GTA is 16 metres. However, some tree species can reach mature heights of up to 30 metres under suitable conditions.

Based on recent findings and in alignment with current Canadian Standards Association (CSA) standards, the following guidelines apply to new development where glazing and other transparent or reflective surfaces are proposed:

1. All exterior glazing and other transparent or reflective surfaces within the first 16 metres from finished grade should incorporate bird-friendly treatment.

2. Bird-friendly treatment should be applied to all exterior glazing and other transparent or reflective surfaces including glass balcony railings, clear glass corners, glazing, and other transparent or reflective surfaces surrounding interior courtyards and other glass areas.

90% Rule

While treating all glass surfaces is ideal, in certain cases, maintaining clear views through some portions of the glass may be permitted. Studies have shown that the effectiveness and acceptance of bird-friendly treatment can be improved by strategically leaving small gaps in the treatment to allow for desired views, while still ensuring sufficient visibility of the glass to birds.

Based on recent findings and in alignment with current CSA standards, the following guidelines apply to new development where glazing and other transparent or reflective surfaces are proposed:

1. A minimum of 90% of all glazing and other transparent or reflective surfaces should be treated.

2. 100% of all glazing and other transparent or reflective surfaces are encouraged to be treated, particularly in site conditions or glass configurations that present a high-risk to birds.

Figure 10: Fritted pattern on glass is integrated into the building façade help reduce bird collisions by making large glazed surfaces more visible to birds

2.2 Special Site Conditions

Highly transparent or reflective surfaces, especially when framed by vegetation on both sides, poses a significant threat to birds. Certain architectural configurations such as glass-enclosed courtyards or atria adjacent to gardens and water features are particularly high-risk, as these elements attract birds while increasing the likelihood of collisions. Additionally, site conditions can elevate the risk, particularly when developments are located on a sloped terrain, or near existing bird habitats.

Given these increased risks, bird-friendly design measures that exceed standard guidelines should be considered. In cases where both glass configurations and site context contribute to a high collision risk, enhanced mitigation strategies are warranted. The following context-specific guidelines should be taken into account.

A) Sloped Sites

Buildings with glazing and other transparent or reflective surfaces located on vegetated slopes pose an elevated risk of bird-window collisions. Birds may mistake reflected vegetation for open habitat, such as sky or trees, and attempt to fly through. On sloped sites, these reflections can appear much higher on the building façade compared to flat terrain, often exceeding the standard 16 metres treatment zone.

On sites located on or adjacent to vegetated slopes, birds may approach buildings from higher elevations and at greater speeds, increasing the risk of collisions. To mitigate this risk, the bird-friendly treatment zone should be extended beyond standard height of 16 metres. To ensure that glass surfaces remain visible to birds approaching from elevated terrain and provides adequate protection in sloped environments with surrounding vegetation, the following guideline applies:

1. Increase the vertical extent of bird-friendly treatments to 16 metres from the finished grade at the higher elevation of the slope.

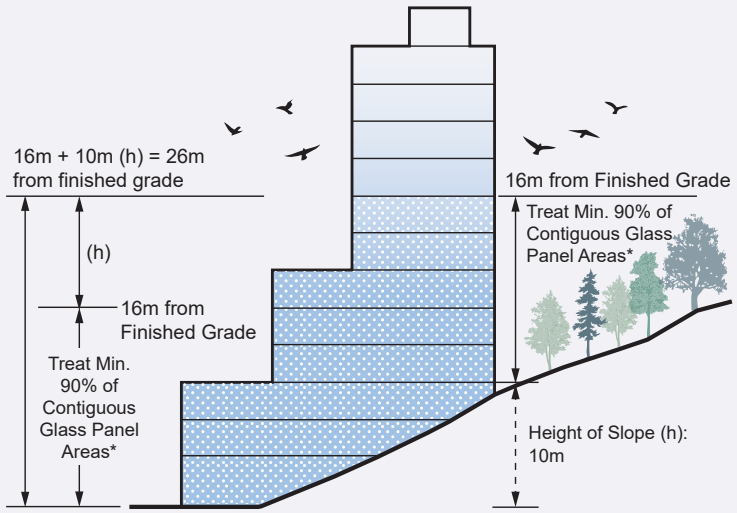

Figure 11: In this example, if a mature tree canopy measuring 16 metres in height is situated at the top of an adjacent 10 metres high slope (h), bird-friendly treatments should be applied up to 26 metres above the building's finished grade (16 metres canopy height + 10 metres slope). In such cases, the total height of the potentially reflected vegetation (approximately 26 metres in this scenario) should guide the extent of glazing and other transparent or reflective surfaces treatment on the building façade

B) Sites Adjacent to Existing Bird Habitats

Site design should carefully consider the presence of nearby bird habitats, such as ravines, natural areas, or known migratory corridors. Proximity to these environments significantly increases the risk of bird-window collisions due to elevated bird activity and intensified movement during migration seasons. On these high-risk sites, bird-friendly treatments should go beyond minimum standards. The following guideline should be applied:

1. Treat 100% of the glazing and other transparent or reflective surfaces.

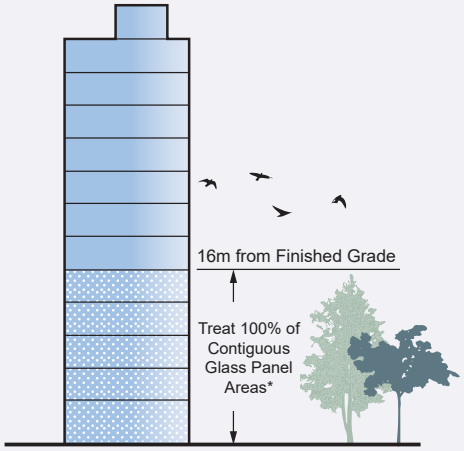

Figure 12: Buildings adjacent to existing bird habitats

C) Roof Landscaping Conditions

Green roofs and rooftop landscaped areas with vegetation provide valuable amenity spaces for building occupants, enhancing both usability and environmental performance. These spaces often include vegetation and planted surfaces, offering recreational and ecological benefits. However, they can also attract birds, increasing the risk of collisions with nearby untreated glass surfaces.

