SAN FRANCISCO
PLANNING
DEPARTMENT

Standards for
Bird-Safe Buildings

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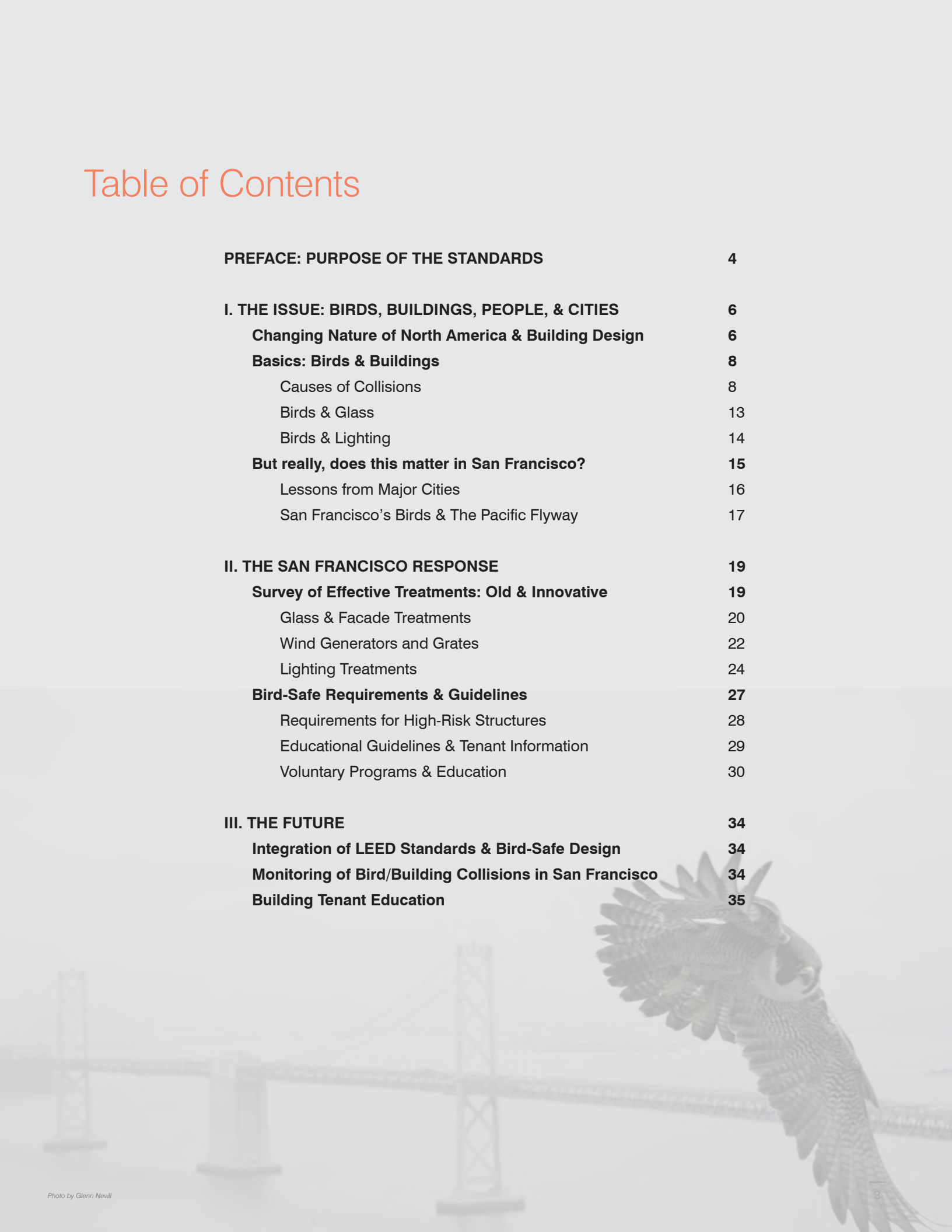


Photo by Glenn Nevill

Preface: Purpose of the Standards

Photo by Robert Lewis

Varied Thrush

"The wide variety of native birds that thrive in urban areas underscores the importance of these artificial habitats to the survival of many bird populations. Creating greenspace in urban environments, landscaping with native plants in backyards and parks, adopting architecture and lighting systems that reduce collisions, and keeping pets indoors will provide the greatest benefit to breeding birds and migrants seeking safe places to rest and find food during their spectacular journeys."

- 2009 State of The Birds Report by the United States Government US Department of Interior.

Pigeons and sparrows are readily visible in San Francisco. These ubiquitous city birds are not shy about sharing our urban spaces. But the casual observer may be shocked to learn that our City's birds are much more diverse. There are about 400 species of birds in San Francisco; remarkably, this is nearly half the species in all North America (*Kay 2009*). For those who look, the shyer species are just around the corner. This is due in part to the diverse habitats of the Bay Area and its position on the coastal migration path, the Pacific Flyway. Some birds are well-adapted to urban life, and they may remain here as year-round "residents." Others are migratory passing through the City southward in autumn en route to their winter feeding-grounds, then returning northward in spring to establish territories in their summer breeding grounds.

Photo by Robert Lewis

Anna's Hummingbird

While our birds are diverse and exciting, there are special problems posed for birds living in or flying through cities. Over 30 years of research has documented that buildings and windows are the top killer of wild birds in North America (*Banks 1979; Ogden 1996; Hager et al. 2008; Klem 2009; Gelb and Delacretaz 2009*). Structure collision fatalities may account for between 100 million and 1 billion birds killed annually in North America (*United States Fish and Wildlife Service 2002; Klem 2009*). According to the leading expert, Dr. Daniel Klem Jr. this toll strikes indiscriminately culling some of the healthiest of the species. "From a population standpoint, it's a bleeding that doesn't get replaced," he added, estimating that between 1 percent and 5 percent of the total migratory population die in window crashes annually (*Knee, 2009*). Many of these are endangered or threatened species whose populations are already sinking due to habitat loss, toxin loads, and other severe environmental pressures.

Juvenile residents and migrants of all ages — those least familiar with the urban setting — bear the greatest risk of injury or death from the hazards of the city environment. Collision hazards include vehicles, bridges, transmission towers, power lines, and turbines, but the majority of avian deaths and injuries occur from impacts with building components such as transparent or reflective glass. Night-time lighting also interferes with avian migrations. Scientists have determined that bird mortality caused by building collisions is "biologically significant". In other words, building collisions are a threat of sufficient magnitude to affect the viability of bird populations, leading to local, regional, and national declines. Night-migrating songbirds--already imperiled by habitat loss and other environmental stressors--are at double the risk, threatened both by illuminated buildings when they fly at night and by daytime glass collisions as they seek food and shelter.

While species that are plentiful may not be threatened by structure collisions, many species that are threatened or endangered show up on building collision lists (*Ogden 1996 and references therein*).

Strategies that improve the urban design quality or sustainability of the built environment may also help to make a more bird-safe city. For example, San Francisco has a long-standing policy prohibiting installation of mirrored glass, to meet aesthetic goals. This policy also benefits birds, which mistake reflections for real space and don't perceive the glass as a deadly barrier. The launch of the Golden Gate Audubon Society, Pacific Gas & Electric Company, and Department of the Environment's voluntary Lights Out San Francisco program in 2008 links smart energy policy with proven bird preservation strategies. Research by ornithologists at Chicago's Field Museum of Natural History found that consistently turning off bright lights or closing blinds reduces bird deaths by 83%.

Occasionally policy goals may conflict, and we must balance the benefits and costs of one policy against the other. For instance, gains in energy and resource conservation provided by wind generators could also have negative environmental impacts if installations of those wind farms increase mortality among flying animals.

Photo courtesy New York Audubon's "Bird-Safe Guidelines"

A Red-Tailed Hawk may see its reflection as a territorial rival to be driven away, resulting in a collision.

What This Document Does

Annual kills at high-risk structures are foreseeable and avoidable and merit protection (*Klem, 2009*). The controls recommended in this document aim to identify high-risk features in an urban setting and regulate these situations to the best of current scientific understanding. In areas where the risks are less well known, the Department does not propose to apply controls but instead recommends project sponsors use the checklist contained in this document as an educational tool to increase their understanding of potential dangers. If the Commission chooses to implement this document, the City would establish a voluntary bird-safe rating system to acknowledge building owners who voluntarily take measures to keep birds safe on their property. At this time, the Planning Department also urges local researchers to further explore the issue.

I. The Issue: Birds, Buildings, People and Cities

CHANGING NATURE OF NORTH AMERICA & BUILDING DESIGN

The consequences of our population growth are well-known: sprawling development across the country compounds habitat loss and causes changes to vital ecological functions. The rate of sprawl in the United States almost quadrupled between 1954 and 2000. An area of undeveloped land about the size of Connecticut is converted to urbanized landscapes annually in the United States (*U.S. Department of Agriculture 1997*). This loss of habitat exerts great pressures on our wildlife.

Less well-known to the general public are the effects of our specific development forms on wildlife. Buildings and birds have coexisted since people first sought shelter. Early blocky buildings posed little threat to birds as the building elements were quite visibly solid. The advent of mass produced sheet glass in 1902 greatly increased the potential for transparency. The innovation of steel frame buildings with glass curtain walls resulted in entire high-rise buildings that appeared transparent.

After the Second World War, these steel and glass buildings came into widespread use and became the iconic 20th Century American building. Today, planners and urban dwellers increasingly demand building transparency to achieve street activation and pedestrian interest. As glass surface area increases so do the number of bird collisions. After World War II birdwatchers began documenting major bird-building, single-event collisions that resulted in the deaths of hundreds of birds. The first recorded event occurred on September 10, 1948 when more than 200 birds of 30 species were killed upon collision with the Empire State Building. Similar events have occurred every decade with notable events killing 10,000 to 50,000 birds at a strike (*Bower 2000*). These single-event strikes are often tied to inclement weather, night migration, and brightly lit structures.

