City of Mississauga

Green Development Standard

Mid-Rise and High-Rise Multi-Unit Residential Development Guidebook Tier 1 Mandatory Metrics

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Land Acknowledgement

We acknowledge the lands which constitute the present-day City of Mississauga as being part of the Treaty and Traditional Territory of the Mississaugas of the Credit First Nation, The Haudenosaunee Confederacy, and The Huron-Wendat and Wyandot Nations. We recognize these peoples and their ancestors as peoples who inhabited these lands since time immemorial. The City of Mississauga is home to many global Indigenous Peoples.

As a municipality, the City of Mississauga is actively working towards Reconciliation by confronting our past and our present, providing space for Indigenous peoples within their territory, to recognize and uphold their Treaty Rights and to support Indigenous peoples. We formally recognize the Anishinaabe origins of our name and continue to make Mississauga a safe space for all Indigenous peoples.

Prepared for:

City of Mississauga

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Abbreviations

ADC: Alternative daily cover

BEAM: Building Emissions Accounting for Materials

BECxA: Building Enclosure Commissioning Agent

BOD: Basis of Design

BOP: Builder Option Package

CAGBC: Canadian Green Building Council

CHBA: Canadian Homebuilder's Association

CO2e: Carbon Dioxide Equivalent

CSA: Canadian Standards Association

EA: Energy Advisor

EV: Electric Vehicle

EVSE: Electric Vehicle Supply Equipment

EVEMS: Electric Vehicle Energy Management Systems

FLAP: Fatal Light Awareness Program

GDS: Green Development Standard

GHG: Greenhouse Gas

GHGI: Greenhouse Gas Intensity

ICI: Institutional, Commercial and Industrial

LCA: Life Cycle Assessment

LEED: Leadership in Energy and Environmental Design

LID: Low Impact Development

MCE2: Material Carbon Emissions Estimation

MEP: Mechanical, Electricity, and Plumbing

MFA: Modelled Floor Area

MURB: Multi-Unit Residential Building

NECB: National Energy Code of Canada

NIBS: National Institute of Building Sciences

NRCan: Natural Resources Canada

OBC: Ontario Building Code

OESC: Ontario Electrical Safety Code

OPR: Owner's Project Requirements

Pa: Pascal

PAM: Pre-Application Meeting

PV: Photovoltaic

TEDI: Thermal Energy Demand Intensity

TEUI: Total Energy Use Intensity

Guidebook Purpose

This Mid-Rise and High-Rise Multi-Unit Residential Guidebook provides details on the performance measures, submission and documentation requirements, specifications and applicable site exclusions, and resources to assist applicants in completing their Green Development Standard (GDS) submission. The requirements presented in this Guidebook are applicable to mid-rise and high-rise multi-unit residential development with a height equal to or greater than 5 storeys. Applicants are required to complete the Developer Checklist using the information provided in this Guidebook.

Mississauga's GDS has been designed as three tiers of performance across five themes: energy and building performance, resilience, climate change, ecology, and natural systems.

- Tier 1 Mandatory Metrics provide the minimum criteria needed to be met across all themes and measures for the project submission. The subsequent tiers include increased performance criteria, all of which need to be achieved to meet the next tier. The performance and submission requirements for each mandatory metric are provided in the Mandatory Metrics Section of this Guidebook.
- Tier 2 and Tier 3 High-Performance Metrics provide additional criteria across all themes and measures. The performance and submission requirements for each high-performance metric are provided in the accompanying High-Performance Metrics Guidebook.

Green Development Standard Scope

The GDS applies to all new residential and non-residential development subject to the City's Site Plan Control By-law (0293-2006), which is designed to review the location and function of buildings and structures and maintain City standards. Table 1 provides a summary of the City's GDS scope.

Table 1. Mississauga's Green Development Standard scope.

	GDS SCOPE
Applicability	As all lands in the city are designated as a Site Plan Control Area (per the City's Official Plan 19-9), the GDS applies to all new development subject to the Site Plan Control By-law (0293-2006).
Exemptions	The following classes of development are not required to submit a GDS application; however, applicants are encouraged to implement relevant sections of the GDS where possible: • Residential buildings with less than 10 residential units. • Limited Site Plans for site alterations, ground-based units, and telecommunications towers; • Renovations and expansions to existing buildings; • Applicant's that already have an approved Site Plan Application and/or active Site Plan Application submitted prior to March 1, 2025; and • City of Mississauga corporate buildings, as the City has a separate Corporate Green Building Standard.