Where glazing and other transparent or reflective surfaces are adjacent to green roofs or other rooftop vegetation, the following guidelines apply:

1. Apply bird-friendly treatments to a minimum of 90% glazing and other transparent or reflective surfaces located within 16 metres vertically from the finished floor elevation of the rooftop landscaping level.

2. Treat 100% of the glazing and other transparent or reflective surfaces.

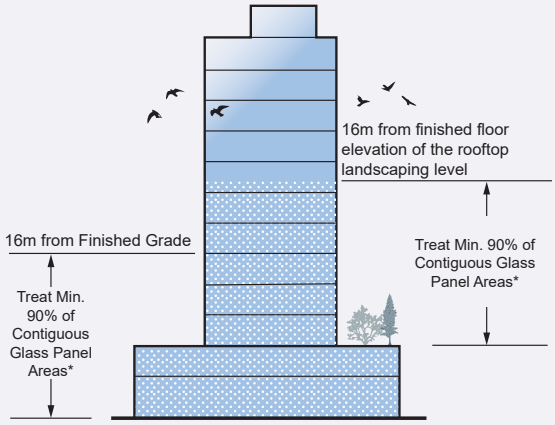

Figure 13: Bird-friendly glazing for roof landscaping conditions

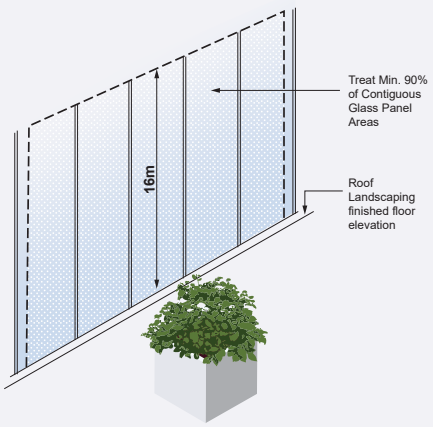

Figure 14: Brid-friendly treatment provided from finished floor elevation of the rooftop landscaping level

D) Fly-through Conditions

Fly-through conditions are created when two glazing and other transparent or reflective surfaces meet at a corner or are positioned in a way that creates the illusion of an open passage. These configurations can resemble open tunnels or sky corridors to birds, leading them to attempt flight through what appears to be unobstructed space. This often results in bird collisions.

Fly-through conditions are particularly hazardous in features such as glass bridges, walkways, outdoor railings, freestanding glass elements, and perpendicular glass building corners especially when they provide clear views to vegetation or sky on the other side.

To reduce the risk of bird collisions in these conditions, the following guidelines apply:

1. Consider alternative building designs to eliminate fly-through conditions.

2. Apply bird-friendly treatments to 100% of glazing and other transparent or reflective surfaces within the first 16 metres from finished grade in areas where fly-through conditions are proposed.

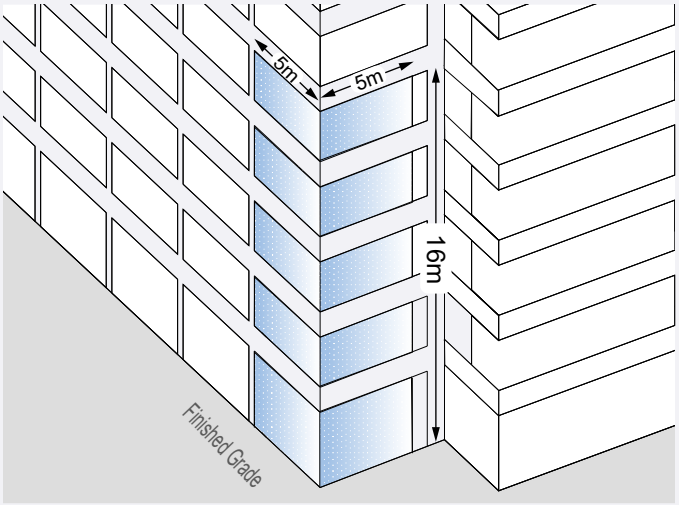

Figure 15: Bird-friendly treatments should be applied to building corners to mitigate fly-through conditions

E) Parallel Glass Conditions

Parallel glass conditions occur when two glazing and other transparent or reflective surfaces face each other directly, typically within 5 metres or less. These configurations can exist at any hight and are often found in features such as glass corridors, walkways or bridges.

Such conditions are particularly hazardous to birds, as they create visual traps through reflections and transparency that birds cannot interpret as barriers, frequently resulting in bird collisions.

Where parallel glass conditions are proposed, the following guidelines apply:

1. Apply bird-friendly treatments to both opposing/ facing glazing and other transparent or reflective surfaces at full heights to ensure visibility and reduce the risk of bird collisions.

Figure 16: Bird-friendly treatments should be applied to opposing/facing glazing and other transparent or reflective surfaces at full heights to mitigate the risk of parallel glass conditions

F) Black Hole or Passage Effect Conditions

Birds often navigate through small gaps while flying, including spaces between leaves or branches, nest cavities, and other narrow openings. In certain lighting conditions, glass can appear black or highly reflective, creating the illusion of a cavity or passage. Birds may misinterpret these reflections or dark patches as viable openings and attempt to fly through them.

For example, a dark or reflective spot on an otherwise solid, impermeable building may appear to be a safe route. This misperception can lead to collisions. The size of the bird plays a significant role in the size of the perceived passage that can become problematic. Smaller birds, such as hummingbirds, are particularly vulnerable, as they may attempt to fly through even narrow, seemingly navigable gaps in glass surfaces.