ABOVE: The proposed new Transbay Terminal presents a transparent façade with enticing vegetation visible both inside the building and on the roof. The facade is currently planned to include fritted glass.

ABOVE: Many historic buildings such as the old Transbay Terminal present a solid appearance.

Photo courtesy of Lundberg Design

ABOVE: The City's new bus shelters designed by Lundberg Design use a subtle frit pattern to indicate the barrier. This design, called "SF Fog," is effective in alerting both people and birds to the glass. INSETS show how the frit pattern is more dense at the bottom and dissipates like the City's fog at the top.

While the single-event collisions are dramatic, the bulk of bird deaths result from the cumulative effects of a lone, confused bird mistaking glass for a safe flight path. The lone bird strike occurs over and over with conservative estimates calculating that each building kills 10 birds per year on average in the United States (*Klem 1990*). Poorly designed buildings kill hundreds per year (*Hager et al. 2008*). Current research finds that earlier estimates of up to 1 billion bird deaths per year due to building collisions were conservative (*Klem et al. 2009 and references therein*).

New trends in design towards green architecture can increase or moderate the risk for birds. Green design that facilitates bird safety includes: the avoidance of light pollution, reduced disturbance to natural landscapes and biological systems, and lowered energy use. Green design can also be hard on birds. Green buildings surrounded by lush landscaping may be attracting more birds. Window reflections of adjacent greenery lure birds to false trees. Green atria inside buildings too may call birds to an inaccessible haven only to have their journey harshly interrupted mid-flight.

But, green building design can go hand-in-hand with bird-safe design. The Green Building Council rating system, LEED, challenges designers to assess the impact of building and site development on wildlife, and incorporate measures to reduce threats. Buildings may be certified as silver, gold or platinum according to the number of credits achieved. LEED Version 3 will offer the first optional points for bird-safe building design. There is room for growth. In the future, green design should thoroughly consider the impact of design for wild flora and fauna.

BELOW: The California Academy of Sciences showcases many green design features including a green roof set within a lush, green landscape that is a natural respite for birds migrating through the city. These features combined with the building siting in an park and the extensive use of glass raise the hazard potential for birds. While no study has been completed on bird strikes at this building, birders have anecdotally reported bird strikes.

http://slowmuse.files.wordpress.com/2008/10/cast.jpg

Across the concourse from the California Academy of Sciences, the De Young Museum presents less hazards due to its low amount of glazing and perforated copper facade.

THE BASICS: BIRDS & BUILDINGS

We don't know exactly what birds see when they look at glass but we do know that the amount of glass in a building is the strongest predictor of how dangerous it is to birds. Other factors can increase or decrease a building's impact, including the density and species composition of local bird populations, the type, location and extent of landscaping and nearby habitat, prevailing wind and weather, and patterns of migration through the area. All must be considered when planning bird-friendly environments. Commercial buildings with large expanses of glass can kill large numbers of birds, estimated at 35 million per year in the US (*Hager et al 2008*). With bird kills estimated at 1-10 per building per year, the large number of buildings multiplies out to a national estimate of as much as a billion birds per year (*Klem et al 2009; Klem 1990, 2009*). As we'll discuss, certain particularly hazardous combinations can result in hundreds of deaths per year for a single building.

Photos by Eddie Bartley

Causes of Collisions:

LOCATION/SETTING:

San Francisco is on the Oceanic Route of the Pacific Flyway. During migration, birds tend to follow rivers and the coastline. In this way migrants funnel southward together in the fall and disperse northward in the spring.

LEFT: According to the Golden Gate Audubon Society, over 250 species migrate through San Francisco Bay, many of them small songbirds such as warblers, thrushes, tanagers and sparrows that migrate at night and may be most susceptible to collisions with structures.

VISITING BIRDS:

Migrating birds are unfamiliar with the City and may be exhausted from their flight. Instances of collisions rise during the migratory seasons (*Hager et al. 2008*).

RIGHT: Millions of birds – more than 350 species - follow the Pacific Flyway. Of the two primary routes, the Oceanic Route passes through the Bay Area. Spring migration occurs between February through May, and fall migration begins in August and lasts through November. During this time, collisions with buildings can increase notably.

http://archives.microbeworld.org/images/news/west_nile/na_flyways.gif

LOCATION/SITING:

How a building meets adjacent landscape features can be critical in determining the risk to birds. Buildings with large windows located adjacent to extensive vegetation present great hazards. In suburban areas, buildings with these features have been documented to kill 30 birds per year (*Klem 1990; and O'Connell 2001*). This combination may be even more lethal in urban areas. Studies of Manhattan sites with these features have recorded well over 100 collisions per year (*Gelb and Delacretaz 2009*).

RIGHT MIDDLE: The Randall Museum in San Francisco features large windows adjacent to lush landscaping and is set within Corona Heights Park. These features can combine with deadly results for birds as has been documented elsewhere (see page 16).

http://www.examiner.com/parks-in-san-francisco/summertime-at- he-randall-museum

WEATHER CONDITIONS:

Inclement weather can obscure obstacles and exacerbate skyglow conditions (*Ogden 1996 and references therein*).

http://izismile.com/2009/09/30/beautiful_pictures_of_san_francisco_covered_wi h_fog_10_pics_1_video.html

AMOUNT OF GLASS:

Glass causes virtually all bird collisions with buildings. It's logical that as the amount of glazing increases on a building the threat also increases. A study in New York (*Klem et al, 2009*) found a 10% increase in the area of reflective and transparent glass on a building facade correlated with a 19-32% increase in the number of fatal collisions, in spring and fall, when visiting migrants are present.

Hand Print Rule: Small birds may try to fly through any spaces that are about the size of a child's handprint.

Exceptional Acrobats: Some birds such as the barn swallow pictured here can easily fly through spaces that are more narrow. This bird is traveling at 35 mph through a 2-inch seam.

http://zuzutop.com/2009/07/a job-for-superswallow/

GLAZING CHARACTERISTICS:

Reflective or transparent glass quality both present hazards to birds (*Gelb and Delacretaz 2009*).

LEFT: Reflections: A bird looking for a perch may mistake the reflected tree for an actual tree.

RIGHT: Transparent glass can be mistaken for a clear flightpath.

Photos Courtesy NY Audubon

TOP: Foundry Square presents a full façade of highly reflective glass. While all glass can be reflective, glass manufacturers label glass with standards “reflectivity” ratings.

BUILDING FEATURES:

Well-articulated buildings orient people as well as birds.

BUILDING HEIGHT & MASSING:

Typically, as building size increases, so usually does the amount of glass, making larger buildings more of a threat. It is generally felt that the lower stories of buildings are the most dangerous, because windows that are at canopy height are more likely to reflect trees and other landscape features that attract birds. This makes a long, low building more of a hazard than a tall one of equal interior square-footage. However, as monitoring programs access setbacks and roofs of tall buildings, they are finding that birds also collide with buildings at the higher floors at significant rates. This is an area where more information is needed.

DESIGN TRAPS:

Photo Courtesy NY Audubon

ABOVE LEFT: This café on Market Street uses a glass wind barrier lined with attractive flowers that may entice birds.

ABOVE RIGHT: This glass walkway allows for a clear sightline though the passage. Without treatment to the glazing, this can create a hazards for birds.

DESIGN TRAPS:

Windowed courtyards and open-topped atria can be bird death traps, especially if they are heavily planted. Birds fly down into such places, and then try to leave by flying directly towards reflections on the walls. Glass skywalks, 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.

LIGHTING:

While we typically think of birds as early risers, during migration season many species will travel at night. White lights, red lights, skyglow, brightly lit buildings and interiors can distort normal flight routes (*Poot et al. 2008*). The risks vary by species. Songbirds, in particular, seem to be guided by light and therefore appear more susceptible to collisions with lit structures. Migrant songbirds have been documented by multiple sources to suffer single night mortalities of hundreds of birds at a single location (*Ogden 1996 and references therein*).

Image courtesy Lights Out SF

ABOVE: Lighting & Navigation: Birds migrate by reading light from the moon and stars, as well as by geomagnetic signals radiated from earth. Cumulative light spillage from cities can create a glow that is bright enough to obscure the starlight needed for navigation. Current research indicates that red lights in particular may disrupt geomagnetic tracking. Red lights required for airline safety would be permitted (above image). Decorative red lighting, such as on the building below, would be discouraged.

LEFT: Beacon Effect: Individual structures may be lit in a manner that draws birds like a moth to a flame. Beacon structures can draw birds towards land that may offer little shelter or food or towards collisions with glass. Once at the structure, birds may be hesitant to leave the lit area causing them to circle the structure until exhaustion.

RIGHT: Skyglow can be increased during periods of inclement weather.

Image courtesy Lights Out SF

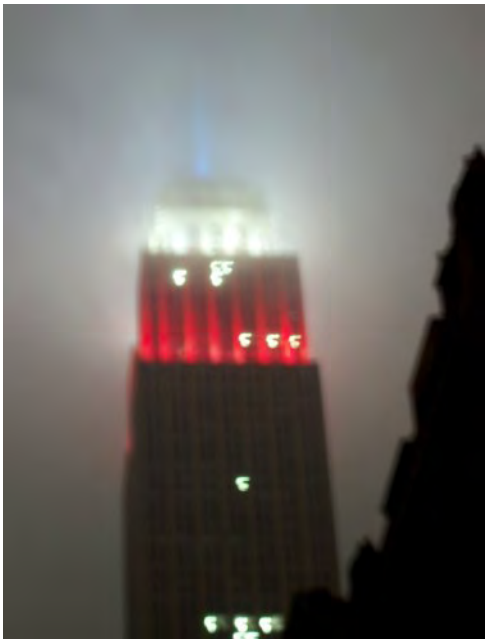


Image courtesy NY Audubon

Birds & Glass

Glass is everywhere, yet it is one of the least recognized, but most serious threats to birds; one that is increasing as humans continue to build within bird habitats across the planet. Clear glass is invisible to birds and to humans, but both can learn to recognize and avoid it. Unfortunately, most birds' first encounter with glass is fatal. They collide at full speed when they try to fly to sky, plants, or other objects seen through glass or reflected on its surface. Death is frequently not instantaneous, and may occur as a result of internal hemorrhage days after impact, far away from the original collision site, making monitoring the problem even more difficult. The two primary hazards of glass for birds are reflectivity and transparency.

