Port of Vancouver USA

# Bird Friendly Building Design

A RESOURCE GUIDE ASSEMBLED BY PORT OF VANCOUVER

THE PORT OF / *Possibility*

Port of Vancouver USA

# Bird Friendly Building Design

## Table of Contents

1. **Bird Friendly Buildings Flyer: Port of Vancouver**

A brief summary that describes the problem of bird fatalities, due to building strikes and potential solutions.

# BIRD-FRIENDLY BUILDINGS

Port of Vancouver USA

3103 NW Lower River Road, Vancouver, WA 98660 T: 360.693.3611 F: 360.735.1565 E: info@portvanusa.com www.portvanusa.com

The concept of bird-friendly buildings is based on the alarming results of studies linking a high number of bird deaths to avian building strikes. One study estimated that up to five percent of migratory birds are killed annually due to building collisions. Your organization can help reduce such collisions through careful building planning, design and operation.

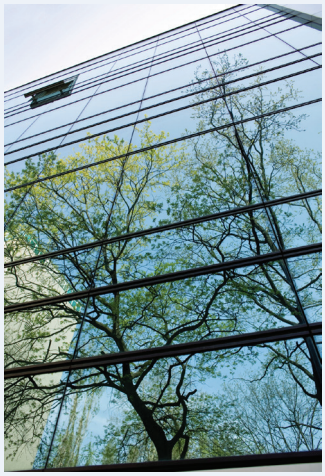
*Native Lazuli Bunting*

## AT THE PORT

The Port of Vancouver is situated along the Pacific Flyway, a north-south migratory flight path. This location, coupled with the port's proximity to wetlands, the Columbia River, Vancouver Lake, farmland, and undeveloped upland environments make the area ideal habitat for many types of migratory and resident birds. This environment increases the importance of bird-friendly buildings.

## COLLISION CULPRITS

Glass is a primary culprit associated with avian collisions into structures. Glass' properties of reflectivity and transparency can cause glass to appear to be a safe flight path: reflections on glass provide images of the natural environment while transparency of glass provides clear sight lines to enticing locations. Collisions usually occur at or near ground level--the size of the building makes little difference.



*Tree reflection on building*

Another cause of collisions is artificial light. Nocturnal migrants depend heavily on visual reference to maintain orientation. Interior or exterior artificial light can lure birds into lit areas, causing birds to become disoriented and entrapped while circling in the illuminated zone. As a result, birds can succumb to exhaustion, predation or collision.

## WHAT YOU CAN DO: WINDOW SOLUTIONS

- Design well-articulated buildings where structures are easily distinguishable from the natural environment
- Incorporate features that reduce or break-up reflections or transparency of glass: overhangs, louvers, window treatments, awnings, external screens, lattice or grill-work
- Apply to glass: fritting, etching, film or frosting
- Angle glass to 20-40 degrees versus the common 90 degrees
- Use patterned UV glass where the patterns are visible to birds, but invisible to humans ("bird-safe glass")
- Plant lush landscape immediately adjacent to windows

## WHAT YOU CAN DO: LIGHTING SOLUTIONS

- Avoid "up lighting" (lights pointing upward)
- Install motion sensors or timers on interior lights
- Avoid exterior decorative lighting and flood lighting
- Use lowest light lumens possible

INFORMATION SOURCES

*Bird-Safe Building Guidelines*, Audubon Society of New York City • *Standards for Bird-Safe Buildings*, City of San Francisco Planning Department • www.birdsandbuildings.org • Audubon Society of Portland, Ore.

FOR MORE INFORMATION CONTACT MATT HARDING AT 360-693-3611

## 2. Retrofit Case Study: Port of Vancouver

Description of the Port of Vancouver's bird-friendly window retrofit derived from the City of Portland/Portland Audubon Society's, *Bird Friendly Building Guidelines* 2012.

## Retrofit Case Study: Port of Vancouver

*Resource Guide for Bird-friendly Building Design*, Portland Oregon, July 2012

Highly reflective windows at the administrative building at the Port of Vancouver (POV) have been the site of historic window collisions. POV has initiated a pilot installation of roll-up solar shades to provide seasonal screening on six windows. Manufactured by Portland-based Suntek Solar Shades, the screens were supplied and installed by Integrity Window Coverings of Vancouver, WA, and cost $260 each, installed. Screens will be tested for effectiveness and acceptability by POV staff, and will be coupled with a vegetation screening strategy. POV also acts as a landlord to various industrial tenants, including two tenants who are undertaking new construction. Bird-Friendly Building flyers, produced by POV, as well as additional resource materials have been provided to tenants to encourage consideration of bird friendly design.

**Shades raised**

**Shades lowered**

Vegetation can be used to interrupt reflection as well. Dense evergreen shrubs and trees no further than approximately 2 feet from the glass can block the view of reflective glass. The port planted rhododendron shrubs along the east side of its administrative building to take advantage of this aspect. Deciduous trees in front of glass can have the opposite effect, creating the illusion of a second tree in the reflection, thereby attracting birds. Special bird collision preventative windows that reduce glass reflectivity were included in the new port security building.

**Bird Friendly Shade Installation**

In 2012 and 2013, a total of 28 shades were installed at the port's administrative office. Originally intended to be lowered only during migratory seasons, spring and fall, the shades have been useful year round. The shades are raised periodically during high winds and for cleaning. Otherwise, the shades have remained lowered throughout the year and have not suffered any damage from the elements.

A trampoline effect to cushion possible impacts is created by mounting the shades to unroll from the outside of the roll and pulling the shades taught against two grommets and galvanized hooks mounted at the bottom corners of the window. Added benefits from the shades are the option to raise them when not needed or wanted, increased interior privacy, reduced glare, and temperature regulation.

The number of birds observed to impact the administrative building has been greatly reduced since installation of the shades.

**3. A City of Glass Towers, and a Hazard for Migratory Birds**

New York Times article discussing the problem of bird mortality in cities and current practices to prevent bird collisions with buildings, September 14, 2011.

New York Times
September 14, 2011

## A City of Glass Towers, and a Hazard for Migratory Birds

By Lisa W. Foderaro

Most bird-watching enthusiasts spend their days looking up in the hope of seeing the flash of a yellow warbler or a scarlet tanager. Deborah A. Laurel looks at the ground.

Ms. Laurel is a volunteer for New York City Audubon, and during the weeks of the fall migration, she is part of a dawn patrol that scans the sidewalks and plazas of Manhattan, searching for victims of the city's forest of glass towers. The other morning she spied the bodies of six that had collided with the plate-glass ferry terminal at the World Financial Center.

"We live in an age of glass," said Ms. Laurel, an architect. "It can be a perfect mirror in certain lights, and the larger the glass, the more dangerous it is."

New York is a major stopover for migratory birds on the Atlantic flyway, and an estimated 90,000 birds are killed by flying into buildings in New York City each year, the Audubon group says. Often, they strike the lower levels of glass facades after foraging for food in nearby parks. Some ornithologists and conservationists say such crashes are the second-leading cause of death for migrating birds, after habitat loss, with estimates of the national toll ranging up to a billion a year.

As glass office and condominium towers have proliferated in the last decade, so, too, have calls to make them less deadly to birds. The San Francisco Planning Commission adopted bird-safety standards for new buildings in July, and this month that city's Board of Supervisors will vote on making it law. Legislation is pending in Washington that would require many federal buildings to incorporate bird-friendly designs.

The United States Green Building Council, a nonprofit industry group that encourages the creation of environmentally conscious buildings, will introduce a bird-safety credit this fall as part of its environmental certification process, called LEED.

There are no easy fixes, however. A few manufacturers are exploring glass designs that use ultraviolet signals visible only to birds, but they are still in their infancy. Opaque or translucent films, decals, dot patterns, shades, mesh screens — even nets — are the main options available. And they have been a tough sell in the high-design world.

New York City Audubon, the American Bird Conservancy and other groups are actively pressing for their use. "I hope there will come a time when putting up an all-glass building is like wearing a fur coat," said Glenn Phillips, executive director of New York City Audubon. "Not that no one will do it, but maybe they'll think twice about it."

A group of New York City Audubon volunteers are gathering evidence of bird collisions this fall at a dozen buildings, including some of the city's most prominent structures, like the Metropolitan Museum of Art, the World Financial Center and the Time Warner Center. Most sites were chosen because they feature glass walls next to parkland or vegetation.

Since 1997, when the collision-monitoring program began, Audubon has collected nearly 6,000 dead birds, carefully bagging and documenting them. The group has used the findings to ask for modifications to buildings that prove to be the worst offenders.

Often, only one section of a building is the culprit. “You don’t necessarily have to treat every window,” Mr. Phillips said. “It would be prohibitive to do the whole building.”

Several years ago, volunteers witnessed a slow-motion slaughter at the Morgan mail processing center in Chelsea, where more than 300 dead birds were discovered in 2006 alone. (A row of London plane trees, reflected in the mirror-like, south-facing facade, was luring the birds to their death.)

The building’s manager agreed to place an opaque cover over the windows; the next year, Audubon scouts found no casualties. Other buildings, like 26 Federal Plaza and even the World Trade Center, when the towers still stood, erected nets on lower floors to prevent bird crashes.

The Jacob K. Javits Convention Center, which has been undergoing renovation, is the most recent building to voluntarily correct the problem of bird collisions. After pleas from Audubon, the architects, FXFowle, designed retrofitting that included less reflective glass and a dot pattern.

Some new all-glass buildings are designed so that birds can easily detect them. Conservationists point to Frank Gehry’s IAC headquarters in Chelsea as an example. Horizontal, dotted white bands control the flow of light, while the curvilinear — almost billowing — facade prevents a mirror effect.

When birds do fly into an angled wall, the result is usually a glancing blow rather than a head-on collision, conservationists theorize. That may be one reason why volunteers who survey the Metropolitan Museum have found few victims outside the Sackler Wing, with its slanted glass exterior.

But volunteers have found 20 to 120 dead birds a year near the museum’s vertical expanse of glass facing west into Central Park. Audubon has suggested nets or a glass prototype that uses ultraviolet signals, but museum officials have thus far demurred.

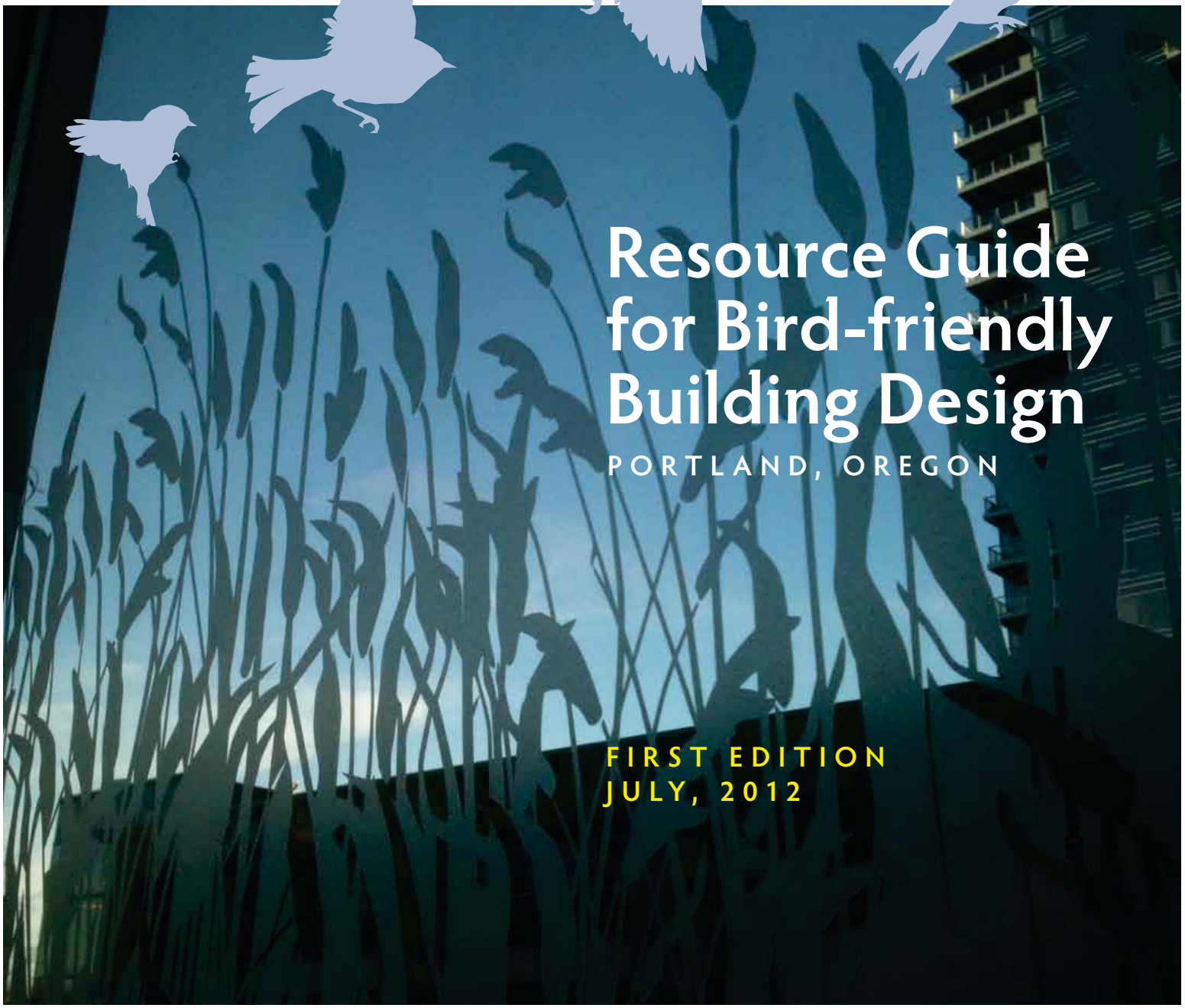
“Frankly, the museum has not yet discovered a workable solution for those parts of the building where this has been a problem,” Harold Holzer, the senior vice president for external affairs, said in a statement. “We will continue to monitor developments in technologies.”