The following guidelines should be applied to mitigate black hole or passage effect conditions:

1. Avoid freestanding, narrow, or darkened glass panels that may resemble small entrances or cavities to birds.

2. Use low-reflectivity coatings or angled glass to reduce mirror-like surfaces and shadows that create a "hole" effect.

3. Design interior and exterior lighting to minimize deep shadows or silhouettes behind the glass.

4. Apply bird-friendly treatments to the full surface to ensure it appears visibly solid to birds.

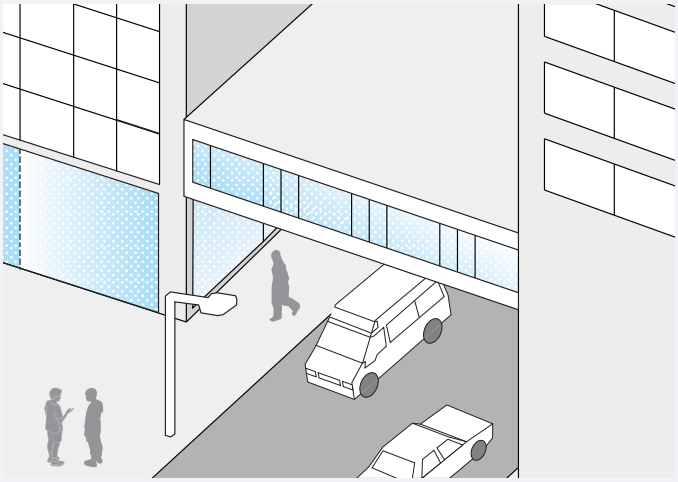

Figure 17: Bird-friendly treatments should be applied to mitigate black hole and passage effect conditions

2.3 Treatment Types

To effectively reduce bird-window collisions, bird-friendly design incorporates specific treatments that improve the visibility of glazing and other transparent or reflective surfaces to birds. There are three main treatment types, each offering a different approach to achieving bird safety while accommodating architectural and functional needs:

Treatment 1 – Visual Markers:
Design elements applied to glass to break up reflections and increase visibility.

Treatment 2 – External Coverings:
Physical elements or materials installed outside the building envelope (especially on glass surfaces) to reduce reflective and provide visual cues.

Treatment 3 – Non-Vision Glazing:
Opaque or translucent materials that eliminate the illusion of clear passage through or into reflective surfaces.

Each treatment type can be used independently or in combination depending on building design and context. Detailed descriptions of each treatment are provided in the following section.

Figure 18: Bird-Friendly Treatments are used on building façades t

o reduce bird collisions by eliminating the illusion of clear passage through glass surfaces

Treatment 1 - Visual Markers

Visual markers are design elements applied to reflective or transparent surfaces to make them visible to birds and help prevent collisions. Birds often perceive untreated glass as open sky or habitat due to its reflective or transparent nature. Visual markers eliminate these illusions by providing cues that help birds recognize the barrier.

Visual markers can be integrated into architectural design or applied as an external film, and can serve dual purposes such as visual aesthetics, branding, or privacy, while meeting bird-safety objectives.

There are four different types of visual markers:

- Stripes;
- Dots;
- Patterns;
- Frit and Etched Patterns

The following section provides further guidance on applying visual markers.

Notes:
The Canadian Standards Association (CSA) has developed a minimum standard for visual cues. To minimize bird collisions, visual markers on reflective or transparent surfaces should be spaced no more than 50 millimetres (2 inches) apart, both horizontally and vertically (CSA, 2019).

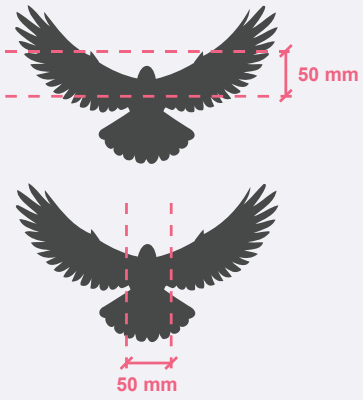

Figure 19: A minimum standard for visual cues/ markers developed by the CSA

Figure 20: Decorative visual marker is applied to glass to help prev

vent bird collisions

Stripes

Integral/ Applied Covering

Stripe pattern treatments, whether applied as integral elements or exterior adhesive films on glass, are highly effective in reducing bird-window collisions. According to the American Bird Conservancy (ABC), vertical or horizontal stripes help disrupt reflections and transparency that contribute to bird-window collisions.

When applying stripe patterns, it is important to evaluate the treatment in relation to the building's internal function to ensure that the visual treatment aligns with both aesthetic and operational needs. Stripe patterns can be used in both new buildings and retrofits, offering flexible solutions to enhance bird-safety across a variety of building types.

Where stripe patterns are proposed, the following guidelines should apply.

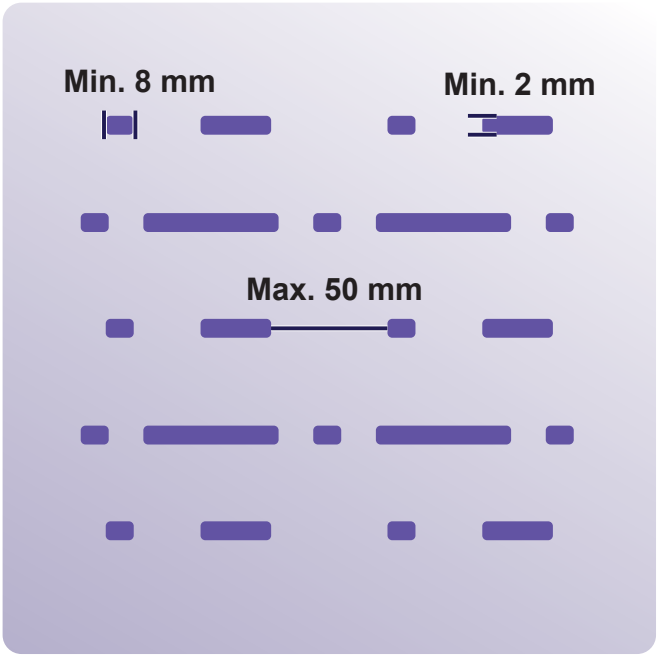

Figure 21: Illustration of stripe pattern treatment

Guidelines:

1. Treatment should be applied to a minimum of 90% of the contiguous glass area within the first 16 metres from the finished grade.
2. All glass balcony guards or guardrails located within the first 16 metres from finished grade should receive full-surface treatment (100%).
3. Glass corners located within the first 16 metres from finished grade should receive full-surface treatment (100%), extending at least 5 metres in each direction from the corner.
4. Stripes should be spaced no more than 50 millimetres (2 inches) apart, measured on centre.
5. Stripes should measure a minimum of 2 millimetres in width by 8 millimetres in length for effective visibility.
6. Stripe colour should be high-contrast relative to the background (light or dark, depending on surrounding conditions).
7. Treatment should be applied to the first (exterior) surface of the glass. Treatments applied to inner surfaces do not reduce glass reflectivity and are therefore ineffective in preventing bird-window collisions.
8. Vertical or horizontal stripe pattern that cross at different angles, can offer considerable flexibility for creating interesting and dynamic designs.