REFLECTIVITY

Viewed from outside buildings, transparent glass often appears highly reflective. Almost every type of architectural glass under the right conditions reflects the sky, clouds, or nearby trees and vegetation. Glass which reflects the environment presents birds with the appearance of safe routes, shelter, and possibly food ahead. When birds try to fly to the reflected habitat, they hit the glass. Reflected vegetation is the most dangerous, but birds may also attempt to fly past reflected buildings or through reflected passageways.

TRANSPARENCY

During daylight hours, birds strike transparent windows as they attempt to access potential perches, plants, food or water sources and other lures seen through the glass. "Design traps" such as glass "skywalks" joining buildings, glass walls around planted atria and windows installed perpendicularly on building corners are dangerous because birds perceive an unobstructed route to the other side.

http://www.princeton.edu/pr/pictures/l-r/princeton_modern/

Photo by AnMarie Rodgers

Photo by Hendrik Dacquin

TOP RIGHT: Clouds and neighboring trees reflect in the glass curtain wall of Sherrerd Hall on the Princeton campus. Distinguishing real from reflection may be difficult.

MIDDLE RIGHT: A Market Street building with a transparent corner may lead birds to think the tree is reachable by flying through the glass.

BOTTOM RIGHT: A fatal bird-strike leaves behind a print of the bird's plumage as evidence of the force of the impact.

Birds & Lighting

LIGHT

At night artificial light degrades the quality of migratory corridors and adds new dangers to an already perilous journey. These conditions can be exacerbated by unfavorable weather and San Francisco fog. Flood lighting on tall buildings or intense uplights, emit light fields that entrap birds reluctant to fly from a lit area into a dark one. This type of lighting has resulted in mass mortalities of birds (*Ogden 1996 and references therein*).

Further, the lights impede birds' ability to see navigational markers in the stars and moon. Birds may cluster around such lights circling upward, increasing the likelihood of collisions with the structure or each other. Importantly, vital energy stores are consumed in nonproductive flight. (*Ogden 2006*)

Besides reducing adverse impacts on migrating birds, there are significant economic and human health incentives for curbing excessive building illumination. In June 2009, the American Medical Association declared light pollution a human health threat and developed a policy in support of control of light pollution.

Overly-lit buildings waste tremendous amounts of electricity, increasing greenhouse gas emissions and air pollution levels, and of course, wasting money. Researchers estimate that the United States alone wastes over one billion dollars in electrical costs annually because poorly designed or improperly installed outdoor fixtures allow much of the light to go up to the sky. "Light pollution" has negative aesthetic and cultural impact as well. Recent studies estimate that over two-thirds of the world's population can no longer see the Milky Way, a source of mystery and imagination for countless star-gazers over countless millennia. Together, the ecological, financial, and aesthetic/cultural impacts of excessive building lighting serve as compelling motivation to reduce and refine light usage (*Scriber 2008*).

Light at night, especially during bad weather, creates conditions that are particularly hazardous to night migrating birds. Typically flying at heights over 500 feet, migrants often descend to lower altitudes during inclement weather, where they may encounter artificial light from buildings. Water vapor in very humid air, fog or mist refracts light, greatly increasing the illuminated area around light sources. Birds circle in the illuminated zone, appearing disoriented and unwilling or unable to leave (*Ogden 2006*). They are likely to succumb to lethal collision 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 have received the most attention, mortality has also been associated with ground level lighting and with inclement weather.

Photo by AnMarie Rodgers

Hazards can combine in downtown San Francisco. In this photo beacon lighting, light spillage and fog mix.

BUT REALLY, DOES THIS MATTER IN URBAN SAN FRANCISCO?

Three decades into researching bird building collisions has both yielded many answers and opened many new questions. The high number of North American bird deaths and the ecological importance of birds demonstrate that the problem exists on a national level, but it is natural to wonder if the dense nature of San Francisco presents the same compelling pressure for a local response. The short answer is yes—San Francisco has both an important population of birds and a potentially injurious built environment for them. As discussed above, San Francisco is both home to many birds and is on a major migratory pathway. Locally, there are incidents of celebrated birds such as the Peregrine Falcon repeatedly losing their young due to collisions with downtown skyscrapers. While no rigorous studies have yet been done in San Francisco, anecdotally, local birders have monitored several buildings (including those with large glass facades situated within parks), and have noted significant numbers of bird injury and death (*Weeden, 2010*). In lieu of large-scale local monitoring programs, there are a great many studies of dense urban cities that we can draw upon.

Spotlight on a Local Celebrity

The Peregine Falcon population suffered a huge blow to their numbers due to the use of pesticides including DDT beginning in the 1950s. In 1970 the California Peregrine Falcon population was reduced to only two known breeding pairs. The Santa Cruz Predatory Bird Research Group (SCPBRG) participated in the reintroduction of the species and has monitored the Peregrine Falcons nesting in San Francisco and other sites.

Natural cliff dwellers the species adapted to nesting in bridges and downtown high-rises. As the population increased, Peregrine Falcons were reported in the San Francisco financial district and in 1987 a nest box was placed near a commonly used perch on the PG&E Headquarters Building. In 2003, Peregrine Falcons nested in the downtown for the first time and have been a closely watched since. SCPBRG trained citizens to participate in a group called "Fledge Watch" to increase understanding of how young falcons fare in the city. In 2009, 76 people volunteered for 5 hour shifts monitoring the 36-58 day old Peregrines from sunrise to sunset in either San Jose or San Francisco. The public could also view the falcons from the downtown building nest via a webcam.

According to Glenn Stewart of SCPBRG, "while there have been building collision fatalities, the target nest success of Peregrine Falcons in San Francisco was 1.5 per nest and has been exceeded at 1.6 young fledged per nest."

It appears that several weeks after fledging, urban Peregrine Falcons recognize glass as a barrier. In the first few weeks when the young are learning to fly they are most at risk for a collision. In other habitats, falcons face predators like eagles, owls, and when on the ground by bobcats, and coyotes. Peregrine Falcons see in the ultra violet (UV) range.

Photo by Glenn Newill

A native San Franciscan juvenile Peregrine Falcon (deceased offspring of "Dapper Dan" and "Diamond Lil") perched on sill near reflective glass. All three fledged young from that year died as a result of building collisions.

The architects and designers of the downtown environment did not consider bird building collision as a potential risk. In the future when buildings are being designed and upgraded, the latest information and options should be considered.

- Noreen Weeden, *Golden Gate Audubon Society*

Lessons from Major Cities

Bird-rescue organizations in Chicago, Toronto and New York City have documented thousands of structure collisions and come to some interesting conclusions.

Perhaps the most established monitoring program of bird-building collisions in a dense city is Project Safe Flight in Manhattan. Project Safe Flight has documented over 5400 collisions between 1997-2008. A recent study (*Gelb, Delacretaz 2009*) analyzed this data to determine the critical contributing factors for the structures with the largest number of bird fatalities.

- The study looked at the 10 most deadly collision sites and found the combination of open space, vegetation, and large windows (greater than 1 meter x 2 meter) to be more predictive of death than building height;
- The frequency of collisions is highest along facades that have lush exterior vegetation and either reflective or transparent windows;
- The majority of the collisions occurred during the daytime and involved migrant species;
- High-rise buildings and night lighting presented less risk than windows adjacent to open spaces one hectare or greater in size.
- The majority of collisions are likely due to high-collision sites that feature glass opposite exterior vegetation.
- Urban mortalities may be higher than previously thought. Non-urban studies estimated that high-collision sites would have about 30 collisions per year. At the Manhattan collision sites examined in this study, well over 100 collisions were recorded per year.

The most dangerous building in this study was not a high-rise, but instead was a 6-story office building adjacent to a densely vegetated open space.

Studies in Toronto and other eastern and Great Lakes cities have documented tens of thousands of bird fatalities attributable to building collisions. A 10-year study of bird-building collisions in downtown Toronto found over 21,000 dead and injured birds in the city's downtown core. A 25-year study by researchers from Chicago's Field Museum of Natural History documented a particularly problematic building in Chicago (McCormick Place Convention Center) with over 30,000 dead birds of 141 species. The lights at the McCormick Palace were left on at night until 2000. By simply turning out building lights the number of birds killed decreased by an impressive 80% (*Kousky 2004*).

Photos courtesy NY Audubon

ABOVE: The windows of Morgan Mall in Manhattan are adjacent to green landscaped open spaces.

RIGHT: Morgan mall causality.

Spotlight on San Francisco's Migrant Birds

Bird collisions with buildings occur year-round, but peak during the migration period in spring and especially in fall when millions of birds travel between breeding and wintering grounds. Migration is a complex phenomenon, and different species face different levels of hazards, depending on their migration strategy, immediate weather conditions, availability of food, and anthropogenic obstacles encountered en route.

Photo by Noreen Weeden

Nocturnal migrants: Many songbirds migrate at night, possibly to take advantage of cooler temperatures and less turbulent air, and because they need daylight to hunt insects for food. Generally, these birds migrate individually, not in flocks, flying spread out across most of their range. Migrants depart shortly after sundown. The number of birds in flight peaks before midnight, then drops. Songbirds may fly as many as 200 miles in a night, then stop to rest and feed for one to three days, but these patterns are strongly impacted by weather, especially wind and temperature. Birds may delay departure, waiting for good weather. They generally fly at an altitude of about 2,000 feet, but may descend or curtail flight altogether if they encounter a cold front, rain or fog. There can be a thousand-fold difference in the number of birds aloft from one night to the next. Concentrations of birds may develop in 'staging areas' where birds prepare to cross large barriers such as the Great Lakes or Gulf of Mexico.