	GDS SCOPE

Building archetypes	Building archetypes align with the City of Mississauga's Official Plan classification and generally to the Ontario Building Code classifications:
	• **Multi-unit residential:**
	  • **Low-rise residential buildings** include multi-unit residential buildings less than four storeys with 10 or more residential units.
	  • **Mid-rise to high-rise residential buildings** include multi-unit residential buildings greater than five storeys.
	• **Non-residential buildings:**
	  • **Institutional buildings** include education buildings, nursing homes, retirement homes, care facilities, health care facilities, etc.
	  • **Commercial buildings** include retail, restaurant, grocery, automotive, repair services, office, hotels and lodging, entertainment, etc.
	  • **Industrial buildings** include warehouses, distribution centres, research and development facilities, truck and distribution terminals, etc.

Requirements	Mississauga's GDS is a three tiered system: • Tier 1 Mandatory Performance Requirements : Mar 1 2025 - Dec 31 2027 • Tier 2 Performance Requirements : Jan 1 2028 -Dec 31 2029 • Tier 3 Performance Requirements : Jan 1 2030
Financial incentives	The City of Mississauga is exploring financial incentives for the Tier 2 and Tier 3 voluntary high-performance metrics.

Application Process

The Green Development Standard (GDS) is integrated into the City's existing Site Plan Approval Application process managed by the City's Planning Building Department - Development and Design Division. The GDS submission materials and supporting documentation will be submitted utilizing ePlans and form a part of a complete application. Table 2 outlines the Site Plan Application process and GDS submission requirements during each phase of the application.

Table 2. Green Development Standard submission steps through the Site Plan Application process

STEP	PURPOSE	OUTCOME
Pre-Application Meeting Request	Applicants submit Pre-Application Meeting request via ePlans.	Detailed pre-screen review of Pre-Application Meeting request is completed. Pre-application meeting scheduled (PAM).
Pre-Application Meeting (PAM)	GDS checklist identified as a submission requirement. Applicants are advised of the GDS requirements relevant to their development application.	Submission requirements checklist for complete application identified and provided to applicant.

STEP	PURPOSE	OUTCOME
Revisions (External)	Applicant revises application based on feedback and submission requirements identified through PAM.	Applicant prepares GDS Checklist, plans/drawings, commitment letters and component studies to verify compliance with GDS.
Pre-Submission Work and Application Submission	Applicant uploads complete Site Plan Application including GDS checklist and supporting documents via ePlans.	Complete Site Plan Application is circulated for internal review.
Circulation/ Technical Review (Internal)	City staff review submitted plans/drawings and component studies to verify compliance with GDS.	Application review is completed within 30 calendar days of ePlans submission. Project Status Report including application compliance to GDS and any outstanding documents or unmet metric targets provided by the City to the applicant.
Resubmission	Applicant resubmits application to address all outstanding comments associated with GDS requirements and compliance.	This step repeats until all outstanding comments on the Site Plan Application have been addressed. Application review is completed within 20 calendar days of ePlans submission.
Site Plan Application Approval	Applicants demonstrate compliance with GDS requirements in the Site Plan Application submission.	Site Plan approval issued for development demonstrating compliance to GDS requirements.

Mandatory Metrics

Theme 1: Energy and Building Performance

EB1: ENERGY PERFORMANCE

The Energy Performance requirements are designed to ensure that new mid-rise and high-rise residential buildings are designed to reduce GHG emissions and enhance resilience. This objective is achieved through the following three performance targets:

- TEDI is a measure of the annual heating load per floor area of a building measured in kWh/m2/year, as such, a lower TEDI improves the building's resilience and energy performance.
- TEUI is the annual amount of energy used per floor area of a building measured in kWh/m^2/year. Similar to TEDI, TEUI can be optimized using both design and technology.
- GHGI is the total GHG emissions associated with the use of all energy utilities on site, measured in kg CO2e/m^2/year. A net-zero building for all building archetypes has a GHGI equivalent to 0 kg CO2e/m^2/year, whereas a net-zero-ready building has a GHGI equivalent to 5 kg CO2e/m^2/year. It differs from TEUI and TEDI as it converts the building's energy use into GHG emissions using an equivalent emissions factor for the energy sources used in the building. As a measure of the performance of different fuel types, GHGI can be decreased by prioritizing low-carbon fuel and energy sources, such as for an all electric building.