Figure 22: Strips pattern film on window

Dots

Integral/ Applied Covering

According to the American Bird Conservancy (ABC), integral and film-applied dot patterns on glass are an effective bird-friendly treatment for glazing and other transparent or reflective surfaces. These patterns break up reflections and transparency that birds may mistake for open sky or habitat. Whether applied during manufacturing (integral) or post-production (films), dot patterns make glass visible to birds without significantly impacting aesthetics or daylighting.

While studies suggest that dots may be slightly less effective than stripes, they are often more acceptable to building users. The application of dot patterns should be evaluated in relation to the building's interior functions to ensure that the visual treatment aligns with both aesthetic and operational needs. Dot patterns can be used in both new buildings and retrofits, offering a flexible solution for improving bird-safety across a range of building types.

Where dot patterns are proposed, the following guidelines should apply.

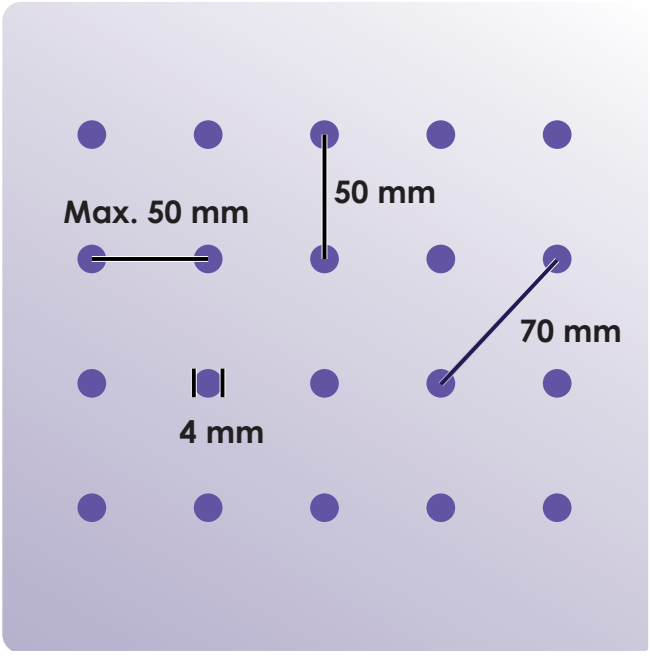

Figure 23: Illustration of dot pattern treatment

Guidelines:

1. Treatment should be applied to a minimum of 90% (100% is encouraged) of the contiguous glass area within the first 16 metres from the finished grade.

2. All glass balcony guards or guardrails located within the first 16 metres from finished grade should receive full-surface treatment (100%).

3. Glass corners located within the first 16 metres from finished grade should receive full-surface treatment (100%) extending at least 5 metres in each direction from the corner.

4. Dots should have a minimum diameter of 4 millimetres to ensure visibility to birds.

5. Dot spacing should be a maximum of 50 millimetres on centre, both vertically and horizontally, and a maximum of 70 millimetres on centre diagonally.

6. Dot colour should provide high contrast with the background (either light or dark, depending on the context) to maximize effectiveness.

7. Treatment should be applied to the first (exterior) surface of the glass. Inner-surface applications are not effective, as they do not reduce reflectivity.

8. Customized dot size or shapes like squares, triangles, or other forms, can be designed to match the building's aesthetic while ensuring bird safety, as long as they meet the minimum visibility and spacing specifications.

9. Insulation value of materials used for patterns should be considered.

Figure 24: Dot pattern film on window at Markham Pan Am Centre

Pattern

Integral/ Applied Covering

Artistic patterns, either integrated into the glass or applied as exterior films, can effectively reduce bird-window collisions when designed with appropriate spacing, contrast, and placement. According to the American Bird Conservancy (ABC), these treatments can significantly mitigate collision risks. When designed to meet bird-friendly spacing guidelines, artistic treatments offer a flexible and creative solution that balances safety, aesthetics, and architectural intent. They are suitable for both new buildings and retrofits, providing design flexibility while promoting avian protection.

Where artistic patterns are proposed, the following guidelines should apply.

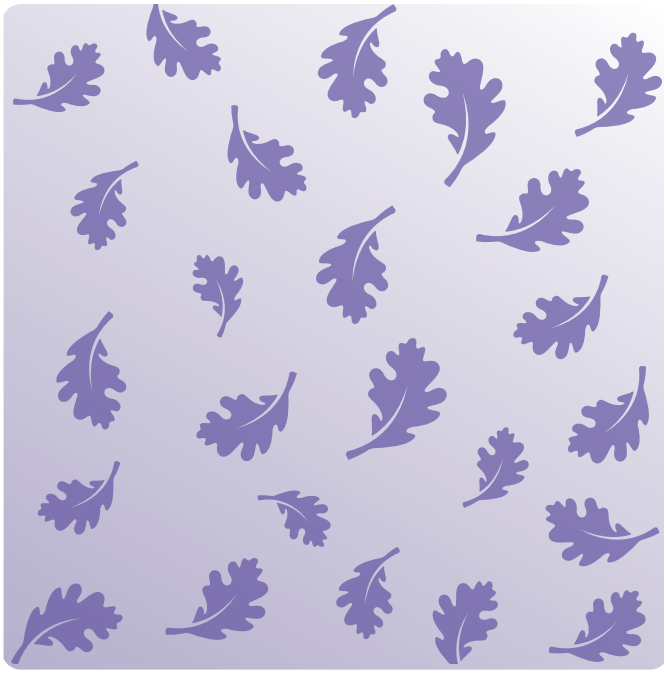

Figure 25: Illustration of a pattern treatment

Guidelines:

1. Treatment should be applied to at least 90% (100% is encouraged) of the contiguous glass area within the first 16 metres from the finished grade.

2. All glass balcony guards or guardrails located within the first 16 metres vertically from finished grade should receive full-surface treatment (100%).

3. Glass corners located within the first 16 metres from finished grade should receive full-surface treatment (100%) extending at least 5 metres in each direction from the corner.

4. Pattern colour should provide high contrast relative to the background (light or dark, depending on context) to maximize visibility.