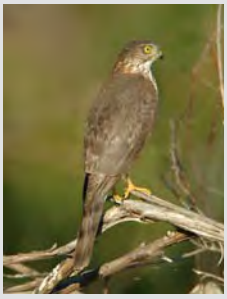


Photo by Eddie Barley

Diurnal migrants: Daytime migrants include raptors, which take advantage of air currents to reduce the energy needed for flight. Other diurnal migrants, including shorebirds and water-birds, often fly in flocks and their stopover sites are less dispersed because of their dependence on bodies of water. This means that day time migration routes often follow land forms such as rivers and mountain ranges, and birds tend to be concentrated along these routes or 'flyways'. Not all songbirds migrate at night--species such as robins, larks, kingbirds and others migrate during the day. Birds' daytime flight altitudes are generally lower than their nighttime counterparts.

Millions of birds, especially songbirds, are thus at risk, as they ascend and descend, flying through or stopping at or near populated areas. As city buildings grow in height, they become unseen obstacles by night and pose confusing reflections by day. Nocturnal migrants, after landing, make short, low flights near dawn, searching for feeding areas and running a gauntlet of glass in almost every habitat: in cities, suburbs and, increasingly, exurbs. When weather conditions cause night flyers to descend into the range of lighted structures, huge kills can occur around tall buildings. Urban sprawl is creating large areas lit all night that may be causing less obvious, more dispersed bird mortality.

- Christine Sheppard, *American Bird Conservancy*

San Francisco's Birds & The Pacific Flyway

Suburban studies do have something to offer. A study of collisions at a suburban office park found a large mortality rate for migrant birds even though the office park was not on the migratory route—suggesting that the combination of mirrored windows and vegetation was more of a collision risk to visiting birds (*O'Connell 2001*). This study also suggests that the location of the building relative to the flyway may be less important than other risk factors such as building design and siting relative to plantings and open space.

By flying at night, migrants like the Orange-Crowned Warbler (NEAR RIGHT) and Western Tanager (ABOVE LEFT) minimize predation, and avoid overheating that could result from the energy expended to fly such long distances. This also enables them to feed during the day and refuel for the night.

Daytime migrants like this Cooper's Hawk (FAR RIGHT) and the Sharp-shinned Hawk (ABOVE RIGHT) depend on the heating earth for added lift. Riding rising air currents called thermals, these birds take advantage of this lift to rise to the top of one thermal, set their wings in the direction they want to travel and then coast to the next thermal.

Photos by Eddie Barley

Spotlight on Building Height and Bird Migration

TALLEST: While birds' migratory paths vary, radar tracking has determined that approximately 98% of flying vertebrates (birds and bats) migrate at heights below 1640 feet during the spring, with 75% flying below that level in the fall. Today, many of the tallest buildings in the world reach or come close to the upper limits of bird migration. Storms or fog, which cause migrants to fly lower and can cause disorientation, can put countless birds at risk during a single evening.

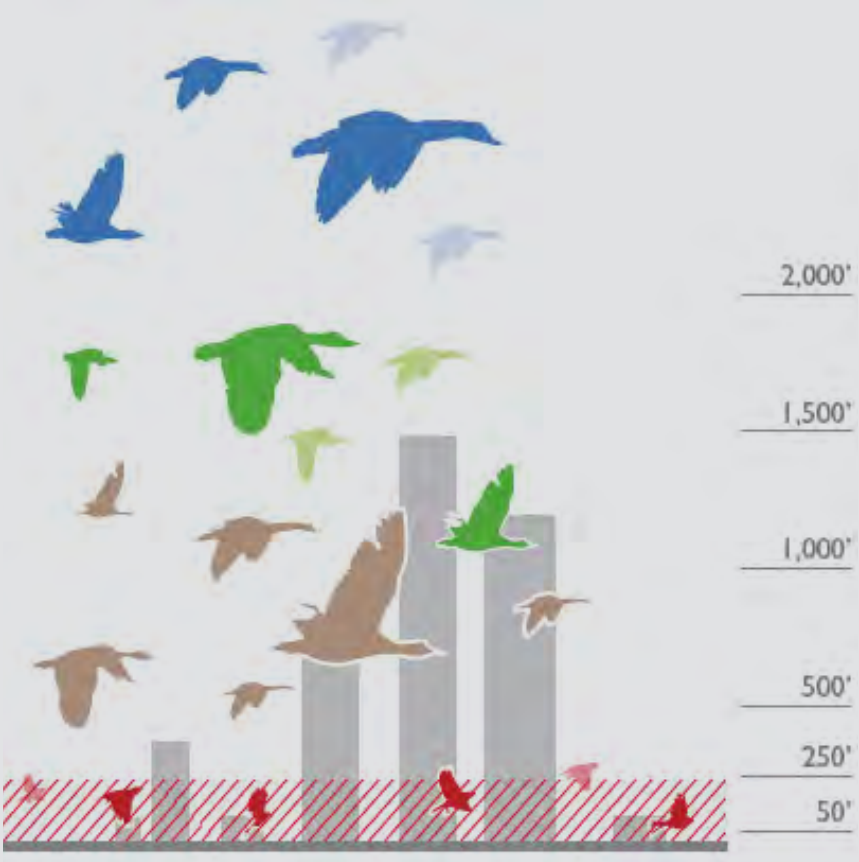
MODERATE HEIGHT: Migrating birds descend from migration heights in the early morning to rest and forage for food. Migrants also frequently fly short distances at lower elevations in the early morning to correct the path of their migration, placing moderate-height buildings of between 50-500 feet in the migratory path of birds and bats.

LOWER LEVELS: The most hazardous areas of all buildings, especially during the day and regardless of overall height, are the ground level and bottom few stories. Here, birds are most likely to fly into glazed facades that reflect surrounding vegetation, sky and other attractive features.

COLLISION ZONES:

UPPER LEVELS = Nocturnal migrants (mostly songbirds and migrating raptors) as well as local fledgling raptors

LOWER LEVELS = High collision zone for local birds and migrants searching for food or shelter



NY Bird-Safe Building Guidelines

II. The San Francisco Response

A SURVEY OF TREATMENTS FROM EASY TO INNOVATIVE

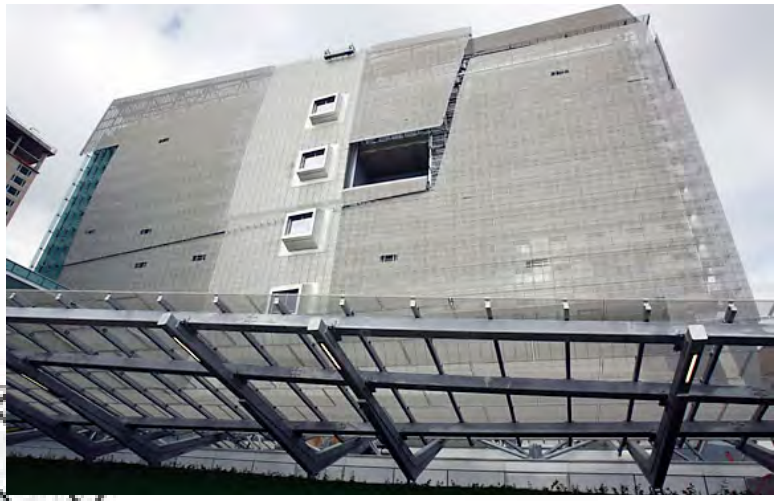
Effective, bird-safe building treatments exist and have been employed on buildings of significant architectural stature. San Francisco's new Federal Building is cited as an example of bird-safe building design in United States Representative Mike Quigley's (D-IL) pending bill (*House Bill No. 4797*). This bill, if adopted, would require federal buildings to incorporate bird-safe design principals.

Bird-safe design options are limited only by the imagination. Safe buildings may have large expanses of glass but use screens, latticework, grilles and other devices, both functional and decorative, outside the glass or integrated into the glass. There are treatments for existing glass that will reduce mortality to zero. These treatments do provide a view from inside, though often presenting a level of opacity from the outside, a factor that can deter application of these solutions. Glass treatments that can eliminate or greatly reduce bird mortality, while only minimally obscuring the glass itself, are therefore highly desirable and encourage more 'bird-friendly' design.

RIGHT: The south façade sports perforated steel panels that filter sunlight and serve as thermal buffers but also may convince birds that the structure is solid.

BOTTOM: San Francisco's Federal Building's north facade boasts floor-to-ceiling glass buffered behind a grid of metal catwalks and opaque glass fins.

Photos by Kurt Rodgers, SF Chronicle
http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2007/02/25/MNG2DOATDN1.DTL



Glass & Facade Treatments

Reduction of bird strikes with new buildings can be achieved with simple and cost-effective means. Creating a visual signal, or "visual noise barrier," that alerts the animals to the presence of glass objects can be achieved with relatively little additional cost. Fritting, the placement of ceramic lines or dots on glass, is one method of creating a noise barrier. People inside the building see through the pattern, which has little effect on the human-perceived transparency of the window. Fritting can also reduce air conditioning loads by lowering heat gain, while still allowing enough light transmission for day-lighting of the interior spaces. There is now a commercially available insulated glass with ultra-violet patterns that are designed to deter birds while largely imperceptible to humans.

FRITTED & FROSTED GLASS:

Ceramic dots, or frits, are applied between layers of insulated glass to reduce transmission of light. These can be applied in different colors and patterns and can commonly be seen on commercial buildings. At Swarthmore College, external, densely fritted glass was incorporated into the design of the Unified Science Center. Virtually no strikes have been reported at either site. Fritting is a commonly-used and inexpensive solution that is most successful when the frits are applied on the outside surface.