About 90 New York buildings now participate in Lights Out New York, Audubon’s initiative to get buildings to turn off lights after midnight during the spring and fall migrations. Bright lights attract and confuse birds. Cities like Boston, Chicago and Toronto also have successful lights-out campaigns.

Exterior lighting is one of many elements in the Green Building Council’s new bird-collision deterrence credit. “I don’t know of any architects out there who want to kill birds,” said Brendan Owens, a council vice president. “To the extent that the LEED credit raises awareness, I think we’ll see more architects sensitive to these issues, which will lead to more companies developing solutions.”

**4. Excerpts on Glass and Lighting *from Resource Guide for Bird-friendly Building Design Portland, Oregon (First Edition, July 2012)***

Descriptions of the problems and solutions associated with the built environment from a document prepared by the Portland Audubon Society in partnership with the American Bird Conservancy, City of Portland, US Fish and Wildlife Service, and Together Green.



# Resource Guide for Bird-friendly Building Design

PORTLAND, OREGON

FIRST EDITION
JULY, 2012

Audubon Society of Portland
Founded in 1902

AMERICAN BIRD CONSERVANCY

CITY OF PORTLAND, OREGON 1851

U.S. FISH & WILDLIFE SERVICE

Together Green
act today shape tomorrow

# Executive Summary

*"Participation in the Urban Conservation Treaty for Migratory Birds demonstrates [Portland's] long term commitment to the protection and conservation of migratory birds. The program instills a sense of stewardship and responsibility…to ensure that [birds] remain an important element in the urban landscape."* – USFWS Portland Urban Conservation Treaty, 2003

In 2003, Mayor Vera Katz and City Commissioners pledged Portland's ongoing stewardship to our bird populations when we entered into the U.S. Fish and Wildlife Service (USFWS) Urban Conservation Treaty for Migratory Birds. In 2011, Portland Received a Challenge grant from the USFWS to develop local, voluntary Bird-friendly Building Guidelines.

Portland is a city characterized by its parks and natural areas, its bridge-nesting peregrines, its ecoroofs and naturescapes. Portlanders famously converge by the thousands on the Chapman Elementary School hill in September to witness the nightly spectacle of Vaux's Swifts taking to their chimney roost, and hundreds of homeowners have enrolled in the Backyard Habitat Certification Program to attract wildlife and improve their backyards' contribution to habitat connectivity through the city. We rely on birds to pollinate our plants, control our pests, disperse our seeds, generate recreation and tourism dollars, and capture our imaginations.

The Portland region hosts a remarkable 209 species of birds – everything from the Great Blue Heron to the Rufous Hummingbird. Some birds are year-round residents, well-adapted to city life. Some are just passing through, using the Pacific Flyway as they migrate northward or southward. Still others come for the winter, taking advantage of our mild Willamette Valley climate. They all contribute to Portland's identity as a green city.

Yet, birds face heightened hazards in the city, where they encounter deceptive and ubiquitous window glass, which they don't perceive as a barrier. Collision threats are exacerbated by unshielded overnight lighting, which draws migratory birds into urban areas at night, increasing their exposure to glass during the day. Research beginning in the late 1970's shows that window collisions are one of the top sources of mortality for birds, ranked second only to habitat destruction in terms of impact. Today, collisions are estimated to account for the death of up to 1 billion birds annually in the US alone. At a time when 1 in 4 bird species are showing precipitous population declines, anthropogenic threats to our bird populations with achievable, if incremental, solutions demand our attention. Surveys coordinated by Audubon Society of Portland have evaluated window collisions since fall 2009. While these surveys represent a small sampling effort, the data indicates that window glass undoubtedly poses a hazard to our urban bird populations. Downtown surveys catalogued a diverse array of native warblers, hummingbirds, flycatchers, and sparrows that fatally collided with buildings, 36 species to date.

Though most survey programs around the country focus primarily on commercial high-rises, window collisions are known to occur at both large and small buildings and residences. Mortality patterns are much more easily tracked in commercial districts, which results in amassing of more data about mortality patterns at high-rises than at homes. However, given the number of small commercial and residential buildings across the country, these structures represent a significant source of mortality. Challenges to surveying this type of development make it difficult to accurately quantify the true magnitude of strike mortality. However, Audubon Society of Portland has a unique source of valuable information about window strikes at homes and small buildings: collision intakes and phone calls received by the Wildlife Care Center increase our tracking capacity beyond targeted monitoring programs. What is clear is that all building types, large and small, residential and

**Window collisions are one of the top sources of mortality for birds, ranked second only to habitat destruction in terms of impact. Today, collisions are estimated to account for the death of up to one billion birds annually in the US alone.**

41 Cooper Square in New York City, by Morphosis Architects, features a skin of perforated steel panels fronting a glass/aluminum window wall. The panels reduce heat gain in summer and add insulation in winter while also making the building safer for birds. Photo: Christine Sheppard, ABC

commercial, can pose a collision hazard where unmarked glass is used, and represent an opportunity for improved design.

Bird-Friendly Building Guidelines are an essential component of a comprehensive urban sustainability strategy. Cities such as San Francisco, New York, Toronto, Chicago and the state of Minnesota have already adopted Bird-Friendly Building Guidelines, some regulatory, some voluntary. Integrating Bird-friendly Building Guidelines into Portland's sustainability planning efforts will compliment other adopted strategies including: the Climate Change Action Plan; the Watershed Management Plan, the Urban Forest Action Plan, Grey to Green, Ecodistricts Initiative, and the Portland Bird Agenda.

In recent years, vast improvement in the energy-efficiency of glass has led to proliferation of glass curtain walls in architecture. Research into collision rates has shown the percentage of unmarked glass on a building to be the strongest predictor of bird mortality. And yet, there are already myriad examples of innovative designs which incorporate bird-friendliness into buildings, whether intentionally or incidentally, and many of these can help achieve multiple building objectives. Simply by understanding and avoiding collision hazards in building design, incorporating visual markers into the most predictably hazardous parts of a building, and identifying architectural approaches that elegantly layer bird-friendliness with energy conservation or other objectives, architects can begin to mold their designs toward bird-friendliness while remaining cost-neutral. For example, thoughtfully designed fritted windows can reduce solar heat gain, provide privacy, allow for light entry, and mark windows for birds. Audubon's voluntary Lights Out Portland program dovetails well with the city's Climate Action Plan goal of achieving 80% carbon reduction by 2050.

Evolution of the US Green Building Council's LEED standards to include a Bird Collision Deterrent Pilot Credit (Pilot Credit 55, introduced October 14, 2011) is strong evidence that leaders in the green building movement are committed to ensuring that green buildings are also safe for birds (see Appendix V). Great

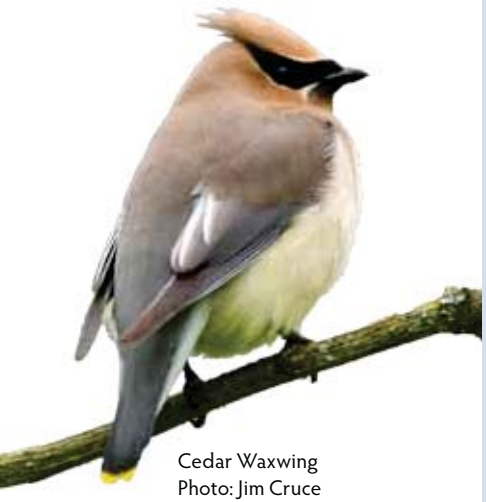
**Simply by understanding and avoiding collision hazards in building design, incorporating visual markers into the most predictably hazardous parts of a building, and identifying architectural approaches that elegantly layer bird-friendliness with energy conservation, architects can begin to mold their designs toward bird-friendliness while remaining cost-neutral.**

strides have been made in recent years to bring ecosystem-level considerations into play, with this new BCD Pilot Credit as well as the Light Pollution Reduction Pilot Credit 7, which predates it.

This resource guide is a customization of American Bird Conservancy's Bird-Friendly Building Design template, which was based on guidelines first developed by NYC Audubon Society. It aims to provide Portland architects, planners, designers, local authorities, and homeowners with a clear understanding of the nature and magnitude of the threat posed by unmarked glass to birds. Given Portland's projected growth by more than 100,000 households in the next 25 years, the development of this guide is well-timed to provide a resource for both the construction of new buildings and retrofits and remodels of existing buildings. Increased awareness among innovative designers about bird-friendly design options will yield thoughtful design of bird-friendly buildings that artfully achieve ecological, energetic, and aesthetic goals.

This edition includes an appendix on the science behind available solutions, examples of how these solutions can be applied to both new construction and existing buildings, and an explanation of the kind of information still needed. We hope it will spur imaginative incorporation of trend-setting bird-friendly designs into our local built landscape, and help illustrate the synergistic benefits that can weave together bird-friendliness with energy efficiency, aesthetics, branding, privacy, and other innovative design objectives.

# A Quick Look at Bird-friendly Building Design Recommendations



Cedar Waxwing
Photo: Jim Cruce

## Treat High Risk Zones:

- Glass on first 40' of a building
- Glass on first floor adjacent to an ecoroof or rooftop garden
- Windows at corners, on skybridges and in atria
- Freestanding glass around courtyards, ecoroofs, patios, and balconies

*See page 13 for more information.*

## Window Treatment Options for High Risk Zones:

- Exterior frits, sandblasting, translucence, etching or screenprinting
- Exterior branding on glass for retail
- Exterior window films
- Exterior shades or shutters
- Glass block
- Exterior netting or screens
- Exterior framework, grilles, or trellises
- Awnings, overhangs, and deeply-recessed windows
- Louvers

*See page 17 for more information.*

## Tips for Achieving Cost-effectiveness in New Construction and Retrofits:

- Have bird-friendly building design in mind from the start of project design.
- Plan to work within your project budget using bird-friendly design principles and materials—may or may not result in design modifications.
- Look for economies—unit costs go down as amount of materials increases.
- Seek opportunities to meet multiple project goals using bird-friendly design approaches (e.g. window treatments that provide privacy or branding or meet energy-reduction goals).