5. Treatment should be applied to the first (exterior) surface of the glass. Applications on interior surfaces are not effective in reducing reflectivity and do not achieve the intended bird deterrent function.

6. Bi-coloured designs should be applied to enhance contrast and maintain visibility under varying lighting conditions, as white patterns alone may become less effective throughout the day due to shifts in glass colouration and ambient light.

7. Treatment applied to new buildings and should be considered early in the design phase to ensure proper integration.

Figure 26: Example of pattern on fritted glass

Frit and Etched Patterns

Fritted and etched patterns on glass are durable, effective bird-friendly treatments that reduce bird-window collisions by making transparent and reflective surfaces visible to birds. According to the American Bird Conservancy (ABC), patterns with proper spacing, contrast, and placement can significantly reduce collisions. These patterns, permanently embedded or etched into the glass surface, can be designed with appropriate spacing and contrast to meet bird safety guidelines. They offer long-lasting performance, require minimal maintenance, and can be tailored to complement the building's aesthetic. Frit and etched treatments provide a reliable, integrated solution for enhancing bird safety for both new buildings and retrofits. Frit and etched patterns are suitable for both new buildings and retrofits, offering a durable and visually cohesive approach to bird-safe design.

Where frit and etched patterns are proposed, the following guidelines should apply.

Figure 27: Examples of fritted and etched patterns are used on the building façade

Guidelines:

1. Treatment should be applied to at least 90% (100% is encouraged) of the contiguous glass Area within the first 16 metres from the finished grade.

2. All glass balcony guards or guardrails located within the first 16 metres from finished grade should receive full-surface treatment (100%).

3. Glass corners located within the first 16 metres from finished grade should receive full-surface treatment (100%) extending at least 5 metres in each direction from the corner.

4. Pattern colour should provide high contrast relative to the background (light or dark, depending on context) to maximize visibility.

5. Treatment should be applied to the first (exterior) surface of the glass. Applications on interior surfaces are not effective in reducing reflectivity and do not achieve the intended bird deterrent function.

6. Bi-coloured patterns should be used to maintain visibility and effectiveness throughout the day, as lighting changes and glass coloration can reduce the visibility of white patterns alone

7. Treatment applied to new buildings and should be considered early in the design phase to ensure proper integration.

Figure 28: Fritted glass treatment applied at the Toronto Metropolitan University Student Centre

Treatment 2 - External Coverings

External coverings are effective at preventing bird-window collisions by creating visible barriers that block reflections and clear views through glass. These systems help reduce the risk of birds mistaking transparent or reflective surfaces for open sky or habitat. In addition to enhancing bird safety, external coverings provide additional benefits such as solar control, increased privacy, and improved energy efficiency. When thoughtfully integrated into a building's design, they offer both functional and aesthetic value and are well-suited for both new buildings and retrofits.

There are five primary types of external coverings:

- Shades;
- Blind Screens;
- Grilles;
- Shutters;
- Louvers

The following section provides detailed guidance on the use and application of external coverings.

Figure 29: Example of external venetian blinds applied to buildi


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Shades, Blind Screens, Grilles, Shutters, and Louvers

External coverings such as mounted shades, blind screens, grilles, shutters, and louvers can effectively reduce bird-window collisions by physically blocking reflections and clear views through glass. These elements create a visible barrier that prevents birds from mistaking glass for open space or habitat. They also offer additional benefits, such as controlling solar heat gain and enhancing privacy. When designed to complement the building's architecture, external coverings provide a functional and aesthetic solution suitable for both new buildings and retrofits.

Louvers, in particular, can be designed as integrated façade elements that enhance energy efficiency by controlling solar gain and interior lighting conditions, contributing to overall building sustainability. Architecturally integrated louvers maintain aesthetic appeal while serving functional purposes for both bird protection and climate control. Movable systems offer seasonal flexibility, allowing increased coverage during peak migration periods.

Permanent stationary coverings, like shutters with gaps no larger than 50 millimetres, can eliminate the need for additional glass treatments by serving as standalone bird deterrents. In this case, no additional glass treatment is required because the coverings themselves provide the necessary bird deterrence.

These solutions are suitable for both new buildings and retrofits, combining design, performance, and bird safety. The guidelines in this section apply to various forms of exterior coverings, including screens, scrims, exterior venetian blinds, and roll-up solar screens.

Where external coverings are proposed, the following guidelines should apply.

Guidelines:

1. Treatment should be applied to a minimum of 90% (100% is encouraged) of the contiguous glass area within the first 16 metres from the finished grade.

2. Treatment should be applied to building exteriors to ensure maximum visibility and effectiveness for bird safety.

3. Opaque or translucent non-reflective material that meet the following conditions should be applied:

    i. The material should be perforated in a pattern with holes no greater than 50 millimetres (mm);

    ii. The material should have a solid-to-void ratio of at least 50%;

    iii. The material surface should not be more than 1 metre from the parallel plane of glass; and

    iv. The material should be placed parallel or angled to the glass surface.

4. Grade-level building ventilation grates should have a porosity not greater than 20mm x 20mm or 40mm x 10mm.

Figure 30: Exterior blinds

Figure 31: External venetian blinds reduce glass reflectivity and enhance the visibility of transparent surfaces, helping to prevent bird collisions

Treatment 3 - Non-Vision Glazing

Architectural glazing and other transparent or reflective surfaces play a pivotal role in shaping the aesthetics, functionality, and energy performance of modern buildings. Among its various components, non-vision glazing serves as a versatile solution for concealing structural elements, enhancing privacy, and adding a refined visual layer to façades. Whether applied in low-rise, mid-rise, and high-rise residential buildings or industrial, commercial, and institutional developments, non-vision glazing has become a key feature in contemporary architectural design.

Non-vision glazing refers to glass areas not intended for human viewing. Despite their non-transparent function, these surfaces can still pose a collision risk to birds—particularly when they are highly reflective or dark, as this can create the illusion of open sky, vegetation, or unobstructed passage. To reduce bird-window collisions, non-vision glazing should be treated using bird-friendly strategies.

Properly treating non-vision glazing ensures consistent bird-collision deterrence across the building façade, contributing to a safer environment for birds while supporting broader goals of sustainable, responsible, and high-performance architectural design.