ANGLED GLASS:

Angled glass may be a useful strategy in special circumstances. In most situations, however, birds approach glass from many angles, and can see glass from many perspectives where angled glass may not be an effective strategy. While not effective for large buildings, where the desired 20-40 degree angle is difficult to maintain, this strategy may work in low-scaled buildings with a limited amount of glass (*Ogden 1996 and references therein; and Klem et al. 2004*).

NY Bird-Safe Design Guidelines

NY Bird-Safe Design Guidelines

LEFT: Swarthmore College uses fritting on a large expanse of glass facing an open space.

RIGHT: The Minnesota Central Library's atrium features angled glass, a dramatic architectural feature that reduces reflections of habitat and sky from most angles. The likelihood of fatal collisions at this angle is also greatly lessened.

ULTRA-VIOLET GLASS:

The Bronx Zoo uses glass that reflects UV light--primarily visible to birds, but not to people (*Klem 2009*). This glass may be about 50% more expensive than typical glass but is comparable to energy-efficient glass (Eisenberg 2010).

TOP RIGHT: The Bronx Zoo from the NYTimes.

http://www.nytimes.com/2010/08/29/business/29novel.html?ref=anne_eisenberg

FILM & ART TREATMENT OF GLASS:

Windows may be used as canvases to express building use through film and art. In certain instances, windows made bird-safe through an application of art may receive funding through San Francisco's One Percent for Public Art Program.

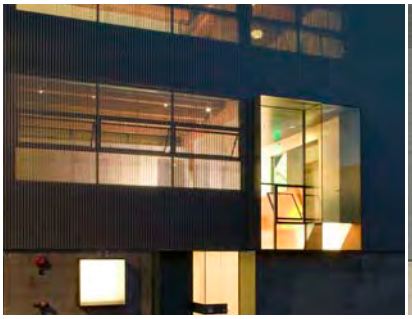
SECOND RIGHT: IIT Student Center, Chicago.

NY Bird-Safe Design Guidelines

SCREENS:

External screens are both inexpensive and effective. Screens can be added to individual windows for small-scale projects or can become a facade element of larger developments. This time-tested approach precludes collisions without completely obscuring vision. Before non-operable windows, screens were more prevalent. At the other end of the spectrum are solutions that wrap entire structures with lightweight netting or screens. To be effective, the netting must be several inches in front of the window, so birds don't hit the glass after hitting the net.

THIRD RIGHT: The Matarozzi/Pelsinger Building in San Francisco, is an Aidlin-Darling design LEED Gold building. It has screens over the majority of its facade that protect birds from impact and allow views out for users of the building (left nighttime/right daytime)



ARCHITECTURAL FEATURES:

Overhangs, louvers, and awnings can block the view of the glass from birds located above the feature but do not eliminate reflections. This approach should be combined with window treatments to achieve results.

BOTTOM RIGHT: Aqua Tower - Chicago uses overhangs and other features that provide bird-safe design.

Minnesota Bird-Safe Building Guidelines

Wind Generators

San Francisco has a policy to encourage the installation of on-site, renewable energy systems, such as small wind generators. There are two general types of wind generators available. One uses scoops or blades to spin on a vertical axis, shown at far left below. It is probable that birds would perceive this type as a solid barrier even when it's rotating.

The second design uses a propeller-like rotor to spin on a horizontal axis. This is a small-scale version of the most common generator used on large-scale wind farms throughout the world.

While it is unreasonable to believe that these small urban systems would cause the annihilation of birds such as the well-known disaster at Altamont, California (see discussion on adjacent page) a certain amount of caution is prudent in the absence of established scientific research. The Planning Department has exercised that caution primarily by allowing a more widespread installation of vertical axis machines, and limiting locations of horizontal axis, open-bladed generators to areas that would seem to be less densely populated by birds, especially migrants and juveniles.

The only clear way at present to learn whether small urban wind generators will harm birds is to allow the installation of a few, and to monitor the interactions with animals, if any. For this reason, all approvals for wind generators have conditions that require monitoring and reporting of bird and bat strikes. These reporting protocols are in accord with recommendations made by the Mayor's Task Force on Urban Wind.

To date, none of the approved windmills have submitted monitoring information to the Planning Department.

Grates and Drain Covers

Birds that survive window hits without suffering fractures or internal bleeding may live if they don't fall through drain grates and become trapped.

LEFT AND CENTER: Vertical axis wind generators may vary in appearance. Blades that present a solid appearance (such as the left image) are encouraged.

RIGHT: Horizontal Axis and vertical access wind generator that do not present a solid appearance are discouraged, especially adjacent to water or open space larger than 1 acre.

ABOVE: Grates on the ground should be smaller than 2 cm x 2 cm to prevent the trapping of stunned birds.

Golden Eagle photo by Eddie Bar ley.

Spotlight on the Altamont Windmills

Golden Eagles, named for the golden feathering at the nape of their necks, are majestic raptors that can be found throughout most of California and much of the northern hemisphere. California protects these magnificent raptors as both a species of special concern and a fully protected species, making it illegal to harm or kill them. Golden Eagles are protected under the Bald and Golden Eagle Protection Act. Golden Eagle are also protected under the Federal Migratory Bird Treaty Act, which forbids the killing (even unintentional killing) of any migratory bird.

Golden Eagles typically prefer open terrain, such as the rolling hills of eastern Alameda County. The open grasslands, scattered oaks, and bountiful prey make this area ideal habitat for Golden Eagles. Today, it supports the highest-known density of Golden Eagle nesting territories in the world.

Conservation Issues

Every year, an estimated 75 to 110 Golden Eagles are killed by the wind turbines in the Altamont Pass Wind Resource Area (APWRA). Some lose their wings, others are decapitated, and still others are cut in half. The lethal turbines have been reduced from 6,000 to less than 5000 which are still arrayed across 50,000 acres of rolling hills in northeastern Alameda and southeastern Contra Costa counties. The APWRA, built in the 1980s, was one of the first wind energy sites in the U.S. At the time, no one knew how deadly the turbines could be for birds. Few would now deny, however, that Altamont Pass is probably the worst site ever chosen for a wind energy project. According to a 2004 California Energy Commission (CEC) report, as many as 380 Burrowing Owls (also a state-designated species of special concern), 300 Red-tailed Hawks, and 333 American Kestrels are killed every year. The most recent study by Dr. Shawn Smallwood, a member of the Altamont Scientific Review Committee estimates that approximately 7,600-9,300 birds are killed here each year. (*Smallwood 2010*)

In 2004, Golden Gate Audubon joined four other Bay Area Audubon chapters (Marin Audubon, Santa Clara Valley Audubon, Mt. Diablo Audubon, and Ohlone Audubon) and Center for Biological Diversity and Californians for Renewable Energy (CARE) in challenging the renewal permits for this facility. The Audubon/CARE CEQA lawsuit settled, with terms requiring the wind companies to reduce avian mortality by 50% within 3 years and to complete a comprehensive conservation plan to govern operations in the Altamont.

Reducing the kill entirely may not be possible as long as the wind turbines continue to operate at Altamont. However, significant progress can be made. The CEC estimates that wind operators could reduce bird deaths by as much as 50 percent within three years–the goal stated in the settlement agreement–and by up to 85 percent within six years–all without reducing energy output significantly at APWRA. These reductions could be achieved by removing turbines that are the most deadly to birds and shutting down the turbines during four winter months when winds are the least productive for wind energy, combined with some additional measures. Anecdotal data indicate there may not be a substantial improvement for Golden Eagles and there may actually be much higher mortality for bats.

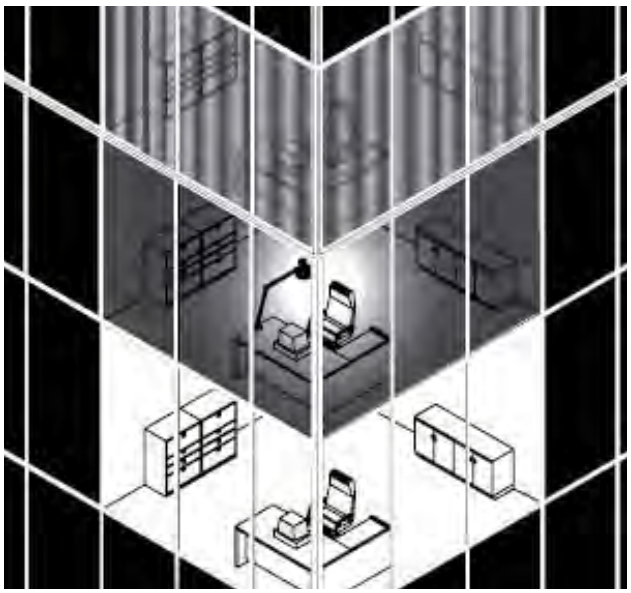
Golden Gate Audubon is working with Alameda County to ensure that the permits granted to the wind industry achieve reductions in bird mortality, in addition to other requirements that will help address the unacceptable bird kills at Altamont Pass over the long term. Pursuit of clean energy technology, when done correctly, can help reduce the risk of global warming and its impacts on wildlife.

Written by the Golden Gate Audubon Society.