## Lighting:

- Shield all outdoor lighting (full cut-off above 90 degrees)
- Properly design all outdoor lighting to be directed to minimize light spill
- Eliminate up-directed architectural vanity lighting
- Minimize down-directed architectural vanity lighting
- Design interior lights to minimize light spill
- Install or design for motion sensor lighting
- Design all non-exempt interior and exterior lighting to be off overnight (minimum: midnight to 6 am)
- Participate in Audubon's Lights Out Portland program

*See page 32 for more information.*

## Other:

- Monitor bird mortality
- Distribute materials about birds and window collisons
- Report window collisions to Portland Audubon 503.292.6855

Song Sparrow
Photo: Jim Cruce

# Problem: Glass

## The Ever-changing Properties of Glass

Glass can appear very differently depending on a number of factors, including: the angle at which it is viewed; the difference between exterior and interior light levels; seasons; weather; and time of day. Combinations of these factors can cause glass to look like a mirror or dark passageway, or to be completely invisible. Humans do not actually "see" glass, but are cued by context such as window frames, roofs or doors. Birds, however, do not perceive architectural signals as indicators of obstacles or artificial environments.

## Reflectivity

Viewed from outside, transparent glass on buildings is often highly reflective – even under Portland's often overcast skies. Almost every type of architectural glass, under the right conditions, reflects the sky, clouds, or nearby habitat familiar and attractive to birds. When birds try to fly to the reflected habitat, they hit the glass. Reflected vegetation is the most dangerous, but birds also attempt to fly past reflected buildings or through reflected passageways.

## Transparency

Birds strike transparent windows as they attempt to access potential perches, plants, food or water sources, and other lures seen through the glass. Glass skywalks joining buildings, glass walls around planted atria, windows meeting at building corners, and exterior glass handrails or walkway dividers are dangerous because birds perceive an unobstructed route to the other side.

## Passage Effect

Birds often fly through small gaps, such as spaces between leaves or branches, nest cavities, or other small openings. In some light, glass can appear black, creating the appearance of just such a cavity or "passage" through which birds try to fly.

The glass-walled towers of the Time-Warner Center in New York City appear to birds as just another piece of the sky. Photo: Christine Sheppard, ABC

**Humans do not actually "see" glass, but are cued by context such as window frames, roofs or doors. Birds, however, do not perceive architectural signals as indicators of obstacles or artificial environments.**

Transparent handrails are a dangerous trend for birds, especially when they are in front of vegetation. Photo: Mary Coolidge

# Problem: Glass

The mirrored windows at Lewis and Clark were highly reflective on gray days as well sunny days. Photo: Mary Coolidge

## Factors Affecting Collisions Rates for a Particular Building

Every site and every building can be characterized as a unique combination of risk factors for collisions. Some, particularly aspects of a building's design, are very structure-specific. Many hazardous design features can be readily countered, or, in new construction, avoided. Others, like a building's location and siting, relate to migration routes, regional ecology, and geography – factors that are difficult if not impossible to modify.

## Overall Design

The relative threat posed by a particular building depends substantially on the amount of exposed glass, the type of glass used, and the presence of "design traps". Klem (2009) in a study based on data from Manhattan, found that a 10% increase in the area of reflective and transparent glass on a building façade correlated with a 19% increase in the number of fatal collisions in spring and a 32% increase in fall.

## Type of Glass

The type of glass used in a building is a significant component of its danger to birds. Mirrored glass is often used to make a building "blend" into an area by reflecting its surroundings, which makes those buildings especially deadly to birds. Mirrored glass is reflective at all times of day, and birds mistake reflections of sky, trees, and other habitat features for reality. Non-mirrored glass can appear highly reflective or transparent, depending on time of day, weather, angle of view, and other variables. Tinted glass may reduce collisions, but only slightly. Low-reflection glass may be less hazardous in some situations but can create a "passage effect" – appearing as a dark void that could be flown through (see page 13).

## Building Size

Unmarked glass on buildings of all sizes, residential and commercial alike, can pose a significant hazard to birds. Still, as building size increases, so usually does the amount of glass, making larger buildings a greater single threat. It is generally accepted that the lower stories of any type of building are the most dangerous because they reflect trees and other landscape features, which themselves are attractive to birds, and therefore the first 40' of a building should utilize bird-friendly features. However, monitoring programs which have access to setbacks and roofs of tall buildings have documented window collisions. Voluntary, internal reporting programs in Portland have documented collisions up to the 19th and 21st stories.

## Orientation and Siting

Building orientation in relation to compass direction has not been implicated as a factor in collisions, but siting of a building with respect to surrounding habitat and landscaping can be an issue, especially if glass is positioned so that it reflects vegetation. Physical features such as outcrops or pathways that provide an open flight path through the landscape can channel birds towards or away from glass and should be considered early in the design phase.

## Design Traps

Windowed courtyards can be death traps for birds, especially if they are heavily planted. Birds are attracted into such places, and then try to leave by flying directly towards reflections on the walls. Glass skywalks and outdoor handrails, and building corners where glass walls or windows are perpendicular are dangerous because birds can see through them to sky or habitat on the other side.

## Reflected Vegetation

Glass that reflects shrubs and trees causes more collisions than glass that reflects pavement or grass (Gelb and Delecretaz, 2006).

**Local Retrofit: Window Screen Installation at Lewis and Clark Law School.** A multistory bank of mirrored windows (top photo) made the LRC building disappear into adjacent Tryon Creek State Park, and was the site of up to 50 documented collisions per season (spring/fall). Since the installation of screens (bottom photo), no fatalities have yet been documented at the LRC building (as of the date of this publication). Photos: Mary Coolidge

# Problem: Glass

Planted, open courtyards lure birds then prove dangerous when they encounter reflections of vegetation on surrounding windows. Photo: Mary Coolidge

Studies have only quantified vegetation within 15 – 50 feet of a façade, but reflections can be visible at much greater distances. Vegetation around buildings will bring more birds into the vicinity of the building; the reflection of that vegetation brings more birds into the glass. Taller trees and shrubs correlate with more collisions. It should be kept in mind that vegetation on slopes near a building will reflect in windows above ground level. Studies with bird feeders (Klem *et al.*, 1991) have shown that fatal collisions result when birds fly towards glass from more than a few feet away.

## Green Roofs, Gardens and Walls

Recent work shows that well designed green roofs and roof gardens can become functional ecosystems, providing food and nest sites for birds. However, green roofs bring habitat elements attractive to birds to higher levels, often near unmarked glass. Glass treatment around green roofs, green walls and rooftop gardens should be considered with features that prioritze protection for birds. Under the new LEED Bird Collision Deterrent Credit, glass on the first floor adjacent to a green roof is Zone 1, or high risk, and must meet a more stringent standard for bird-safety.

Unmarked glass adjacent to ecoroofs can be hazardous to birds that are attracted to available habitat. Photo by Tom Liptan

## Windows Take their Toll on KGW-Audubon Raptor Cam Fledglings

Since 2007, people from around the world have tuned in to watch a pair of Red-tailed Hawks that have nested and raised young on a downtown Portland fire escape. The KGW-Audubon Raptor Cam has provided an intimate view into the lives of these urban hawks. One of the sad realities illuminated by Raptor Cam is the hazard posed by windows to young birds as they begin to explore the world around them. Of the eleven nestlings that have fledged from the Raptor Cam nest between 2007 and 2011, four have suffered serious collisions with windows. Fortunately three were able to be returned to the wild after treatment. Most birds are not so lucky...

## Portland's Bridge-nesting Peregrines

The first Peregrine Falcon to fledge off Portland's Fremont Bridge collided with a window on East Burnside within a week of taking her first flight. She spent a month in captivity recovering from internal injuries before being released back to the wild. Window strikes have remained a significant cause of injury for both resident and migratory peregrine populations in Portland.

# Solution: Glass

Numerous examples of bird-friendly buildings exist, which were primarily designed to be functional and attractive, and incidentally pair well with bird-friendly objectives. These buildings may have screens, latticework, grilles, or other visual noise either outside the glass or integrated into the glass that helps to reduce collisions.

Identifying glass treatments that eliminate or greatly reduce bird mortality while minimally obscuring the glass itself has been the goal of several researchers, including Martin Rössler, Dan Klem, and Christine Sheppard. Their research, discussed in detail in Appendix I, has focused primarily on the spacing, width, and orientation of lines marked on glass, and has shown that patterns covering as little as 5% of the total glass surface can deter 90% of strikes under experimental conditions. Most birds will not attempt to fly through horizontal spaces less than 2" high, nor through vertical spaces 4" wide or less. This concept has become known as the 2" x 4" Rule.

Research on human vision shows a striking ability to complete partial images in order to compensate for missing visual information. This linking of visual fragments and filling-in by our brains means it is possible to design patterns on windows that alert birds to a barrier while minimally impacting views out.

Designing a new structure to be bird friendly can be imaginative, innovative, sustainable and cost-neutral. Architects around the globe have created fascinating structures that incorporate little or no unmarked glass. Inspiration has been born out of functional needs, such as shading in many climatic zones, and/or aesthetics; being bird-friendly was often secondary or incidental. Retrofitting existing buildings can often be done by targeting areas where strikes are known to occur, rather than entire buildings.

## Local Victories

Bird-friendly considerations are just beginning to gain traction in the Portland area. An exterior screening project at Lewis and Clark Law School *(pictured on page 15)* demonstrates a local commitment

View of fritted window pattern (above) at the OHSU Center for Health and Healing demonstrate how frit patterns can be designed to afford views out (Photo at left is a close-up). Frits can synergistically reduce solar heat gain, afford privacy, and provide visual cues to approaching birds. No collisions have been documented at this building in four seasons of monitoring. Photo: Mary Coolidge

**Most birds will not attempt to fly through horizontal spaces less than 2" high, nor through vertical spaces 4" wide or less. This concept has become known as the 2" x 4" Rule.**

# Solution: Glass

**There are many ways to combine the benefits of glass with bird-safe or bird-friendly design by incorporating elements that minimize collisions without obscuring vision.**

to reduce collisions at a problematic bank of windows on the south side of the Legal Research Center. Prototype screens will be incrementally installed campus-wide due to the true scope of the hazard. The Port of Vancouver has also recently undertaken to retrofit problem windows at its Administrative Offices, and has researched alternatives, evaluating effectiveness, affordability and aesthetics. Port staff also developed a memorandum on window collisions for tenants to help prevent and address window strikes. The University of Portland recently committed to designing all new buildings to comply with bird-friendly goals and standards.

## Facades, netting, screens, grilles, shutters, exterior shades

There are many ways to combine the benefits of glass with bird-friendly design by incorporating elements that minimize collisions without obscuring vision. Some architects have designed decorative facades that wrap entire structures. Recessed windows can functionally reduce the amount of visible glass and thus the threat to birds. Netting, screens, grilles, shutters and exterior shades are commonly used elements that can make glass safe for birds. They can be used in retrofits or be an integral part of an original design, and can significantly reduce bird mortality.

Screens once protected birds in addition to their primary purpose of keeping bugs out. Screens and nets are still among the most cost-effective methods for protecting birds. Netting can often be installed so as to be nearly invisible, but must be installed several inches in front of the window, so impact does not carry birds into the glass.

Decorative grilles are also part of many architectural traditions, as are shutters and exterior shades, which have an additional advantage – they can be closed during high-risk seasons for birds, such as migration and fledging (see Appendix II).

Functional elements such as balconies and balustrades can act like a façade, protecting birds while providing an amenity for residents.


The façade of the New York Times building, by FX Fowle and Renzo Piano, is composed of ceramic rods, spaced to let occupants see out, while minimizing the extent of exposed glass. Photo: Christine Sheppard, ABC

External shades on Renzo Piano's California Academy of Sciences in San Francisco are lowered during migration seasons to eliminate collisions. Photo: Mo Flannery



Upper left: If designed densely enough, window films for branding and street activity can pair marketing with bird-friendliness. Photo: Mary Coolidge

Upper right: An exterior trellis on the new Edith Green Wendell Wyatt Federal building will shade the west aspect of the building, and may prove to be bird-friendly. Framework on the south and east aspects of the building does not meet the 2" x 4" rule, but will likely provide some visual cues to approaching birds. Photo: Mary Coolidge

Lower right: Etching patterns on glass at the Bird House at the National Zoo has worked to greatly reduce collision incidents. Photo: Bob Sallinger

Lower left: Fritted bike-themed design work on Whole Foods windows create interest and branding while helping to interrupt reflections. Fritting would be more effective on the outside of the window. Photo: Mary Coolidge

# Solution: Glass

Some approaches that have been described as bird-friendly solutions in recent years need more critical consideration. Awnings, overhangs, tinting, UV patterns, and angled glass are not foolproof solutions, but must be carefully designed in order to be effective at eliminating reflections and reducing strike hazards.