Examples of Non-Vision Glazing Include:

- Low-reflectance Panels or Glass;
- Opaque Spandrel Panels or Glass;
- Black-painted Panels or Glass;
- Glazing and Other Transparent or Reflective Surfaces Located Behind Solid Elements (e.g., walls, ceilings, floor slabs, etc.)

The following section outlines detailed guidelines for applying bird-friendly treatments to non-vision glazing, ensuring both aesthetic integration and bird safety.

Figure 32: Low-reflectance, opaque materials are applied to buildir

ng façades to reduce the risk of bird-window collisions, offering both safety benefits and aesthetic enhancement

Low Reflectance, Opaque Materials

Non-vision glazing, such as low-reflectance or opaque materials (e.g. panels or glass), is an effective bird-friendly treatment that prevents birds from mistaking glass for open sky or habitat. By eliminating transparency and minimizing reflectivity, these materials reduce the likelihood of bird-window collisions. Often used in areas that don't require visibility, such as floor slabs, mechanical spaces, or areas with vertical transitions, non-vision glazing can be integrated into the building façade while enhancing bird safety. This approach is appropriate for both new buildings and retrofits, offering a low-maintenance, integrated solution that supports bird-friendly design.

Where non-vision glazing is proposed, the following guidelines should apply.

Guidelines:

1. Selection of Low-Reflective, Opaque Materials for Non-Vision Glazing:

    i. Non-vision glazing with solid back-painted frit or silicone backing opaque coatings: These coatings provide a solid, non-reflective surface, enhancing both aesthetic appeal and safety by minimizing bird-window collisions.

    ii. Non-vision glazing with reflective or low-emissivity (Low-E) coatings: These coatings should feature an outside reflection of 15% or less to effectively reduce the likelihood of bird collisions while maintaining the energy efficiency of the building.

    iii. Non-vision glazing with reflectance greater than 15%: In cases where glazing, such as spandrel glass, has a reflectance greater than 15%, additional treatments (e.g., visual markers) should be applied to enhance bird visibility, ensuring safer façades.

2. When vision through glazing and other transparent or reflective surfaces is not required, such as in applications involving spandrel glass, shadow boxes, or privacy glazing and other transparent or reflective surfaces:

    i. A full-surface treatment should be applied to all non-vision glazing within the first 16 metres from finished grade

    ii. This treatment should render the glass visually distinguishable to birds and limit first-surface reflectance to no more than 15%, in order to effectively reduce the risk of bird collisions.

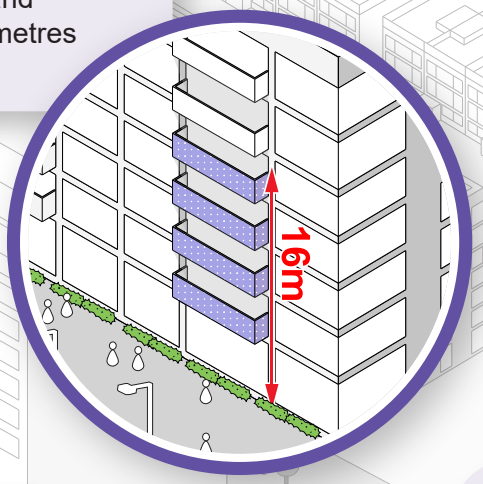
3. Treatment applied to new buildings and should be considered early in the design phase to ensure proper integration.

Figure 33: Low-reflective, opaque materials used for building railings can effectively reduce bird-building collisions

2.4 Demonstration of Bird-Friendly Treatments

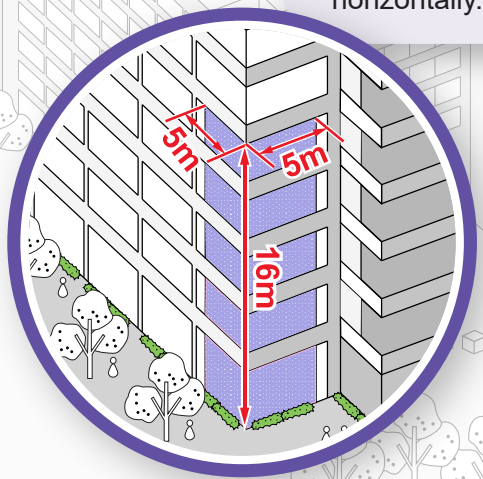
Balcony Railings Treatment

Treat 100% of the glazing and other transparent or reflective surfaces for all balcony railings, guards, and guardrails within the first 16 metres from finished grade.



Fly-through Treatment

Treat 100% of the glazing and other transparent or reflective surfaces at building corners within the first 16 metres from finished grade, with the treatment extending a minimum of 5 metres in each direction horizontally.



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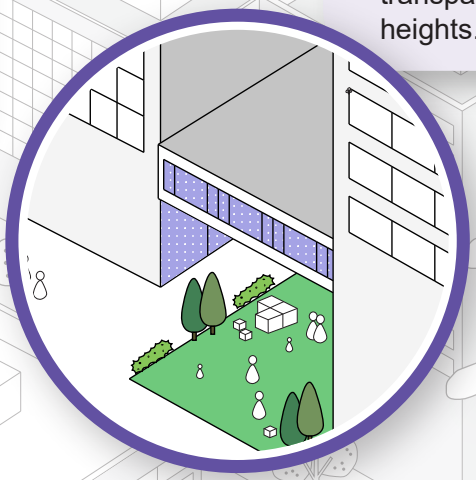


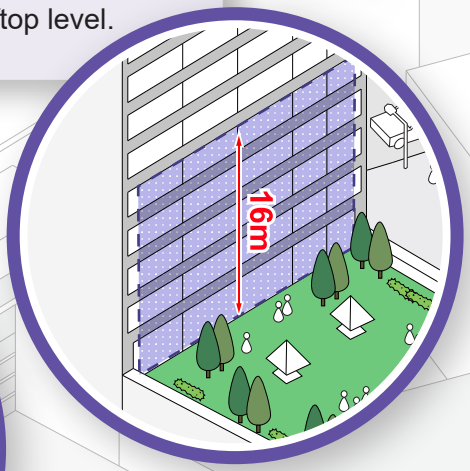
*Note: refer to Section 2.0 for surface treatment guidelines

Window Well Treatment

Treat window wells, vertical pipes, grade-level building ventilation grates and other openings covered by grates to prevent entrapment.