Lighting Treatments

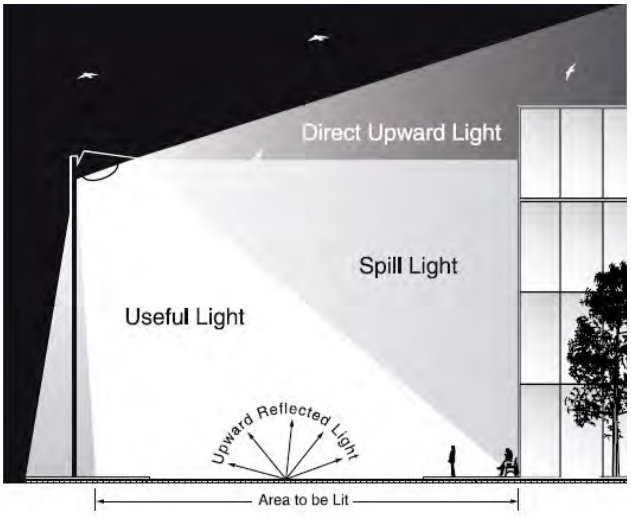
While glazing presents a significant hazard to birds, some birds are also harmed by light pollution. Night migrants depend on starlight for navigation, and brightly-lit buildings can draw them off course. Once within the aura of bright lights, they can become disoriented, and may collide with buildings, or may fly in circles around the light source, until they drop to the ground from exhaustion, having expended their limited energy reserves needed to complete their migration. Architects and building owners should collaborate to address the two key lighting issues: design and operation.

Eliminating unnecessary lighting is one of the easiest ways to reduce bird collisions, with the added advantage of saving energy and expense. As much as possible, lights should be controlled by motion sensors. Building operations can be managed to eliminate or reduce night lighting from activities near windows. Minimize perimeter and vanity lighting and consider filters or special bulbs to reduce red wavelengths where lighting is necessary. Strobe lighting is preferable to steady burning lights. Exterior light fixtures should be designed to minimize light escaping upwards. Motion detectors are thought to provide better security than steady burning lights, because lights turning on provide a signal, and because steady lights create predictable shadows.



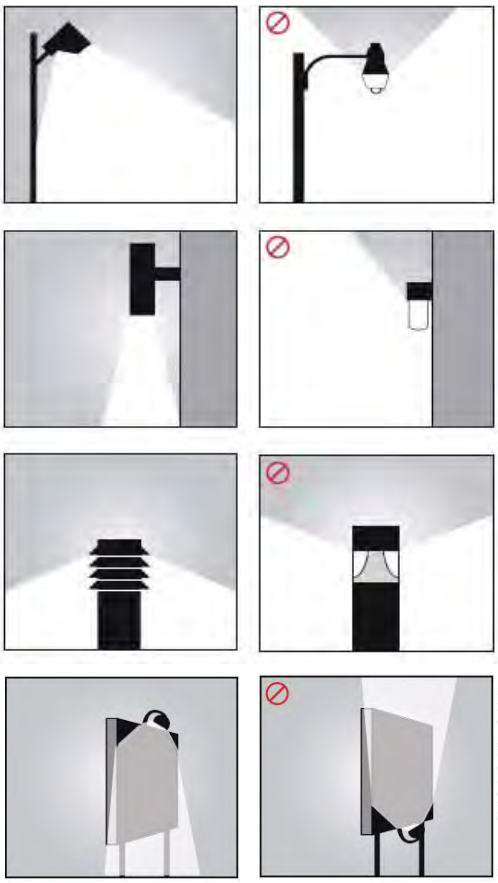
Minnesota Bird-Safe Building Guidelines

REDUCE: UNNECESSARY INTERIOR LIGHT



Minnesota Bird-Safe Building Guidelines

REDUCE: UNNECESSARY EXTERIOR LIGHT



Minnesota Bird-Safe Building Guidelines

PREFERRED DISCOURAGED

The Tribute of Lights / Copyright (c) 2010 John de Guzman: http://johndeguzman.com

LIGHTING DESIGN:

The built environment should be designed to minimize light pollution including: light trespass, over-illumination, glare, light clutter, and skyglow while using bird-friendly lighting colors when possible (*Poot et al. 2008*).

- → **Avoid uplighting**
- → **Avoid light spillage**
- → **Use green and blue lights when possible**

LIGHTING OPERATIONS:

While recent research suggests that nighttime collisions may be more limited in scope (*Gelb and Delacretaz 2009 and references therein*), these precautions may be recommended until this issue is better understood. Unneeded interior and exterior lighting should be turned off from dusk to dawn during migrations: February 15 through May 31 and August 15 through November 30. Rooms where interior lighting is used at night should have window coverings that adequately block light transmission, and motion sensors or controls to extinguish lights in unoccupied spaces. Event searchlights are strongly discouraged during these times.

Several cities, including San Francisco, have launched citywide efforts to reduce unneeded lighting during migration. In addition to saving birds, these “Lights Out” programs save a considerable amount of energy and reduce pollution by reducing carbon dioxide emissions. The savings for a building can be significant. One participating municipal building in the Toronto Lights Out program reported annual energy reductions worth more than $200,000 in 2006.

Lights Out requires that building owners, managers and tenants work together to ensure that all unnecessary lighting is turned off during Lights Out dates and times. Spring migration is February 15th through May 31st, and the fall migration is August 15th through November 30th. Turn off unnecessary lights after dusk and until dawn. If inside lights are needed, window coverings such as blinds or drapes should be closed.

LEFT: The white streaks are the time-exposed paths of birds attracted to, dazed by, and circling within the columns of light. Many succumbed to exhaustion and perished without completing their migration. LIGHTS OUT policies do not allow the use of searchlights during the Spring and Autumn migration periods for this reason.

BIRD-SAFE REQUIREMENTS & GUIDELINES ACROSS NORTH AMERICA

When discussing human-caused threats to birds, the US Fish and Wildlife Service reports "that the incidental, accidental or unintentional take of migratory birds is not permitted by the Service and is a criminal violation of the Migratory Bird Treaty Act" but that the Service first attempts to work with industries and individuals who unintentionally cause bird death before pursuing criminal prosecution (*US Fish and Wildlife Service 2002*).

Several major cities are addressing the issue through local legislation.

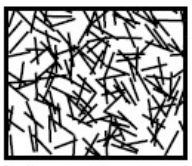
- **Chicago:** In July of 2008, Cook County, Illinois, which includes Chicago, passed an ordinance requiring that all new buildings and major renovations incorporate design elements to reduce the likelihood of bird collisions. This Ordinance established the Illinois county containing Chicago as the first major jurisdiction with a requirement for bird-safe elements.

- **Toronto:** This effort has evolved from voluntary ratings and incentive program to bird-friendly construction guidelines that became mandatory at the beginning of 2010. This year the bird-friendly guidelines became integrated into Toronto's local Green Development Standard, required for nearly all new construction. In addition, The City of Toronto offers an acknowledgement program to give incentive to developers and building owners and managers to implement the Bird-Friendly Development Guidelines. Once a development has been verified by City staff as "bird-friendly", the City provides the owner with an original print by a local artist and the building may be marketed as "bird-friendly". A bird-friendly designation could give these buildings a competitive advantage by identifying these features to an increasingly environmentally concerned and aware marketplace. Toronto also has had great success with their Lights Out program which has been in effect since 2006. (See images on page 31.)

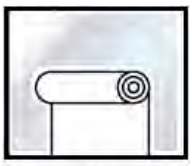
- **Minnesota:** As of 2009, the State of Minnesota requires that all state owned and leased buildings have their lights turned off at night during migration. Since 2006, the governor of Minnesota has issued an annual proclamation, declaring "Safe Passage" dates during spring and fall migration, when buildings managers are asked to turn off lights at night. Bird-safe building criteria are scheduled to be incorporated into the State of Minnesota Sustainable Building Guidelines (*B3-MSBG*) in 2010.

- **Nationally:** In 2010, Congressman Howard Quigley introduced a bill (*H.B. 4797*) into the U.S. Congress that, if passed, would mandate bird-friendly construction practices for federal buildings.

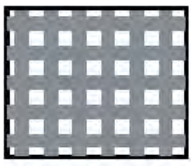
NY Bird-Safe Building Guidelines



Solution: Visual Noise



Solution: Use of plastic films, diachroic coatings and tints on facade



Solution: Screen / scrim / fritting

San Francisco's Bird-Safe Requirements & Guidelines

This document, if adopted, would recommend the following bird-safe measures for San Francisco:

NY Bird-Safe Building Guidelines

1 **REQUIREMENTS:**
Proposals to build structures which create or alterations which modify "the most hazardous conditions," as defined on the following pages, would be required to install bird-safe glazing treatments.

2 **EDUCATIONAL GUIDELINES:**
Since much is currently unknown about San Francisco's bird/building collisions, the City recommends educating building owners about potential risks, when buildings are constructed using a high percentage of glass.

3 **VOLUNTARY PROGRAMS AND ACKNOWLEDGEMENT:**
Buildings which avoid creating hazards or which treat potential hazards with bird-safe treatments, identified as effective in this booklet, would be eligible for voluntary recognition as a bird-safe building by the City and could be marketed as such.

1

REQUIREMENTS FOR HIGH-RISK STRUCTURES

San Francisco has yet to replicate detailed East Coast studies to determine if specific locations pose a greater risk to flying vertebrates due to the location of the building. However, it is clear from studies done elsewhere and from observations at two particularly problematic sites in San Francisco that certain building and landscape configurations can be especially dangerous. These sites present heightened risks for collisions and necessitate requirements.

Identifying "Bird Hazards"

The combination of characteristics that present the greatest risk to birds are called "bird-hazards" and include:

- Buildings located within or immediately adjacent to open spaces of more than 1 acre with lush landscaping (line *6 on page 33*), and with a facade of more than 35% glazing (lines *10 or 11 on page 33*); or
- Buildings located immediately adjacent to open water or on a pier (line *7 on page 33*), and with a facade of more than 35% glazing (lines *10 or 11 on page 24*); or
- Buildings with "bird-traps" as defined in the citywide bird-safe checklist (lines *21-25 on page 33*).