## Awnings and Overhangs

Overhangs may reduce collisions. However, they do not eliminate reflections, and only block glass from the view of birds flying above, and thus are of limited effectiveness.

## UV Patterned Glass

Birds can see into the ultraviolet (UV) spectrum of light, a range largely invisible to humans *(see page 36)*. UV-reflective and/or absorbing patterns (transparent to humans but visible to birds) are frequently suggested as a solution for many bird collision problems. Progress in the search for bird-friendly UV glass has been slow due to the inherent technical complexities. Ornilux Mikado by Arnold Glass has been rated for use in LEED Pilot Credit 55 and is now available in the United States *(photo page 47)*. The cost for this product has already dropped 20% since early 2011. With the introduction of LEED Pilot Credit 55, development of Bird-friendly Building Guidelines in multiple cities, and increased awareness, demand will drive product development and availability.

## Angled Glass

In a study (Klem et al., 2004) comparing bird collisions with vertical panes of glass to those tilted 20 degrees or 40 degrees, the angled glass resulted in fewer mortalities. While angled glass may be useful in special circumstances, the birds in the study were flying parallel to the ground from nearby feeders. However, birds approach glass from many angles. Therefore, angled glass is not considered a reliable strategy. The New York Times printing plant, pictured below, clearly illustrates angled glass reflecting nearby vegetation.

## Tinting

Some colors and densities of tinted glass may reduce collisions, but these have not been sufficiently tested to determine the density necessary to achieve deterrence. Collisions have been documented on BirdSafe surveys at various Portland buildings with blue, green, and dark tints.

Overhangs block viewing of glass from some angles, but do not necessarily eliminate all reflections. Photo: Christine Sheppard, ABC

The angle on the New York Times printing plant facade is not sufficient to eliminate deceptive reflections of nearby vegetation. Photo: Christine Sheppard, ABC

Tinted windows at the State Building readily reflect vegetation. More testing on colors and density is needed. Photo: Mary Coolidge

Deeply recessed windows, such as these on Stephen Holl's Simmons Hall at MIT, can block viewing of glass from oblique angles. Photo: Dan Hill

**Translucent glass panels on the Kunsthaus Bregenz in Austria, designed by Atelier Peter Zumthor, provide light and air to the building interior without dangerous reflections.**

Photo : William Heltz

# Solution: Glass

The glass facade of SUVA Haus in Basel, Switzerland, renovated by Herzog and de Meuron, is screen-printed on the outside with the name of the building owner. Photo: Miguel Marqués Ferrer

## Patterns on Glass: Meeting Multiple Objectives

Patterns are often applied to glass to reduce the transmission of light and heat or to provide screening or branding. When designed according to the 2 x 4 rule, *(see page 17)* patterns on glass can also prevent bird strikes. External patterns on glass deter collisions effectively because they interrupt glass reflections. Ceramic dots or 'frits' and other materials can be screened, printed, or otherwise applied to the glass surface. This design element, useful primarily for new construction, is more common in Europe and Asia, but is increasingly available in the United States.

Patterns applied to an internal surface of double-paned windows may not be visible if the amount of light reflected from the frit is insufficient to overcome reflections on the glass' outside surface. Some internal frits may only help break up reflections when viewed from some angles and in certain light conditions. This is particularly true for large windows, but also depends on the density of the frit pattern. The internet company IAC's headquarters building in New York City, designed by Frank Gehry, is composed entirely of fritted glass, most of high density *(page 23)*. No collision mortalities have been reported at this building after two years of monitoring by Project Safe Flight. Current research is testing the relative effectiveness of different frit densities, configurations, and colors.

## Opaque and Translucent Glass

Opaque, etched, stained, frosted glass, and glass block are excellent options to reduce or eliminate collisions, and many attractive architectural applications exist. They can be used in both retrofits and new construction.

Frosted glass is created by acid etching or sandblasting transparent glass. Frosted areas are translucent, but different finishes are available with different levels of light transmission. An entire surface can be frosted, or frosted patterns can be applied. Patterns should conform to the 2 x 4 rule described on page 17. For retrofits, glass can also be frosted by sandblasting on site.

The Studio Gang's Aqua Tower in Chicago was designed with birds in mind. Strategies include fritted glass and balcony balustrades. Photo: Tim Bloomquist

Galeo, part of a complex designed by Atelier Christian de Portzamparc in Issy les Moulineaux, France, has an external skin of printed glass scales which help to reduce reflections. Photo: Sipane

Renzo Piano's Hermes Building in Tokyo has a façade of glass block. Photo: Mariano Colantoni

The dramatic City Hall of Alphen aan den Rijn in the Netherlands, designed by Erick van Egeraat Associated Architects, features a façade of etched glass. Photo: Dik Naagtegal

External frit, as seen here on the Lile Museum of Fine Arts, by Ibos and Vitart, is more effective at breaking up reflections than patterns on the inside of the glass. Photo: G. Fessy


While some internal fritted glass patterns can be overcome by reflections, Frank Gehry's IAC Headquarters in Manhattan is so dense that the glass appears opaque. Photo: Christine Sheppard

# Solution: Glass

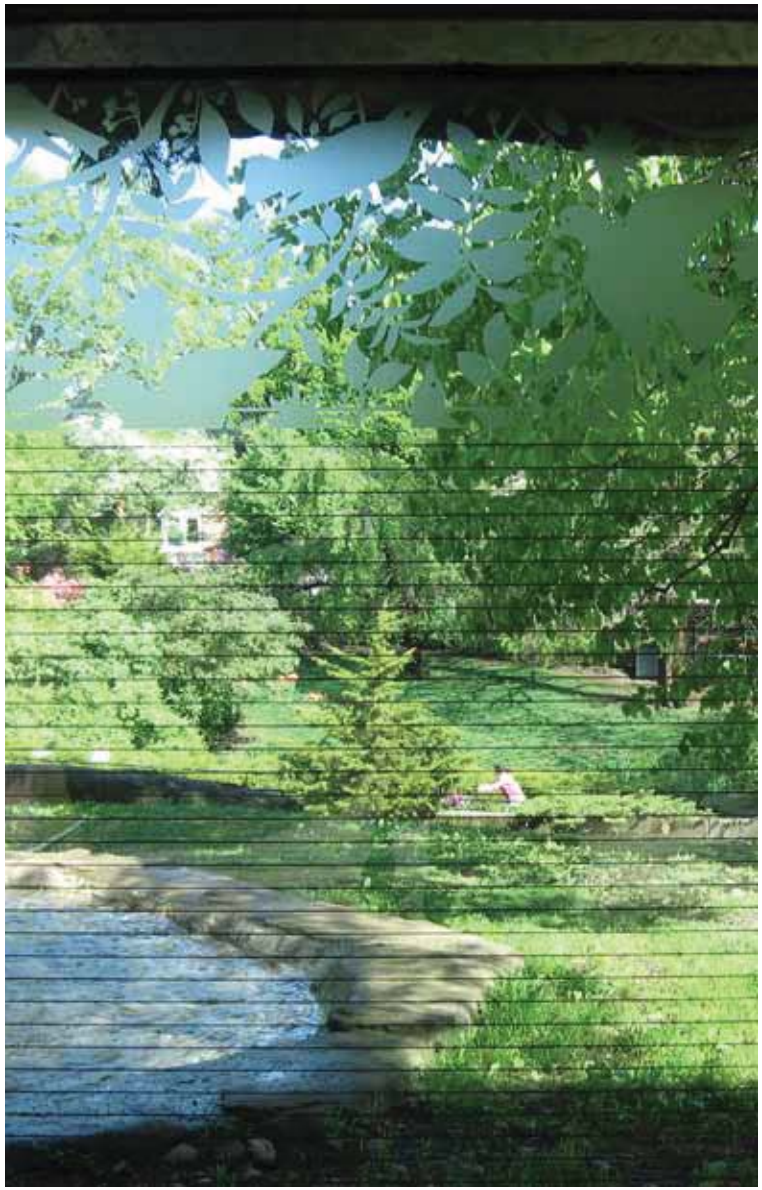
**Patterns are often applied to glass to reduce the transmission of heat or to provide screening or branding. When designed according to the 2" x 4" rule, patterns on glass can also prevent bird strikes.**

Dense stripes of internal frit on University Hospital's Twinsburg Health Center in Cleveland, by Westlake, Reed, Leskosky will overcome virtually all reflections. Photo: Christine Sheppard, ABC

Privacy film on Mirabella windows preserves light entry and views out while marking the window for birds. Such film is more effective if applied to the exterior. Photo: Mary Coolidge

A detail of a pattern printed on glass at the Cottbus Media Centre in Germany. Photo: Evan Chakroff

Visual markers on the balcony glass at the Eliot Tower provide some privacy and decrease strike hazards. Photo: Mary Coolidge



The window at the Philadephia Zoo's Bear Country exhibit was the site of frequent bird collisions until this window film was applied. Collisions have been eliminated without obscuring views out. Photo: Philadephia Zoo.

Fritted glass photo panels on the Gibbs Street Pedestrian Bridge elevator in South Waterfront are part of a public art project made possible by the Regional Arts & Culture Council and the Portland Bureau of Transportation through the City's Percent for Art Program. Artist Anna Valentina Murch made the photographs of water, which were printed onto the glass panels by Peters Studios, thus marking the windows for birds. Photo by Jeanne Galick.

# Solution: Glass

Photo : Dariusz Zdziebkowski

**The American Bird Conservancy, with support from the Rusinow Family Foundation, has produced ABC BirdTape to make home windows safer for birds. This easy-to-apply tape lets birds see glass while letting you see out, is easily applied, and lasts up to four years. For more information, visit www.ABCBirdTape.org**

## Window Films

Currently, most patterned window films are intended for interior use as design elements or for privacy, but this is beginning to change. 3M™ Scotchcal™ Perforated Window Graphic Film, also known as CollidEscape, is a well-known external solution. It covers the entire surface of a window, appears opaque from the outside, and permits a view out from inside. Interior films, when applied correctly, have held up well in external applications, but this solution has not yet been tested over decades. A film with horizontal stripes has been effective at the Philadelphia Zoo's Bear Country exhibit (see photo on right) and the response of people has been positive.

## Internal Shades, Blinds, and Curtains

Light colored shades do not effectively reduce reflections and are not visible from acute angles. Blinds have the same limitations, but when visible and partly open, can help to break up reflections.

Tape decals (Window Alert shown here) placed following the 2 x 4 rule can be effective at deterring collisions. Photo: Christine Sheppard, ABC

## Temporary Solutions

In some circumstances, especially for homes and small buildings, quick, low-cost, DIY solutions such as applications of tape or paint can be very effective. Such measures can be applied to problem windows and are most effective following the 2 x 4" rule. For more information, see Portland Audubon's Tips for Reducing Strikes at Home and a Birds and Windows Brochure at www.audubonportland.org/issues/metro/bsafe/tips.

## Decals

Decals are probably the most popularized solution to collisions, but their effectiveness is dependant on density of application. Birds do not recognize raptor decals as predators, but simply as obstacles to try to fly around.

Decals are most effective if applied following the 2" x 4" rule, but even a few may reduce collisions.