Roof Landscaping Treatment

Treat a minimum of 90% of all glazing and other transparent or reflective surfaces located within 16 metres from the finished floor elevation of the landscaped rooftop level.



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Low Reflectance & Opaque Material Treatment

Treat 100% of all non-vision glazing within the first 16 metres from finished grade, ensuring that reflective or low-emissivity coatings have an outside reflectance of 15% or less.

3.0 Lighting Treatment Guidelines

3.1 Lighting Mitigation

3.0 Lighting Treatment Guidelines

3.1 Lighting Mitigation

Bird rescue monitoring data from the Markham region indicates that daytime bird-window collisions are significantly more common than nighttime incidents. As a result, applying bird collision deterrent markers to glazing and other transparent or reflective surfaces should be a primary focus for the City of Markham.

While nighttime collisions are less frequent, artificial lighting still plays a critical role by attracting birds to urban areas, particularly commercial zones, where the highest rates of nighttime collisions occur. This highlights the importance of adopting responsible lighting practices, especially during peak bird migration seasons.

Lighting mitigation guidelines aim to reduce the impact of artificial night lighting and help mitigate its role in drawing birds into high-risk areas.

Figure 34: Excessive urban lighting can disorient migratory birds, i

ncreasing the risk of collisions with buildings

Mitigate Interior and Exterior Lighting

Lighting mitigations help reduce bird-window collisions by minimizing light pollution that can attract and disorient birds, particularly during nighttime migration. While birds fly at high altitudes on clear, moonlit nights, artificial lighting can disorient them during fog, rain, or low cloud cover and draw them toward lit structures like skyscrapers and lighthouses. White and red lights are especially disorienting, while blue and green lights are less disruptive. Spotlights can trap birds in their beams, leading to exhaustion, collisions, or increased risk of predation.

Light mitigation strategies are cost-effective, energy-efficient, and applicable to both new buildings and retrofits. The following guidelines should apply to both exterior and interior lighting, especially areas near wildlife habitats or along migration routes and are especially important during peak migration periods in spring and fall to reduce bird disorientation and collisions

Guidelines:

1. Exterior lighting fixtures should be dark sky compliant to reduce light pollution and minimize disorientation for migrating birds.
2. Uplighting should be eliminated by using cut-off shields that direct light downward and reduce sky glow.
3. Illumination should be limited to areas necessary for safety and security, with measures in place to prevent light spill beyond property lines.
4. Lighting schedules should ensure lights are turned off from sunset to sunrise or during bird migration periods in spring (March – June) and fall (August – October).
5. Task lighting should be used instead of illuminating entire rooms or floors, in order to reduce unnecessary light output.
6. Control systems such as motion sensors or automatic shut-offs should be installed to deactivate lighting after no more than 30 minutes of inactivity.
7. Light distribution should avoid creating bright light “pools,” especially during rain, fog, or other low-visibility conditions.

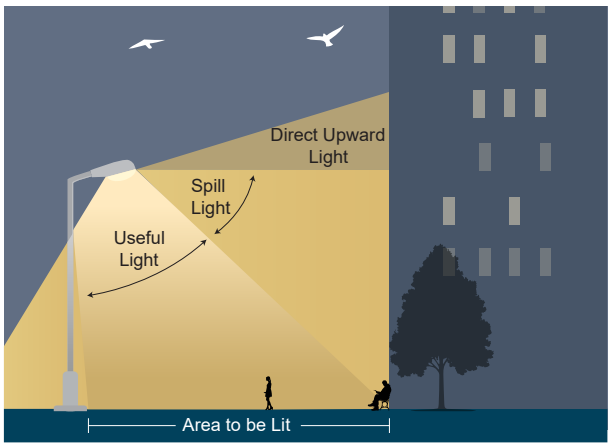

Figure 35: Illustration of exterior light trespass

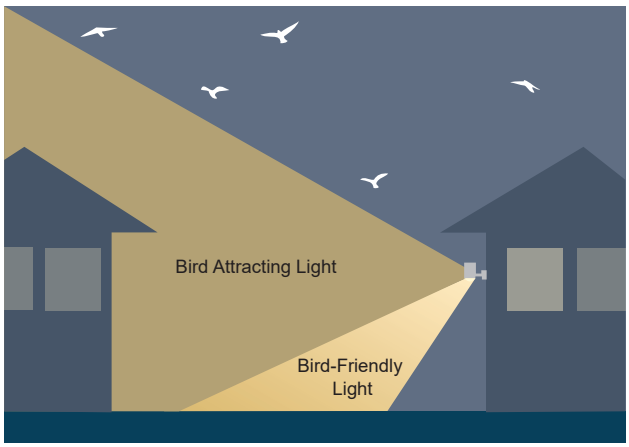

Figure 36: Illustration of comparison between bird attracting light and bird-friendly light

Figure 37: Several lighting mitigation strategies, such as energy-efficient lighting and adaptive lighting controls, are implemented at the Angus Glen Community Centre & Library

4.0 Implementation

4.0 Implementation

Bird-friendly design practices should be established as a fundamental and integral aspect of the building design process for all developers, builders, property owners, residents, professionals (e.g. architects, engineers), and others involved in building design and development in Markham. By implementing a combination of bird-friendly treatments for both new and existing buildings that pose a high-risk to bird collisions, as well as adopting lighting practices designed to reduce the attractiveness of buildings to migratory birds, Markham can contribute to a safer environment for local wildlife. This comprehensive approach will help reduce the cumulative hazards of birds that rely on Markham as a migration route, rest stop, foraging ground, winter refuge, and nesting area.

The Bird-Friendly Guidelines should be appropriately integrated with City practices and protocols to ensure effective implementation. A comprehensive approach is recommended, which goes beyond just window treatments to include a variety of measures aimed at reducing bird-window collisions in Markham. These measures may include:

- Lighting practices that minimize light pollution, which can disorient migrating birds.
- Vegetation and landscaping strategies that support bird habitat while enhancing the safety of the environment.
- Treatments for glazing and other transparent or reflective surfaces, along with architectural design elements, that reduce the risk of bird collisions with windows.