When Bird-Safe Treatments are Required:

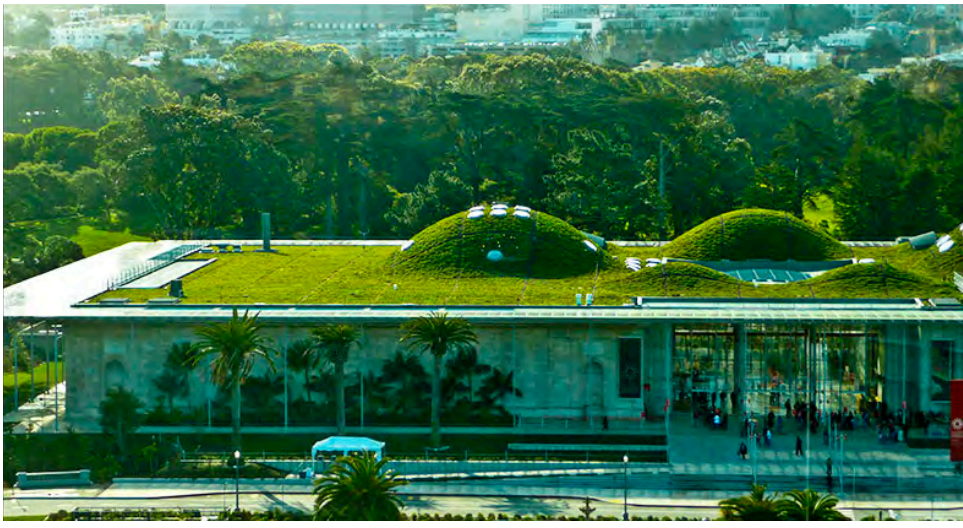
Buildings that create a "bird-hazard," as defined above, will be required to provide Bird-Safe Building treatments for the façade(s) facing the open space or water in the following circumstances:

- The creation of any new condition that creates a new bird hazard as defined above; or
- The replacement of glazing on an existing bird-hazard as defined above.

ABOVE: Rescued thrush resting safely in the hand of a Chicago Bird Collision Monitor volunteer.

Photo: Willowbrook Wildlife Center http://www.chicagoaudubon.org/imgcas/21-02/rescued hrush jpg)

RIGHT: Under these controls, the Academy of Sciences would be required to use bird-safe features when the glazing is due for replacement.



http://forums.steves-digicams.com/attachments/architectural-photos/135534d1238294806-greenist-building-san-francisco-grass-roof-green jpg

Required Treatments to Address a Bird-Hazard:

The following treatments are all required for "bird-hazards":

- Glazing treatments: Fritting, permanent stencils, frosted glass, exterior screens, physical grids placed on the exterior of glazing or UV patterns visible to birds, is required so that the amount of untreated glazing is reduced to less than 35% of the facade facing the landscaping or water (lines 6 or 7 on page 33) for 100% of a bird trap (as defined in lines *21-25 on page 33*). Vertical elements of the pattern shall be at least 1/4" wide at a maximum spacing of 4 inches, and horizontal elements at least 1/8" wide at a maximum spacing of 2 inches (*Klem 2009*). Equivalent treatments recommended by a qualified biologist may be used if approved by the Zoning Administrator. No glazing shall have a "Reflectivity Out" coefficient exceeding 30%; and

- Lighting Design: Minimal lighting (limited to pedestrian safety needs) shall be used. Lighting shall be shielded. No uplighting or red lighting should be used; and

- Wind Generators: The site must not feature horizontal access windmills or vertical access wind generators that do not appear solid.

Encouraged Treatments to Address a Bird-Hazard:

The following treatments are encouraged for "bird-hazards":

- Other window treatments: latticework, grilles and other devices, both functional and decorative, outside the glass or integrated into the glass spacing requirements;

- Lighting Operation: no event searchlights should be permitted for the property.

2

EDUCATIONAL GUIDELINES & TENANT INFORMATION

Owners of new buildings and buildings proposing major renovations with a facade of greater than 35% glass would be required to evaluate their building against the Citywide Bird-Safe Design Checklist and agree to provide future tenants with a copy of this guide. While corrective action would not be required because the potential hazards of these situations is not well understood, building owners and architects would become more aware of potential hazards and treatments. By agreeing to help educate future tenants, the people of San Francisco would also become better educated about potential risks.

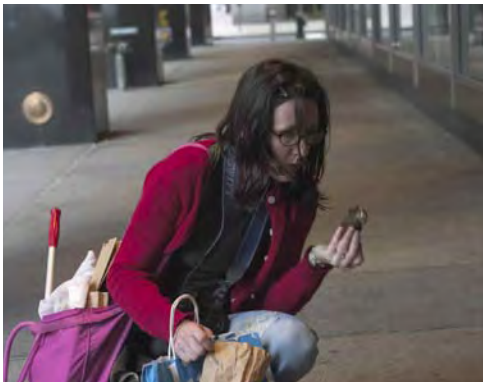


Photo courtesy NY Audubon

A volunteer examining a window casualty.

3

VOLUNTARY PROGRAMS & ACKNOWLEDGEMENT

Bird-Safe Building Certification & Acknowledgement:

Buildings which avoid creating hazards or which treat potential hazards with bird-safe treatments identified as effective in this booklet would be acknowledged by the City and could be marketed as such. This document proposes three levels of certification be offered by the City.

Bird-Safe Building:
The building meets the minimum qualifications for bird-safety. This level focuses on ensuring that "bird hazards" and "bird traps" are not created or are remedied with bird-safe treatments; providing bird-safe lighting design; and educating future building occupants.

Bird-Safe Select Buildings:
The building meets all of the minimum requirements while reducing the total glazing (regardless of treatment); treating at least 95% of the lowest 40' (the bird-collision zone) with bird-safe glazing treatments; and committing to "lights out" practices during the migratory seasons.

Sterling Bird-Safe Buildings:
This is the highest level of Bird-Safe building certification possible. These buildings have reduced glazing quantities greatly while applying bird-safe treatments to nearly all glass surfaces (5% untreated would be permitted).

Lights Out San Francisco:

The Golden Gate Audubon Society, Pacific Gas and Electric Company and the San Francisco Department of the Environment administer "Lights Out for Birds – San Francisco." This voluntary program helps building owners, managers and tenants save energy and money while protecting migratory birds. Lights Out for Birds asks participants to turn off building lights during the bird migration (February through May and August though November each year).

"Participants in the Lights Out for Birds program can save natural resources, money, and birds by turning off lighting after dusk each evening and leaving lights off until dawn," said Mike Lynes, Conservation Director for Golden Gate Audubon. "Over 250 species of birds migrate through San Francisco in the spring and fall, and many that migrate at night can become confused by the City's lights and collide with tall buildings and towers. The Lights Out for Birds program can reduce bird deaths while cutting energy costs and saving participants thousands of dollars each year."

The North American Bird Conservation Initiative—a joint effort of federal agencies and non-profit conservation organizations—released the "2009 State of the Birds" in which it reported that the majority of migratory birds in North America are suffering significant population declines due to human-induced causes, including habitat loss and collisions. Effective Lights Out programs can help stem these population declines.

Participants in the Lights Out for Birds program also gain significant financial benefits. Building operators and tenants have reported significant savings on energy bills as a result of participation—one business in Toronto reported a savings of $200,000 in 2006. This year Mayor Gavin

Newsom announced energy efficient retrofit funding for 2,000 small to mid-sized businesses and 500 homes. By installing timers or motion detectors and turning off unnecessary lights, building owners and operators can significantly reduce their energy bill. Reduced energy consumption decreases overall greenhouse gas emissions, which is essential in the effort to combat climate change.

San Francisco was one of the first cities to implement a Lights Out program in 2008. Now over 21 cities in the US and Canada have a Lights Out program. Conservationists hope that the program extends to every major city in North America, to save birds, energy and money.

Building owners, managers and tenants interested in an energy evaluation and current rebates should contact the San Francisco Department of the Environment or a PG&E representative. For more information on how to participate in the program and to learn about local bird populations and how to help, contact the Golden Gate Audubon Society at (510) 843-6551.

PARTICIPANTS IN SAN FRANCISCO LIGHTS OUT:

- 101 California Street
- Allsteel Inc.
- Barker Pacific Group, Inc.
- New Resource Bank
- Pacific Gas & Electric Company
- San Francisco Department of the Environment
- Tishman Speyer

Photos by Dick Hemingway via WWF-Canada

Toronto's established Lights Out Program creates a dramatic change in the skyline appearance. As San Francisco's program spreads we should be able to see seasonal changes as our skyline lights up in non-migratory months and dims down during migration.

San Francisco
Bird-Safe Building Checklist

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 facade with greater than 35% glazing (line 10 or 11) with a high-risk location (line 6 or 7), glazing treatments will be required for the façade(s) such that the amount of untreated glazing is reduced to less than 35% for the facade facing the landscaping or water. If a project creates a new bird-trap (lines 21-25) or remodels an existing bird-trap (lines 21-25), bird-safe glazing will be required on the bird-hazard.

2 EDUCATIONAL GUIDELINES AND TENANT EDUCATION AGREEMENT: Owners of new buildings and buildings proposing major renovations with a facade of greater than 35% glass (lines 10 or 11) would be required to evaluate their building against the this checklist and agree to 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.

3 VOLUNTARY RATINGS: Project sponsors interested in submitting a project for "bird-safe" certification may use this form. Yellow boxes indicate minimum treatments to be certified as a "bird-safe" building. Structures which meet all of the minimum (yellow) requirements and at least the green shaded boxes for glazing conditions will qualify as a "San Francisco Bird-Safe Select Building". Structures which meet all of the minimum requirements and meet the blue shaded boxes for glazing conditions and other building elements will qualify for certification at the highest level, "San Francisco Sterling Bird-Safe Building".

LEGEND:

Potential Risk Factors: This shades indicate factors that may present hazards to birds. Note: actual risks vary greatly depending on 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.