Reflections on home windows are a significant source of bird mortality. Partially opened vertical blinds may break up reflections enough to reduce the hazard to birds. Photo: Christine Sheppard, ABC

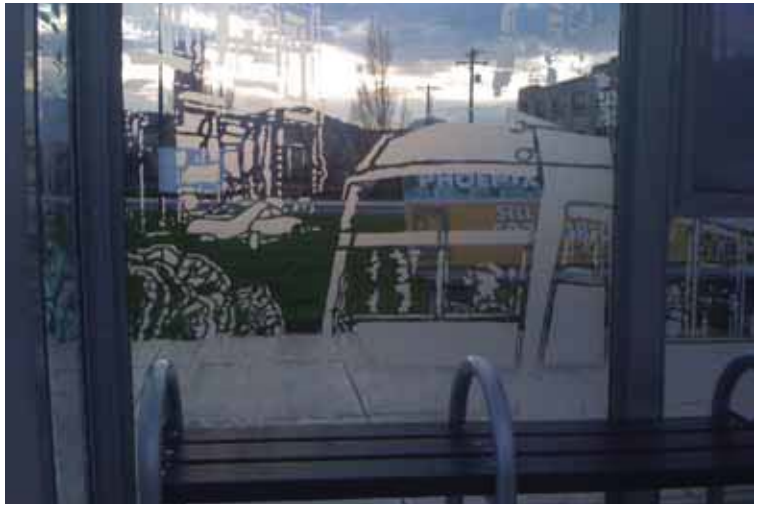
## Residential and Small Building Collisions and Treatments

Though Bird-friendly Building Guidelines developed to date primarily address strike hazards, data, and solutions at the larger commercial scale, strikes can occur as readily at small-scale commercial and residential developments where unmarked glass is used. Research at large commercial buildings is far more common simply because of scope, access, and logistical limitations. High-rises in commercial districts tend to be geographically clustered and accessible to volunteers via sidewalk rights-of-way, thus lending themselves well to targeted observation, and resulting in a predominance of data from commercial districts.

Some research has endeavored to focus on residential construction. Dunn (1993) estimated that between 0.65 and 7.7 bird deaths per residential home occur every year in North America (described in Appendix 1: The Science of Bird Collisions). Therefore, though it may be tempting to implicate high-rise buildings in the majority of collisions, homes do contribute significantly to sources of collision risk and their distribution across the landscape in urban, exurban, and rural areas makes their cumulative impact undeniable. San Francisco's new Bird Safe Building Standards require residential buildings with "substantial glass façade" (those with a greater than 50% glass façade area) to incorporate glazing treatments such that 95% of all unbroken glass expanses 24 square feet or larger are treated.

Single and two-story homes occur largely within the highest risk zone of collisions, that is: within 40 feet of the ground. Homes often have vegetation near to and reflected in windows. Vegetation, bird-feeders, and birdbaths attract birds into yards, where they face deceptive reflections. Even small windows pose a hazard, because birds are accustomed to flying into small gaps in vegetation. Though the scale and budgets of residential and small commercial development may indeed call for unique, cost-effective approaches, the same principles of hazard-reduction apply. Architects and designers can mitigate hazardous features (such windows meeting

Silhouettes placed every 12 inches on the exterior of this residential window are spaced too far apart to reliably eliminate all strikes, but will likely reduce strike incidence.



Designwork on TriMet bus shelters has been shown to help to reduce vandalism and also marks the freestanding glass for birds. Photo: Mary Coolidge

# Solution: Glass

## When designing homes and small buildings with glass:

- Treat all glass on home or building, especially glass which meets at corners or allows view through another pane of glass to the outside
- Treat all freestanding glass around courtyards, patios, and balconies

## Window design/ treatment options:

- Exterior screens
- Exterior framework, grilles, trellises or louvers; shades or shutters
- Awnings, overhangs, and deeply-recessed windows
- Glass: Exterior frits, sandblasting, translucence, UV patterns, glass block or screenprinting
- Consider exterior branding on glass for retail locations
- Exterior window films

at corners, unmarked glass expanses, glass balcony walls, or garden walls) by marking windows (with divided light panes, stained glass, UV patterns or frit patterns) or using exterior screening (screens, shades, or trellises) to reduce predictable collision threats. There is no single prescriptive one-size-fits all approach to designing bird-friendly buildings; solutions will be unique and innovative responses to a variety of variables and objectives. The exploration and development of more residentially-geared solutions will be addressed in updates of this document as they become available.

As reported in Appendix 1: the Science of Bird Collisions, Audubon's Wildlife Care Center (WCC) brought in 590 window strikes of 86 species in 2009, 2010, and 2011 combined, the majority from residential properties. Catalogued phone call reports tallied nearly 100 public reports per year during this same period, primarily from residential buildings in the Portland area, underscoring the vital importance of addressing both residential hazards and commercial-scale hazards.

Top left: Diamond leaded glass present on old English style houses in Portland adheres to the 2"x4" rule and effectively marks windows for birds.

Top right: Stained glass like this Frank Lloyd Wright reproduction by local designer Lisa Peterson can add aesthetic interest while effectively marking a window for birds.

Middle left: Close up of fritted glass residential entry provides privacy, reduces solar heat gain on this southern exposure, and still affords views in and out.

Middle right: Povey Brothers Glass Company produced extraordinary art glass in Portland at the turn of the century, and their windows are both beautiful and bird-friendly!

Bottom left: Ribbed glass used in a residential window retrofit provides privacy and effectively eliminates reflections.

Bottom Right: Window screens are still one of the most cost effective ways to reduce strike hazards while keeping insects out of building and home interiors.

## Small-scale Retrofits to Prevent Window Strikes:

- Position bird feeders within 3 feet or more than 30 feet away from windows. At very close distance, birds have less momentum if they strike the window.
- Apply decals to the outside of the window, more densely than packaging suggests. Some decals will help reduce collision risk, but the best practice is still to adhere to the 2" x 4" rule. Available at Audubon's Nature Store, Backyard Bird Shops, and online.
- Apply tape horizontally, spaced ~2 inches apart to outside of window (www.abcbirdtape.org).
- Apply string, cord, mylar tape, raptor sillhouettes or other moving deterrents to the outside of the window (www.birdsavers.com/).
- Affix screen or mesh netting several inches in front of a window to cushion impact (www.birdbgone.com, www.birdscreen.com).
- Apply window film to the outside of a window (www.lfdcollidescape.com, www.thesunshieldpros.us).
- Participate in Lights Out Portland! Turn outside lights off and close drapes from August 25 through November 15 and March 15 through June 7 (migration season) to minimize the luring of migrants into cities.

There are many quick, easy, and cost-effective ways to deter collisions on a short term basis. Here, tape stripes, stenciled, and free hand patterns in tempera paint on home windows. Photo: Christine Sheppard, ABC

Waterproof, washable markers can be used in imaginative, fun, and cost-effective ways to deter collisions. This peacock window design offered a family-friendly activity and produced a beautiful image while marking the window for birds! Photo: Mary Coolidge

The view out of a window with horizontal tape spaced every 2 inches looks much like a view through miniblinds. Photos: Mary Coolidge

When birds encounter beams of light, especially in inclement weather, they tend to circle in the illuminated zone, appearing disoriented and unwilling or unable to leave. In this photo, each white speck is a bird trapped in the beams of light forming the *9/11 Tribute in Light* in New York City. Volunteers watch during the night and the lights are turned off briefly if large numbers of entrapped birds are observed.

Photo: Jason Napolitano

# Problem: Lighting

Artificial light is increasingly recognized as a hazard for humans as well as wildlife. Rich and Longcore (2006) have gathered comprehensive reviews of the impact of "ecological light pollution" on the feeding, migrating and reproductive cycles of vertebrates, insects, and even plants.

## Beacon Effect and Urban Glow

Light at night, especially during bad weather, creates conditions that are particularly hazardous for night-migrating birds which rely on celestial cues to navigate. Typically flying at altitudes over 500 feet, migrants often descend to lower altitudes during inclement weather, where they may encounter artificial light from buildings. Water vapor in fog or mist refracts light, forming an illuminated halo around light sources and can lead to catastrophic mortality events (see Appendix II).

## Fatal Light Attraction

There is clear evidence that birds are attracted to and entrapped by light (Rich and Longcore, 2006; Poot et al., 2008; Gauthreaux and Belser, 2006). When birds encounter beams of light, especially in inclement weather, they tend to circle in the illuminated zone. This has been documented recently at the *9/11 Memorial in Lights*, where lights must be turned off intermittently when large numbers of birds become caught in the beams.

Significant mortality of migrating birds has been reported at oil platforms in the North Sea and the Gulf of Mexico. Van de Laar (2007) tested the impact on birds of lighting on an off-shore platform. When lights were switched on, birds were immediately attracted to the platform in significant numbers. Birds dispersed when lights were switched off. Once trapped, birds may collide with structures or fall to the ground from exhaustion, where they are at risk from predators.

While mass mortalities at very tall illuminated structures (such as skyscrapers) during fog or other inclement weather have received the most attention, mortality has also been associated with ground-level lighting during clear weather. Once birds land in lit areas overnight, they are at increased risk from colliding with nearby structures as they begin to forage for food in the vicinity the following day.

In addition to killing birds, overly-lit buildings waste electricity, and increase greenhouse gas emissions and air pollution levels. Poorly- designed or improperly-installed outdoor fixtures add over one billion dollars to electrical costs in the United States every year, according to the International Dark Sky Association. Recent studies estimate that over two thirds of the world's population can no longer see the Milky Way, just one of the nighttime wonders that connect people with nature. Together, the ecological, financial, and cultural impacts of excessive lighting are compelling reasons to reduce and refine light usage.

Unshielded lights in Elizabeth Caruthers Park in South Waterfront would benefit from full cutoff shielding to reduce contribution to ecological light pollution. Photo: Mary Coolidge

**Light pollution has been shown to impact the Circadian rhythm of birds, fish, wildlife, and plants as well as humans.**

# Problem: Lighting

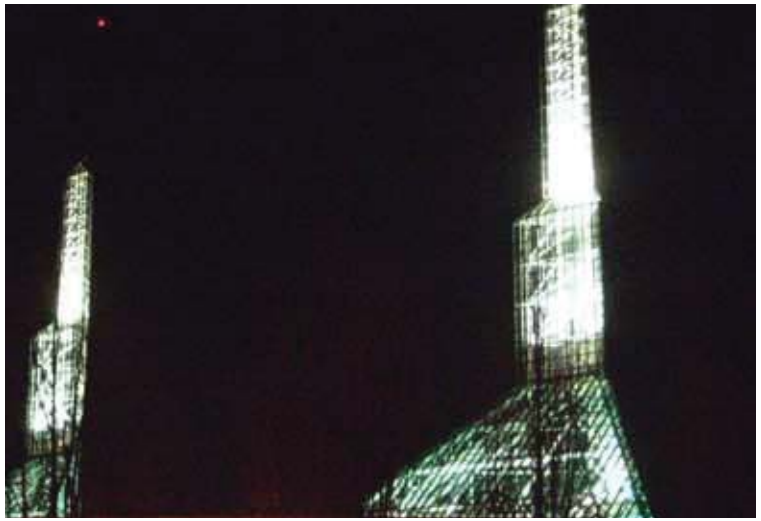
**Overly lit buildings waste electricity, increase greenhouse gas emissions and air and light pollution levels as well as pose a threat to birds.**

Floodlight at the base of the OHSU tram tower. Photo: Mary Coolidge

Unshielded, upward-directed floodlights at the base of the OHSU Tram Tower contribute directly to Portland's skyglow; existing fixtures which light the tram from above could instead be utilized as the primary lighting system. Photo: Mary Coolidge

Light spill is apparent from this stairwell in the Pearl District, and could be minimized by exterior shielding. Photo: Mary Coolidge

The height of the Wells Fargo Tower, coupled with its corner floodlights, make this building a potential collision hazard for migrants. Dimming or extinguishing exterior and rooftop lighting during migration season can help reduce collision hazards. Photo: Mary Coolidge



The iconic spires of the Oregon Convention Center feature unshielded light fixtures, rendering the spires visible for miles; though controversial, dimming or extinguishing these lights during migration season could reduce a potential collision hazard. Photo: Mary Coolidge

Though newer acorn-style light fixtures in South Waterfront have incorporated some shielding design, full cut-off improvements to the design of these fixtures would reduce contribution to light pollution. Photo: Mary Coolidge

# Solution: Lighting Design

**Poorly-designed or improperly-installed outdoor fixtures add over one billion dollars to electrical costs in the United States every year, according to the International Dark Sky Association.**

Reducing exterior building and site lighting can:

- reduce mortality of night migrants
- reduce building energy costs
- decrease air pollution and
- decrease light pollution.