The following sections outline key recommendations that the City may consider to implement bird-friendly treatments and improve the safety of the built environment for migratory and local bird populations. These measures will help create a more sustainable and bird-friendly community in Markham.

4.1 Council Approval and Future Updates

The Bird-Friendly Guidelines were adopted by Council in 2014 and are available to all developers, builders, property owners, residents, professionals (e.g. architects, engineers), and others involved in building design and development.

To ensure the guidelines remain relevant and practical, they should be treated as a living document and regularly updated to reflect new best practices, and technology in the field of bird safety. In 2026, the Bird-Friendly Guidelines were updated to:

- Reflect Canadian Standards Association (CSA) Bird-Friendly Building Design Standards;
- Address provincial Bill and Legislation requirements;
- Align with the City's Sustainability Metrics Program;
- Establish new best management practices for bird-friendly and site design; and,
- Expand bird-friendly implementation to include low-rise developments.

As the document evolves over time, updates should focus on Section 2: Surface Treatment Guidelines, Section 3: Lighting Treatment Guidelines and Section 4: Implementation. New advancements in bird-window collisions research may be incorporated into other sections to support any revised recommendations. The document should generally undergo a formal review every five to ten years. However, if new research emerges that provides critical insights into bird-window collisions, it may be incorporated into the guidelines sooner.

Figure 38: A leading example of bird-friendly retrofit design at the TD Centre in Toronto

4.2 Markham Bird-Friendly Specification Checklists

Section 41 of the Ontario Planning Act allows municipalities to consider matters related to Site Plan Control and emphasizes a sustainable approach. It ensures that developments meet specific standards for design, environmental considerations, and infrastructure, aligning projects with sustainable goals and addressing environmental challenges.

Markham's Official Plan (2014) contains policies that require the application of sustainable design practices in site planning and building design, including window applications to reduce bird-window collisions and minimizing the impact of building lighting on the night sky.

One key aspect of this sustainable approach is incorporating bird-friendly design elements, such as window treatments that help reduce the risk of bird-window collisions. Integrating these bird-friendly measures into development applications helps protect local wildlife while maintaining the aesthetic and functional quality of the development.

Bird-friendly specification checklists have been developed for various application types, including Draft Plan of Subdivision, Site Plan Control, and Major Heritage Permits, to document a developer's commitment to bird-friendly measures.

This process ensures that Markham's sustainability goals are met and the community continues growing environmentally responsible and wildlife-conscious.

4.3 Voluntary Monitoring Program

The Fatal Light Awareness Program (FLAP) Protocol is a voluntary program that can be integrated into the development approval process, with the program administered by a third party during the development phase. This ensures that appropriate bird-friendly treatments are properly implemented and inspected. However, it is essential to note that while the program aims to reduce bird collisions, it is impossible to eliminate the possibility of all collisions. The likelihood of a collision at any given time depends on a combination of site-specific factors, and as such, collisions may not always be predictable.

Voluntary Monitoring Program is highly recommended, particularly when glass façades are proposed, and especially when bird-friendly treatments or measures are selected in accordance with the Bird-Friendly Guidelines. The FLAP protocol offers a structured framework for monitoring bird collisions, with the goal of refining and enhancing bird-friendly treatments for buildings in Markham. FLAP's monitoring program involves collecting data both before and after the implementation of bird-friendly measures, helping track the effectiveness of treatments and improve strategies over time.

While the City of Markham supports the Voluntary Monitoring Program, it does not mandate or require it as part of the formal development approval process. Applicants interested in participating in this program can find more information about FLAP's protocol on their website, including guidance on implementing the program and potential financial incentives.

The City encourages applicants to consider this Voluntary Monitoring Program as a valuable tool for contributing to the long-term success of bird-friendly design, but participation remains at the applicant's discretion. For further details, please refer to FLAP's Bird-Window Collision Monitoring Protocol on their website (see **Part 2: Appendix F** - References).

Figure 39: Bird-safe retrofit of Western Interdisciplinary Research Building

4.4 Retrofit and Audit of Existing Buildings

The Bird-Friendly Guidelines apply to new buildings subject to Draft Plan of Subdivision, Site Plan Control, and Major Heritage Permit. It is recommended that existing commercial, retail, industrial, institutional, recreational, and residential buildings, which pose a high-risk of bird-window collisions, be retrofitted wherever possible and feasible. These existing structures may not only be subject to potential legal action related to harm caused to birds but also have a responsibility to reduce these risks through mitigation efforts.

FLAP Canada offers risk assessment services that can help identify buildings and façades at high-risk of bird-window collisions. The assessment can help determine priority sites for retrofitting, making it easier for building owners, homeowners, and municipal staff to target high-risk buildings and plan for appropriate retrofit measures. The FLAP Canada BirdSafe® Building Standard and Audit can also be utilized to identify these high-risk buildings and prioritize which sites may require immediate action.

More information on these risk assessments and retrofitting opportunities can be found on FLAP's website (see **Part 2: Appendix F** - References).

In addition, if opportunities arise to collaborate with educational institutions, FLAP Canada, Environment Canada, or other research institutions, a monitoring study should be considered. This study could provide valuable insights into the effectiveness of various bird-friendly treatments and strategies, contributing to further development of best practices in bird-window collisions prevention.

4.5 Education and Outreach

Education and outreach are key components of Markham's bird-friendly initiatives, helping raise awareness about the importance of bird-friendly treatments and how easily they can be implemented.

To demonstrate the City's commitment to bird-safe buildings, various communication and marketing materials should be considered to communicate the importance and practice of bird-friendly implementation to the general public, the development industry, business owners, and homeowners. For the development community, the Markham Sustainability Metrics Program (2022) helps implement bird-safe buildings through a development application. It provides information on available treatments, which may further encourage support for retrofitting buildings. Educational sessions and presentations to the development community will further encourage bird-safe environments.

The City's Good Neighbour Handbook (2024) provides information on the impacts of glazed and reflective windows on birds and the City's support for bird-safe buildings for all developers, builders, property owners, residents, professionals (e.g. architects, engineers), and others involved in building design and development.

Figure 40: The Aanin Community Centre, the City of Markham has implemented several bird-friendly treatments aimed at reducing bird collisions with building glass