Bird-Safe Building Certification & Acknowledgement: Buildings which avoid creating hazards or which treat potential hazards with bird-safe treatments identified as effective in this booklet would be acknowledged by the City and could be marketed as such. This document proposes three levels of certification by the City.

Bird-Safe Building: The building meets the minimum conditions for bird-safety. This level focuses on ensuring that "bird hazards" and "bird traps" are not created or are remedied with bird-safe treatments; providing bird-safe lighting design; and educating future building occupants.

Bird-Safe Select Buildings: The building meets all of the minimum requirements while reducing the total glazing (regardless of treatment); treating at least 95% of the lowest 40' of the building (the bird-collision zone) with bird-safe glazing treatments; and committing to "lights out" practices during the migratory seasons.

Sterling Bird-Safe Buildings: This is the highest level of Bird-Safe building certification possible. These buildings have reduced glazing quantities greatly while applying bird-safe treatments to nearly all glass surfaces (5% untreated would be permitted).

Bird-Safe Building Checklist

		QUESTION		YES	NO
LOCATION (SETTING) (PAGE 8,9)	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 within a dense urban context with reduced sky visibility?** (Adjacent to buildings greater than 200)			
	4	**Is the structure location in a fog-prone area?** (Within 1/2 mile from the ocean or bay)			
LOCATION (SITING) (PAGES 9, 16)	5	**Is the structure located such that large windows greater than (1 meter by 2 meters) will be opposite of, or will reflect interlocking tree canopies?**			
	6	**Is the structure within or immediately adjacent (not separated by roadways or other buildings) to open space larger than 1 acre?** (Requires treatment of glazing, see page 29)			
	7	**Is the structure located on or immediately adjacent (not separated by roadways or other buildings) to water, waterfeatures or wetlands?** (Requires treatment of glazing, see page 29			
GLAZING QUANTITY (PAGE 10, 13)	8	**Is the overall quantity of glazing as a percentage of facade:** (Risk increases with amount of glazing)	**Less than 20%?**		
	9		**Between 20% - 35%?**		
	10		**Between 35 - 50%?** (Requires completion of this checklist AND distribution of this guide to future tenants)		
	11		**More than 50%?** (Requires completion of this checklist AND distribution of this guide to future tenants)		
GLAZING QUALITY (PAGE 10, 13)	12	**Is the quality of the glass best described as:**	**Transparent** (If so, remove indoor bird-attractions visible from outside the windows)		
	13		**Reflective** (If so, keep below 30% reflective and consider what will reflect in the windows)		
	14		**Mirrored** (Prohibited.)		
GLAZING TREATMENTS (PAGE 20-21)	15	**Is the building's glass treated with bird-safe "visual noise" treatments, including but not limited to, fritting, frosting, film, UV patterns, art or other methods for all identified "bird hazards" (lines 6 or 7) and "bird traps" (lines 21- 25)?**			
	16	**Is the building's glass treated for specific "bird hazards" and for at least 95% of the collision zone (from the ground floor to 40 feet) but not for the entire building?**			
	17	**Is at least 95% of the facade treated for bird-safe applications (in addition to lines 15 and 16)?**			
BUILDING FACADE GENERAL (PAGE 6, 11)	18	**Is the building facade well-articulated (as opposed to flat in appearance)?**			
	19	**Is the building's fenestration broken with mullions or other treatments?**			
	20	**Does the building use unbroken glass at lower levels?**			
BUILDING FACADE SPECIFIC BIRD TRAPS (PAGE 11)	21	**Does the structure contain a known "bird-trap" such as:**	**A glass courtyard?** (Prohibited unless the glazing is treated with bird-safe applications.)		
	22		**Transparent building corners?** (Prohibited unless the glazing is treated with bird-safe applications.)		
	23		**A glazed passageway and/or sight lines through the building broken by glazing?** (Prohibited unless the glazing is treated with bird-safe applications.)		
	24		**Clear glazed railings, or bus shelters?** (Prohibited unless the glazing is treated with bird-safe applications.)		
	25		**Clear-glass walls, greenhouse or other clear barriers on rooftops or balconies?** (Prohibited unless the glazing is treated with bird-safe applications.)		
LIGHTING DESIGN (PAGE 14-15, 24-25)	26	**Does the structure, signage or landscaping feature uplighting?**			
	27	**Does the structure use interior "lights-out" motion sensors?**			
	28	**Does the structure minimize light spillage and maximize light shielding?**			
	30	**Is night lighting minimized to levels needed for security?**			
	31	**Does the structure use red-colored lighting?**			
LIGHTING OPERATIONS (PAGE 12, 24-25)	32	**Will the building participate in San Francisco Lights Out during the migration seasons?** February 15- May 31 and August 15- November 30			
OTHER BUILDING ELEMENTS (PAGE 22)	33	**Does the structure feature rooftop antennae or guy wires?**			
	34	**Does the structure feature a horizontal access wind generator?**			
	35	**Does the structure feature a solid-appearing vertical access wind generator?**			
CONSENT (PAGE 35)	36	**Does the building owner agree to distribute San Francisco's Bird-Safe Building Standards to future tenants?**			

III. The Future

INTEGRATION OF LEED STANDARDS & BIRD-SAFE DESIGN

In recent decades growing concern for the environment has stimulated the development of 'green' standards and rating systems. The most widely known is the Green Building Council's Leadership in Energy and Environmental Design or LEED. LEED has encouraged a trend towards use of glass, for natural lighting and for landscaping to manage water runoff while preserving or enhancing local habitat. Ironically, this juxtaposition of providing food and habitat near glass is inadvertently increasing the number of sites with high rates of collisions (*Klem, 1989*). The Green Building Council has recognized the problem and their Resource Guide calls attention to it, along with practices already covered by LEED that can be used to reduce negative impacts on birds.

Projects seeking LEED certification can earn innovation credits for demonstrating "quantifiable environmental benefits not specifically addressed by current LEED Rating Systems". The American Bird Conservancy and Bird-safe Glass Foundation have taken on the challenge of creating an outline for a 'bird-friendly' innovation credit. While progress has been made in quantifying the potential of different materials for deterring collisions, quickly quantifying the risk factors associated with a particular site are more difficult, as they range from shrubs planted next to a building, to migration routes to local populations of endangered species.

SAN FRANCISCO BIRD/BUILDING COLLISION MONITORING

Project Safe Flight in Manhattan has collected and documented over 4,000 dead and injured birds since 1997. In 2009 the Chicago Bird Collision monitors recovered more than 6,000 dead or injured migratory birds from more than 100 different species. In Toronto, Fatal Light Awareness Program (FLAP) volunteers patrol Toronto's downtown core in the early morning hours rescuing live birds and collecting the dead ones since 1993. This summer the Oregon Zoo funded a six-week sunrise study of Portland's newest and tallest buildings where volunteers collected dead and injured birds.

Photo by Eddie Barkey

A 2008 San Francisco pilot study discovered a Green Heron in the Downtown area. Further monitoring may revel other unexpected neotropical migrants passing through the dense core.

San Francisco does not currently benefit from any large bird/building monitoring group. Regular monitoring of the hazard in San Francisco is desperately needed to help in the evaluation and refinement of appropriate controls. Collaborations between building owners and bird-research groups should be encouraged to help increase our understanding of San Francisco's unique conditions.

While this document recommends establishing bird-safe building standards for what appears to be the most hazardous urban situations, little is actually known about San Francisco's bird-strikes. With the publication of this report, the City calls for local research to increase our understanding.

BUILDING TENANT EDUCATION

Building owners can help make their buildings safer by evaluating the risks of their buildings and retrofitting buildings with known hazards. Engaging in conservation measures outlined in this guide and granting access to collision monitoring groups help to address the issue and increase our understanding. Many factors that establish the safety of a building are beyond the control of designers and even of building owners. Interior furnishings, plantings, and the use of shades and blinds as well as lighting conservation are often managed by building tenants.

Some of the most effective treatments for making buildings bird-safe are those that require the cooperation of building owners and tenants. For this reason, the City should continue to use and should expand a "carrot"-based system to widely encourage participation in bird-safe efforts. San Francisco's existing Lights Out Program seeks to educate residents and provide recognition of voluntary bird-safe measures. Since 2008, the City has urged building owners and managers to turn off unnecessary interior and exterior lights. Twenty-two of the City's forty-four tallest buildings have been asked to participate.

To raise bird-awareness of building occupants, building owners may supply tenants with copies of this booklet. Building occupants can help make buildings bird-safe through the following good practices:

- → Unneeded interior and exterior lighting shall be turned off from dusk to dawn from February 15 through May 31 AND August 15 through November 30. Rooms where interior lighting is used at night should have window coverings closed to block light transmission adequately.
- → Interior plants should be moved so as not to be visible from the outside.
- → Consider daytime cleaning to reduce bird mortality and light pollution while increasing energy conservation.

Greater Scaup

Photo by Robert Lewis

Western Sandpiper

Photo by Robert Lewis

From City of Toronto Green Development Standard: "Bird-Friendly Development Guidelines."

Some of the birds killed by building collisions and collected during one migration season in Toronto's Financial District.

"A vast and growing amount of evidence supports the interpretation that, except for habitat destruction, collisions with clear and reflective sheet glass and plastic cause the deaths of more birds than any other human-related avian mortality factor. From published estimates, an upper level of 1 billion annual kills in the U.S. alone is likely conservative; the worldwide toll is expected to be billions.

Birds in general act as if sheet glass and plastic in the form of windows and noise barriers are invisible to them. Casualties die from head trauma after leaving a perch from as little as one meter away in an attempt to reach habitat seen through, or reflected in, clear and tinted panes... Glass is an indiscriminate killer, taking the fittest individuals of species of special concern as well as the common and abundant."

~ DANIEL KLEM, JR.
Leading researcher of bird/building collisions as presented at Fourth International Partners in Flight Conference, 2008.

Photo by Glenn Nevill

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