Efficient design of lighting systems and operational strategies to reduce light "trespass" from buildings are both important strategies. In addition, an increasing body of evidence shows that red lights and white light (which contains red wavelengths) particularly attract and confuse birds, while green and blue light have less impact.

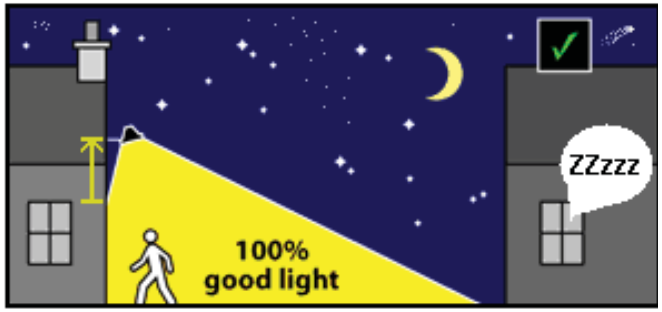
Light pollution is largely a result of inefficient exterior lighting, and improving lighting design usually produces savings greater than the cost of changes. For example, globe fixtures permit little control of light, which shines in all directions, resulting in a loss of as much as 50% of energy, as well as poor illumination. Cut-off shields can reduce lighting loss and permit use of lower wattage bulbs, resulting in lower costs.

Most "vanity lighting" is unnecessary. At minimum, building features should be illuminated using down-lighting rather than up-lighting. Spotlights and searchlights should not be used during bird migration.

Using automatic controls (timers, photo-sensors, and infrared and motion detectors) is more effective than reliance on people to turn off lights. These devices generally pay for themselves in energy savings in less than a year. The Center for Climate and Energy Solutions (www.c2es.org) Lighting Efficiency page cites that "some estimates suggest that occupancy sensors can reduce energy use by 45 percent, while other estimates are as high as 90 percent." Energy Trust of Oregon provides incentives to help offset up-front costs.

Workspace lighting should be installed where needed, rather than lighting large areas. In areas where indoor lights will be on at night, minimize perimeter lighting and/or draw shades after dark.


BADLY AIMED 500W HALOGEN FLOODLIGHT




WELL AIMED 100W FLOODLIGHT

Switching to daytime cleaning is a simple way to reduce lighting while also reducing costs.

## Safety Concerns

Safety is a primary concern when designing exterior building lighting systems. Unshielded lighting that causes glare is problematic because it saturates rod cells in the eye (responsible for night-vision) and causes pupils to dilate, which reduces the amount of light that enters the eye. The result is temporary night-blindness, which may actually compromise a person's safety. Constant lighting can also allow intruders and prowlers to remain concealed in predictable shadows, which underscores the importance of well-shielded motion sensor lighting instead of constant-burning lights that produce a dazzling glare.

The Federal Bureau of Investigation's 2009 crime statistics actually indicate that over half of residential burglary crimes are known to have occurred during daylight hours, and less than 30% are known nighttime burglaries. In 2000, the Chicago Alley Lighting Project worked to increase both the number of alley streetlights and the wattage of bulbs (from 90 watt to 250 watt), with the goal of decreasing crime and increasing Chicagoans' sense of safety. Data analysis of pre- and post-installation of these alley lights revealed an increase of 21% in reported offenses occurring at night. Read more here: http://www.icjia.state.il.us/public/pdf/ResearchReports/Chicago%20Alley%20Lighting%20Project.pdf. Communities that have implemented programs to reduce light pollution have not found an increase in crime.

The International Dark Sky Association advocates for putting light where it is needed, during the time period it will be used, and at the levels that enhance visibility. Outdoor lighting directed usefully at the ground reduces dazzling glare, allows for use of lower wattage bulbs, and saves money, electricity, and birds.

## Lights Out Programs

Birds evolved complex systems for navigation long before humans developed artificial light. Recent science has just begun to clarify how artificial light poses a threat to nocturnal migrants. Despite the complexity of this issue, there is one simple way to reduce mortality: turn lights off.

Across the United States and Canada, "Lights Out" programs encourage building owners and occupants to turn out lights visible from outside, at least during spring and fall migration. The first of these, Lights Out Chicago, began in 1995, followed by Toronto in 1997. There are over twenty programs as of mid-2011.

The programs themselves are diverse. They may be directed by environmental groups, by government departments, or by partnerships of organizations. Participation in some, such as Houston's, is voluntary. Minnesota mandates turning off lights

Portland's light-pollution is visible in this satellite image of North America. Photo courtesy of NASA.

Shielded lights, such as those shown above, cut down on light pollution and are much safer for birds. Photo: Susan Harder

Cut-off shields can reduce lighting loss and permit use of lower wattage bulbs, resulting in lower costs. Shielded light fixtures are widely available in many different styles. Top photo: Susan Harder; bottom photo: Dariusz Zdziebkowski, ABC

# Solution: Lighting Design

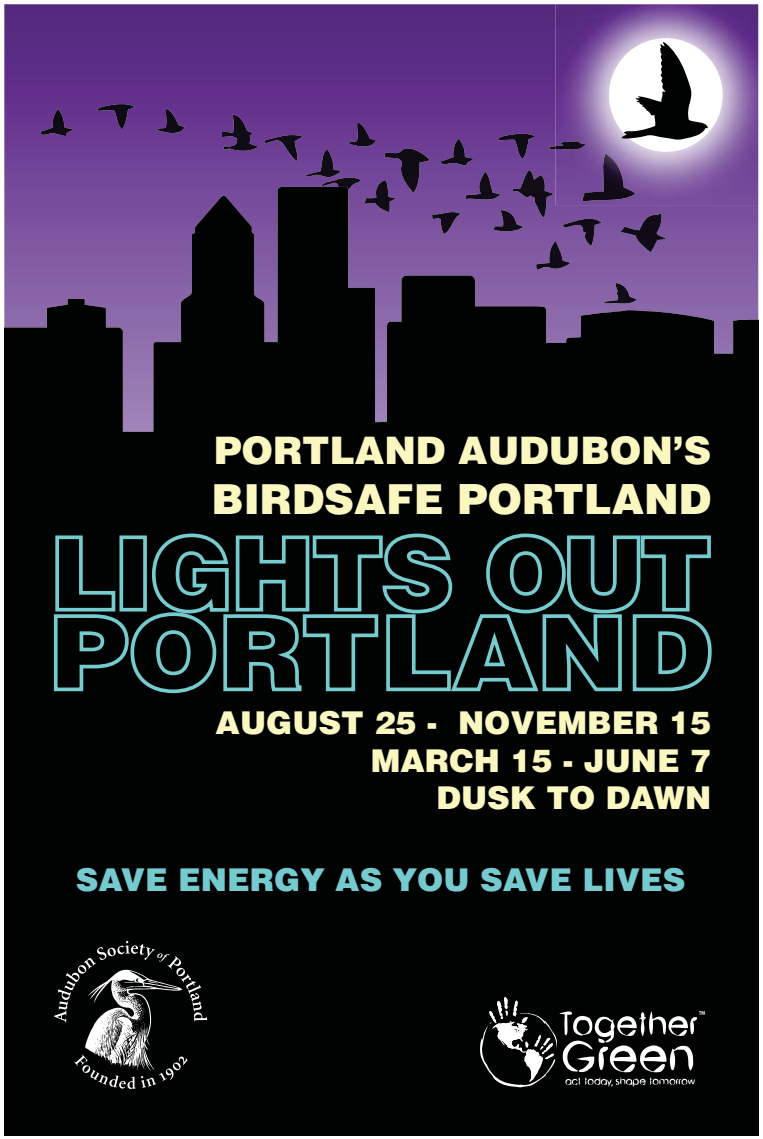
**Lights Out map legend**

- **Red:** state ordinance
- **Yellow:** cities in state-wide programs
- **Turquoise:** program in development
- **Blue:** local programs


in state-owned and -leased buildings, while Michigan's governor proclaims Lights Out dates annually. Many jurisdictions have a monitoring component or work with local rehabilitation centers. Monitoring programs provide important information in addition to quantifying collision levels and documenting solutions. Toronto, for example, determined that short buildings emitting more light can be more dangerous to birds than tall building emitting less light.

## Lights Out Portland

Coordinated by Audubon Society of Portland, Lights Out Portland asks buildings to turn off all unnecessary lighting from dusk to dawn between August 25th and November 15th (fall migration) and between March 15th and June 7th (spring migration). Lights Out provides for 3 levels of participation (silver, gold, platinum), affording some flexibility in the degree of participation. Visit www.audubonportland.org/issues/metro/birdsafe/lo for more information on enrollment, Energy Trust of Oregon incentives, and participating buildings.




Enrollment in Lights Out Portland is voluntary, seasonal and is a way to achieve multiple financial, environmental, and social benefits.

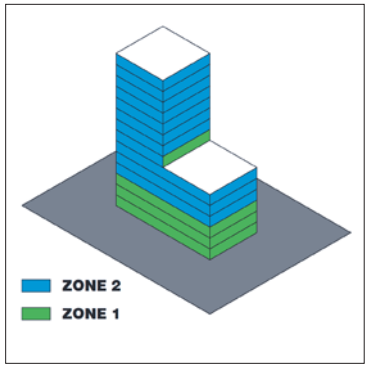
# Houston skyline during Lights Out

Inset: Typical Houston skyline
Photos: Jeff Woodman

## 5. Appendix V: LEED Pilot Credits Addressing Ecosystem-level Considerations

Appendix V of the *Draft Resource Guide for Bird-friendly Building Design*: A summary of the US Green Building Council's pilot program for Bird Collision Deterrence.

# Appendix V: LEED Pilot Credits Addressing Ecosystem-level Considerations




Zone 1 includes the first 3 floors above ground level and the first floor above a green roof. Zone 2 includes all façade area above the 3rd floor. Zone 1 is considered twice as dangerous as Zone 2.

## Pilot Credit 55: Bird Collision Deterrence

On October 14, 2011, The US Green Building Council introduced a pilot credit with the explicit intent of "reduc[ing] bird injury and mortality from in-flight collisions with buildings." The establishment of the Bird Collision Deterrence (BCD) credit demonstrates the USGBC's commitment to expanding the standards of its green building program to include ecosystem-level considerations in its rating system. Since collisions can occur due to a combination of factors, the credit addresses unmarked window glass as well as both interior and exterior lighting. The credit is available to both new construction and existing buildings.

For new construction, the building must comply with a building façade option, an interior lighting option, an exterior lighting option, and develop a 3-year post-construction monitoring plan.

## Building Façade Requirement

Develop a façade design strategy to make the building visible as a physical barrier, and eliminate reflections. The BCD Pilot credit helps to direct architects and designers to window materials that have been tested & rated for their visibility to birds. Strategies for creating visual noise can include opacity, translucence, fritting, UV-patterns, exterior films, louvers, screening, netting, and shutters. A summary of Material Threat Factors allows a designer to calculate the overall Bird Collision Threat Rating (BCTR) for the building, which must score no higher than 15. All glazed corners or fly-through conditions (closely placed unmarked glass) must have a Threat Factor equal to or below 25. If all the materials used in the façade have a Threat Factor of <15, the project may submit a materials list in lieu of a BCTR calculation.

### For more on BCD and BCTR Calculation:

An example of a proposed BCD project and its accompanying BCTR Calculation is available on page 10 of the LEED Pilot Credit Library materials http://www.usgbc.org/ShowFile.aspx?DocumentID=10402

### Sampling of Material Threat Factor ratings:

- Opaque material, 0
- Exterior adhesive film, 2
- Interior patterned film 2" horiz. or 4" vert., 15
- Exterior louvers 2" horiz. or 4" vert., 5
- Glass Block 8" x 8" x 4", textured, 10
- Exterior white dot frit, 15
- Operable shutters, 10
- UV-patterned glass, 25

The building is first separated into two risk zones: Zone 1 (high risk) and Zone 2 (low risk). Zone 1 includes the first 3 floors above ground level and the first floor above a green roof. Zone 2 includes all façade area above the 3rd floor. Zone 1 is considered twice as dangerous as Zone 2.

For each zone, calculate the BCTR according to the formula:

1. [((Material Type 1 Threat Factor) x (Material Type Area)) + ((Material Type 2 Threat Factor) x (Material Type Area))…] / [Total Façade Zone Area = Façade Zone BCTR.

2. Then determine the total building Bird Collision Threat Rating by performing the following calculation with BCTRs for Zone 1 and Zone 2:
   [((Zone 1 BCTR) x 2) + (Zone 2 BCTR)] / 3 = Total Building BCTR

### Lighting Requirement

In addition to a façade treatment and monitoring, the credit requires that overnight lighting be responsibly designed to minimize light spill from both interior spaces and exterior fixtures.

The new bird-safety credit addresses the hazard of light pollution by requiring properly-shielded fixtures, as well as establishment of manual or automatic shutoff programs from midnight to 6 am (safety lighting is exempted). The credit is synergistic with other LEED-spirited goals: it minimizes waste of electricity (and money!), helps to reduce carbon emissions, minimizes impacts to wildlife, and preserves our age-old cultural heritage of star-gazing.

### Post-Construction Monitoring Plan

Submit a copy of the 3-year post-construction monitoring plan to routinely monitor for collision-prevention effectiveness. Include methods to identify and document strike locations, the number, date, and time of collisions, as well as the feature that may be contributing to collisions. The plan should include a process for correcting problem areas if any are discovered. Monitoring is not intended to be punitive, but rather, intended to provide data on the effectiveness of different design approaches.

## Existing Building Operation & Maintenance

### Lighting

For both interior and exterior lighting, the building must provide necessary reports, drawings, and descriptions of light fixtures, lighting systems, and operations as above to demonstrate compliance.

### Post-Construction Monitoring Plan

Implement a 3-year façade monitoring Plan in NC, CS, Schools, Retail, Healthcare above. If a collision area is identified, consider a temporary or permanent retrofit. Implement interim retrofits within 120 days, and permanent retrofits within 2 years.

## LEED Pilot Credit 7: Light Pollution Reduction

The US Green Building Council has rewritten the Light Pollution Reduction credit to make it easier to understand, more flexible for designers, and more applicable to different sources of light pollution. The Credit explicitly intends to "increase night sky access, improve nighttime visibility, and reduce development impacts on wildlife environments by reducing uplight (skyglow) and light trespass (glare)." The establishment of the Light Pollution Reduction credit is just one of the ways that the USGBC is demonstrating its commitment to include ecosystem-level considerations in its rating system.

For both the uplight and light trespass requirements, an optional path allows teams to demonstrate compliance by selecting luminaires with an appropriate BUG rating and placing them appropriately. No point-by-point calculation is required. The calculation path is simplified and requires calculations for fewer locations. Many projects can achieve the credit by simply complying with ASHRAE 90.1–2010 and selecting luminaires with an appropriate BUG rating.

The term *lighting boundary* has been introduced to indicate the nearest property line adjacent to the project site (modified in some cases). Light trespass requirements relate to the lighting boundary, rather than the LEED site boundary. Skyglow/Uplight requirements are still met based on all non-exempt exterior luminaires located within the LEED site boundary.

The credit is available for pilot testing in New Construction, Core & Shell, Schools, Retail, Healthcare, and EBOM.

**Full text of the LEED Pilot Credit 55 language:** http://www.usgbc.org/ShowFile.aspx?DocumentID=10402

**Summary of Material Threat Factors:** https://www.usgbc.org/ShowFile.aspx?DocumentID=10397

**Full text of the LEED Pilot Credit 7 language:** http://www.usgbc.org/ShowFile.aspx?DocumentID=8219

**Bird-friendly practices often go hand-in-hand with energy efficiency improvements**

Rufous Hummingbird.
Photo: Jim Cruce

6. **Bird Collision Deterrence: Summary of Material Threat Factors by The American Bird Conservancy, October, 2011**

List of façade materials and their perceived threat factors based on bird collision expectancy as determined by the American Bird Conservancy.

**Bird Collision Deterrence: Summary of Material Threat Factors**
**The American Bird Conservancy**
**October, 2011**

| Façade Material Type | Threat Factor |
|---|---|
| ***Opaque Material*** | 0 |
| | |
| ***Plexiglass*** | |
| Clear plexiglass with 5/64" thick black filament in horizontal arrangement spaced 1-3/16" apart (Evonik Paraglas or similar) | 9 |
| ***Translucent Plastics- all colors except clear*** | |
| Fiberglass panel, single pane or insulated (Kalwall or similar) | 2 |
| Corrugated fiberglass panel, single pane or insulated (Resolite or similar) | 2 |
| ***Glass*** | |
| Clear Glass, single pane or insulated | 100 |
| Glass with pattern on interior (#2) surface, single pane or IGU. 1/8" minimum line thickness or dot diameter. 2" maximum space between horizontal elements and 4" maximum space between vertical elements. | |
| Examples: | |
| Medium grey ceramic frit - 1/8" vertical lines spaced 1/2" apart, 20% coverage (Viracon V-948 or similar) | 10 |
| Dark grey ceramic frit - 1/8" horizontal lines spaced 1/2" apart, 20% coverage (Viracon V-901 or similar) | 6 |
| White ceramic frit - 1/8" dia. dots w/20% coverage (Viracon 5065 or similar) | 41 |
| White ceramic frit - 1/8" dia. dots w/40% coverage (Viracon 5006 or similar) | 24 |
| Glass with continuous frit on interior (#2) surface, single pane or IGU | 25 |
| Glass continuously etched (translucent level 4) on interior (#2) surface, single pane or IGU (Carvart or similar) | 25 |
| Clear wire glass with maximum 2" wire spacing, single pane or IGU (wire on outer pane). | 20 |
| Glass IGU with ½" thick white polycarbonate inner layer, 2" maximum diameter honeycomb (Panelite or similar) | 25 |
| Glass with pattern on exterior (#1) surface, single pane or IGU. 1/8" minimum line thickness or dot diameter. 2" maximum space between horizontal elements and 4" maximum space between vertical elements. | |

| Façade Material Type | Threat Factor |
|---|---|
| Examples: (all Eckelt 4 Bird or similar) | |
| Orange ceramic frit- 1/4" vertical lines on 3½" centers | 10 |
| Orange & black ceramic frit- ½" alternating color vertical lines on 3½" centers | 15 |
| Black ceramic frit- 5/8" vertical "dot-screened" lines on 4" centers | 10 |
| Orange & black ceramic frit- 5/8" alternating color vertical "dot-screened" lines on 4" centers | 10 |
| Orange & black ceramic frit- 1" alternating color vertical "dot-screened" lines on 4 1/4" centers | 10 |
| Glass continuously etched (translucent level 4) on exterior (#1) surface, single pane or IGU (Carvart or similar) | 5 |
| ***Specialty Glass Products*** | |
| Coated glass with 1/16" UV reflective lines arranged in an irregular "webbed" pattern with 2" maximum spacing on interior (#2) surface, IGU (Ornilux Mikado or similar) | 34 |
| Translucent channel glass with cast "orange peel" or linear textured surface- 9" maximum face width (Pilkington Profilit or similar) | 10 |
| Glass block, 8" x 8" x 4" deep with "wavy" translucent appearance and polished surface (Pittsburgh Corning Decora or similar) | 20 |
| Glass block, 8" x 8" x 4" deep with grooved textured surface (Pittsburgh Corning Argus or similar) | 10 |
| ***Adhesive Films for Glass Retrofit*** | |
| Matte perforated vinyl signage film applied to outer (#1) surface (Scotchgal or similar) | 2 |
| Patterned film on interior (#2) surface. 1/8" minimum line thickness or dot diameter. 2" maximum space between horizontal elements and 4" maximum space between vertical elements. | see glass |
| Patterned film on exterior (#1) surface. 1/8" minimum line thickness or dot diameter. 2" maximum space between horizontal elements and 4" maximum space between vertical elements. | see glass |
| Adhesive decals applied to outer (#1) surface, spaced as indicated for patterned film above | 10 |
| ***Protective Screen External to Glass (fixed in place)*** | |
| Horizontal or vertical slats with 1/8" minimum face thickness and 2" maximum space between horizontal elements and 4" maximum space between vertical elements. | 5 |

| Façade Material Type | Threat Factor |
|---|---|
| Horizontal or vertical slats with 1/8" minimum face thickness. Slat depth and spacing ratio shall obscure 85% of glass when analyzed from all possible viewing angles | 15 |
| Expanded metal or perforated screens having elements with maximum spacing of 2" horizontal or 4" vertical | 10 |
| Welded wire mesh with minimum 1/8" dia. wire and 2" maximum space between horizontal elements and 4" maximum space between vertical elements. | 10 |
| Fixed copper or fiberglass insect screens installed 2" minimum outboard of glass | 5 |
| Poly or nylon netting with maximum 1" opening installed 6" minimum outboard of glass | 5 |
| ***Operable Shutters External to Glass*** | |
| Perforated hinged shutter with maximum opening 2" high x 4" wide. | 15 |
| Solid opaque hinged shutter | 10 |
| Roll-up solar screen- translucent polyester woven fabric | 15 |

## 7. Draft Design Guidelines for Port of Ridgefield's Millers Landing, April 2011

Excerpt from draft design guidelines prepared for a mixed use development in Ridgefield, Washington located adjacent to the Ridgefield National Wildlife Refuge.

GROUP MACKENZIE



# DESIGN GUIDELINES

**For**
Port of Ridgefield's
Millers Landing

**Draft**
April __, 2011

**Project Number**
2050304.00

GROUP MACKENZIE
Since 1960

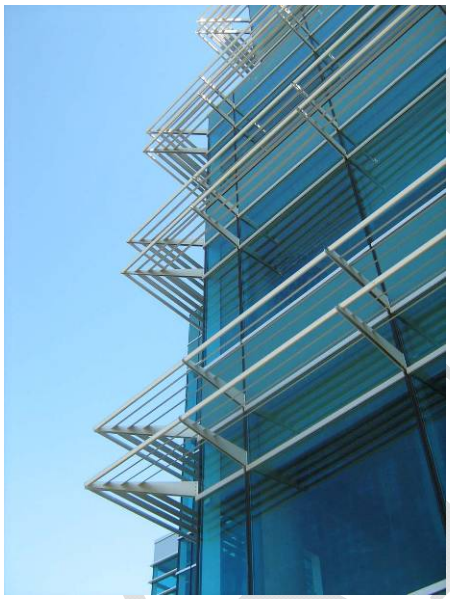
601 Main Street, Suite 101 | Vancouver, WA 98660
T 360.695.7879 | F 360.693.6637 | groupmackenzie.com

- enriched employee lunch areas;
- accent lighting;
- incorporate daylight and natural air flow;
- dynamic building and roof forms;
- jogs or offsets in long walls
- reveals, material changes, and accent paints

- striking window patterns;
- light and shadow patterns; and
- color accents.

- The following wildlife friendly design practices shall also apply to all buildings:
  - Wildlife friendly design practices listed below are intended to apply primarily to the lower levels of buildings at approximately the same heights of the surrounding trees, as these dimensions relate to a typical city tree height and are essential for a building to be considered bird friendly.
  - Ground floor lobbies and walkways inside buildings decorated with trees, shrubs, or other natural vegetation and designed with clear glass fenestration should be avoided unless visual markers described herein are implemented.
  - Site landscaping, or adjacent vistas, reflected in untreated reflective glass is an extreme hazard and should be avoided.
  - Muting of reflections by angling glass or by utilizing internal screens.
  - Implement visual markers in any expanse of glass facing the Ridgefield Wildlife Refuge. Visual markers may include architectural elements of the building which frame the glass, sun shades projecting over windows, or patterned glass achieved by decals, film, or other similar technique.

- Multiple paned glass is an effective method of creating a visual marker. Panes should be limited to one foot or less if this is the only source of creating a visual marker. Panes may be indicated by horizontal and vertical mullions.
- Vertical grills or louvers may also be utilized
- Glass design features on a site such as windbreaks, solariums, and greenhouses should be treated in a way that creates enough visual markers for birds to perceive them.



## XI. LIGHTING STANDARDS

***Objectives***

- Provide site security and pedestrian safety.
- Complement and reinforce the architecture and site design character.
- Ensure the use of consistent parking lot fixtures and illumination levels throughout Millers Landing.
- Prevent lighting from casting glare onto adjacent lots and adjacent streets in such a manner as to decrease the safety of vehicular movement.
- Encourage lighting design that is in conformance with energy saving guidelines.
- Respect the natural environment surrounding Millers Landing

***Standards***

- All lighting potentially visible from an adjacent street, except bollard lighting less than 42 inches high, shall be indirect or shall incorporate a full cut-off shield type fixture.
- Parking areas, access drives, and internal vehicular circulation areas - All parking lot illumination level shall achieve 1 foot candle throughout parking and pedestrian circulation routes through parking/ maneuvering areas.
- Service area lighting shall be contained within the service yard boundaries and enclosure walls. No light spillover should occur outside the service area. The light source should not be visible from the street or the adjacent hillside.
- Building illumination and architectural lighting shall be indirect in character (no light source visible). Indirect wall lighting or "wall washing" overhead down lighting, or interior illumination which spills outside is encouraged. Architectural lighting should articulate and animate the particular building design, as well as provide the required functional lighting for safety and clarity of pedestrian movement.
- 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 and shielded to light only the areas intended.
- Pedestrian zone lighting for outdoor areas such as courtyards, entry ways, etc., should achieve a uniformity ratio of 1 foot candle average to a minimum, of .18 foot candles.
- Pedestrian walk lighting, where point-to-point lighting is acceptable and no specific illumination levels are required, should clearly identify the pedestrian walkway and direction of travel.

- Roadway and Parking Lot light standard – 25 to 30 feet in height.
- The maximum level of illumination for roadways and parking areas shall not exceed 2 foot-candles.
- Location of lighting fixtures shall be designed to enhance site security.
- On-site lighting shall complement and reinforce the architecture and site design character.
- Design of light fixture placement shall prevent excessive lighting from casting glare onto adjacent lots and streets in such a manner that would impair the safety of vehicular movement.
- Light poles will be required in the front parking areas. Wall mounted lights will not be mounted in the front parking area.
- Wall mounted lights will only be allowed in the rear of the building – out of view from street.
- Encourage lighting design that is in conformance with energy-saving guidelines project
- External lighting of building features, known as 'vanity' or 'architectural' lighting, should be projected downwards.
- Event lighting, such as spotlights and searchlights should be prohibited during the migratory seasons.
- Reducing light pollution by turning off all unnecessary interior lights at night, especially during the migratory seasons.
- Building lighting systems that automatically adjust lighting levels and turn off unnecessary lights can be installed along with the task lighting so that tenants can also help reduce light pollution.

8. **Bird-Safe Building Checklist, San Francisco Planning Department Standards for Bird-Safe Buildings, July 14, 2011**

A one-page, color-coded, guide to help evaluate potential bird-hazards.

# VI. Bird-Safe Building Checklist

**Use of this checklist:** This checklist serves three purposes: 1) assessing risk factors and determining risks which must be addressed by the requirements; 2) increasing awareness of risk factors that are de minimis and don't require treatment; and 3) evaluating buildings for certification as a bird-safe building.

1 REQUIREMENTS FOR THE MOST HAZARDOUS CONDITIONS: The conditions that warrant special concern in San Francisco are designated by red-shaded boxes. These red boxes indicate prohibited building conditions or conditions which are only permitted if the glazing is installed with bird-safe glazing treatments. If the project combines a glass façade with a high-risk location ("location-related hazard", line 5-7), glazing treatments will be required for the façade(s) such that the amount of untreated glazing is reduced to less than 10% for the façade facing the landscaping, forest, meadow, grassland, wetland, or water. If a project creates a new bird-trap or "feature-related hazard" (lines 19-22) or remodels an existing feature-related hazard, bird-safe treatment will be required.

2 INCREASING AWARENESS: Owners of buildings with a façade of greater than 50% glass (lines 9 -10) are strongly encouraged to evaluate the building against the checklist and to help provide future tenants with copies of this guide. Use this checklist to evaluate design strategies for building new structures and retrofitting existing buildings throughout the City. This checklist summarizes conditions that could contribute to bird mortality and will help to identify the potential risks. Interested neighborhood groups and trade associations are encouraged to contact the Department for suggestions on how to proactively increase awareness of the issue and make bird safety practices a part of the construction lexicon.

3 VOLUNTARY RATINGS: Project sponsors interested in submitting a project for "Bird-Safe Certification" may use this form. The Department will partner with local artists to produce appropriate artwork and/or plaques to acknowledge those who actively seek to reduce bird collisions on their property. The ratings system will create tiers certification to recognize projects that meet minimum requirements as well as those projects that exceed the requirements.

## RISK ASSESSMENT LEGEND:

**Potential Risk Factors:** These shade indicate factors that may present hazards to birds. Note: actual risks vary greatly depending upon building and site-specific variables.

**GRAY:** This shade indicates potential increased risk. NOTE: *The net assessment of total risk varies with the combination of building factors. While every building in San Francisco will present some element of risk to birds, only combinations with "red" boxes present a risk level necessitating bird-safe treatments.*

**RED:** This shade indicates prohibited conditions or conditions which are prohibited unless bird-safe treatment is applied.

## CERTIFICATION LEGEND:

**Bird-Safe Building Certification and Acknowledgement:** Buildings which avoid creating hazards or which enhance bird safety with treatments identified as effective in this document would be acknowledged by the City and could be marketed as such. This document proposes three levels of certification by the City. Certification is determined by applying the checklist criteria.

By checking all of the boxes for one (or more) of these colors on the Bird-Safe Building Checklist (page 39), a building owner is eligible to apply to the Planning Department for Bird-Safe Building Certification.

**YELLOW:**
**Bird-Safe Building**
The building meets the minimum conditions for bird-safety. This level focuses on ensuring "bird-hazards" and "bird traps" are not created or are remedied with bird-safe treatments.

**GREEN:**
**Select Bird-Safe Building**
The building meets all of the minimum requirements; commits to "lights out" practices during migratory seasons; reduces untreated glazing beyond the requirements; and commits to educating future building occupants.

**BLUE:**
**Sterling Bird-Safe Building**
This is the highest level of Bird-Safe Building certification possible. The building meets all of the conditions of the other certification levels, plus the building reduces the amount of glass on the façade, avoids or treats additional hazards—beyond the requirements, and features year-round best management practices for lighting.

## BIRD-SAFE BUILDING CHECKLIST

**Using the key on the prior page, complete this checklist as a guide to help evaluate potential bird-hazards or eligibility for Bird-Safe Building Certification.**

| | | QUESTION | | YES | NO |
|---|---|---|---|---|---|
| **MACRO-SETTING** (PAGE 12, 16) | 1 | **Is the structure located within a major migratory route?** (All of San Francisco is on the Pacific Flyway) | | | |
| | 2 | **Is the location proximate to a migratory stopover destination?** (Within 1/4 mile from Golden Gate Park, Lake Merced or the Presidio) | | | |
| | 3 | **Is the structure location in a fog-prone area?** (Within 1/2 mile from the ocean or bay) | | | |
| **MICRO-SETTING (LOCATION-RELATED HAZARD)** (PAGES 13, 16, 28-29) | 4 | **Is the structure located such that large windows greater than 24 square feet will be opposite of, or will reflect interlocking tree canopies?** | | | |
| | 5 | **Is the structure inside of, or within a distance of 300 feet from an open space 2 acres or larger dominated by vegetation?** (Requires treatment of glazing, see page 28) | | | |
| | 6 | **Is the structure located on, or within 300 feet from water, water features, or wetlands?** (Requires treatment of glazing, see page 28) | | | |
| | 7 | **Does the structure feature an above ground or rooftop vegetated area two acres or greater in size?** (Requires treatment of glazing, see page 29) | | | |
| **GLAZING QUANTITY** (PAGE 8) | 8 | **Is the overall quantity of glazing as a percentage of façade:** (Risk increases with amount of glazing) | **Less than 10%?** | | |
| | | | **More than 50%?** (Residential Buildings in R-Districts must treat 95% of unbroken glazed segments 24 square feet or greater in size if within 300 feet of an Urban Bird Refuge.) | | |
| | 9 | **Will the glazing be replaced?** | **More than 50% glazing to be replaced on an existing bird hazard (including both feature-related hazards as described in lines 19-22 and location-related hazard as described in lines 4-7)?** (Requires treatment see pages 29 and 31.) | | |
| **GLAZING QUALITY** (PAGE 6, 7) | 10 | **Is the quality of the glass best described as:** | **Transparent** (If so, remove indoor bird-attractions visible from outside the windows.) | | |
| | 11 | | **Reflective** (If so, keep visible light reflectance low (between 10-20%) and consider what will reflect in the windows. Note: Some bird-safe glazing such as fritting and UV spectrum glass may have higher reflectivity that is visible to birds.) | | |
| | 12 | | **Mirrored or visible light reflectance exceeding 30%.** (Prohibited by Planning Code.) | | |
| **GLAZING TREATMENTS** (PAGE 18-21) | 13 | **Is the building's glass treated with bird-safe treatments such that the "collision zone" contains no more than 10% untreated glazing for identified "location-related hazards" (lines 4-7) and such that 100% of the glazing on "feature-related hazards" (lines 19-22) is treated?** | | | |
| | 14 | **Is the building's glass treated for required "bird hazards" (as described in line 13) *and* such that no more than 5% of the collision zone (lower 60') glazing is untreated but not for the entire building?** | | | |
| | 15 | **Is the building glazing treated (as described above in lines 14 and 15) *and* such that no more than 5% of the glazing on the exposed façade is left untreated?** | | | |
| **BUILDING FAÇADE GENERAL** (PAGE 8, 13) | 16 | **Is the building façade well-articulated (as opposed to flat in appearance)?** | | | |
| | 17 | **Is the building's fenestration broken with mullions or other treatments?** | | | |
| | 18 | **Does the building use unbroken glass at lower levels?** | | | |
| **BUILDING FEATURE-RELATED HAZARDS AND BIRD TRAPS** (PAGE 8, 30-31) | 19 | **Does the structure contain a "feature-related" hazard or potential "bird trap" such as:** | **Free standing clear-glass walls, greenhouse or other clear barriers on rooftops or balconies?** (Prohibited unless the glazing is treated with bird-safe applications.) | | |
| | 20 | | **Free standing clear-glass landscape feature or bus shelters?** (Prohibited unless the glazing is treated with bird-safe applications.) | | |
| | 21 | | **Glazed passageways or lobbies with clear sight lines through the building broken only by glazing?** | | |
| | 22 | | **Transparent building corners?** | | |
| **LIGHTING DESIGN** (PAGE 10, 25) | 23 | **Does the structure, signage or landscaping feature uplighting?** (Prohibited within 300 feet of an Urban Bird Refuge) | | | |
| | 24 | **Does the structure minimize light spillage and maximize light shielding?** | | | |
| | 25 | **Does the structure use interior "lights-out" motion sensors?** | | | |
| | 26 | **Is night lighting minimized to levels needed for security?** | | | |
| | 27 | **Does the structure use decorative red-colored lighting?** | | | |
| **LIGHTING OPERATIONS** (PAGE 12, 24-25) | 28 | **Will the building participate in San Francisco Lights Out during the migration seasons?** (February 15-May 31 and August 15- November 30th) To achieve "sterling" certification the building must participate in year-round best management practices for lighting. | | | |
| **OTHER BUILDING ELEMENTS** (PAGE 23) | 29 | **Does the structure feature rooftop antennae or guy wires?** | | | |
| | 30 | **Does the structure feature horizontal access wind generators or non-solid blades?** | | | |
| **CONSENT** (PAGE 34) | 31 | **Does the building owner agree to distribute San Francisco's Bird-Safe Building Standards to future tenants?** | | | |

**Authorized Signature** X _____ **Date:** _____