The performance requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 3.

Table 3. EB1: Energy Performance requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
EB1: ENERGY PERFORMANCE	GHGI: 15 kg $CO_2e/m^2/yr$ TEUI: 135 kWh/m^2 TEDI: 50 kWh/m^2	Design Development Stage **Energy Modeling Report**.

Submission Specifications

1. All new buildings must complete and submit an Energy Modeling Report. Follow the Energy and Emissions Requirements for each building type outlined in the Energy Modeling Report Terms of Reference and submit completed Design Development Stage Energy Modeling Report.
2. Acceptable software for whole-building energy modeling include: EQuest v. 3.64 or higher, Energy Plus, and IES Virtual Environment, and for Tier 3 projects, Passive House Planning Package (PHPP).

3. At the approval of the City of Mississauga, applicants may pursue alternative compliance options. These include the CAGBC Zero Carbon Building Standard version 2 or later or Passive House Standard certification. If pursued, the Zero Carbon Building Standard and Passive House Certification align with the performance criteria for EB2: Air Tightness Testing, and CI1: Embodied Carbon.

    a. If pursuing, provide proof of registration in the CAGBC Zero Carbon Building (ZCB) Standard or Passive House Standard. Final verification must include either the ZCB design certification and a complete ZCB workbook or a copy of the Passive House Design Documentation Review Report and a Design Stage Assurance Letter and a copy of the final certification to the City once available for either program.

Resources

- BC Energy Step Code: Design Guide (2019)—Design and performance strategies for achieving TEDI, TEUI, and GHGI targets.
- Canadian Association of Consulting Energy Advisors—A list of Energy Advisors familiar with GDS Energy Modeling Reports.
- City of Toronto: Energy Efficiency Report Submission and Modeling Guidelines (2022)—Energy Modeling Report guidelines for TGS V4.
- LEED ID+C: Commercial Interiors, Minimum Energy Performance (V4)—Examples of compliance pathways and building and system requirements.
- National Energy Code of Canada for Buildings (NECB)—Overview of the National Energy Code of Canada for Buildings.

Theme 2: Climate Impact

CI1: EMBODIED CARBON

The Embodied Carbon requirements are designed to measure the energy and carbon associated with the materials, manufacturing, and other processes throughout the building's life cycles. There are three life cycle stages for measuring embodied carbon:

- **Upfront carbon (life cycle stages A1–A5):** Product stage (raw material supply, transport, manufacturing) and construction process stage (transport and construction–installation process).
- **Use-stage embodied carbon (life cycle stages B1–B5):** Use, maintenance, repair, refurbishment, and replacement stages.
- **End-of-life carbon (life cycle stages C1–C4):** Deconstruction/demolition, transport, waste processing, and disposal stages.

The performance requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 4.

Table 4. CI1: Embodied Carbon requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
CI1: EMBODIED CARBON	Conduct an Upfront Embodied Emissions Assessment (LCA) for A1–A5 life- cycle stage emissions in accordance with CAGBC Zero Carbon Building Standard.	Applicants are only required to report on A1–A5 life-cycle stages. The LCA could be combined with the Energy Modeling Report, EB1 metric. Complete the CAGBC Zero Carbon Building Embodied Carbon Reporting Template (V3 or later). Include the LCA software used, the input assumptions, and the preliminary assessment results identifying the changes made to minimize embodied carbon impact and further reductions.

Submission Specifications

1. Acceptable methods include the CAGBC Zero Carbon Building Standard and CAGBC Zero Carbon Building Embodied Carbon Reporting Template (V3 or later).
2. Acceptable software include One Click LCA , Athena Impact Estimator, and TallyLCA.
3. Follow the National Research Council's National Guidelines for Whole-Building Life Cycle Assessment's Appendix A to calculate gross floor area.
4. Calculate the total embodied carbon in kilograms of carbon dioxide equivalent (kg CO2e) and express the building average in kg CO_2/m^2 for the cradle-to-substantial-completion (upfront emissions) life-cycle stages (A1–A5) and complete a contribution analysis by building assembly or material type.
    a. The following materials and features must be included: envelope and structural elements, including footings and foundations, complete structural wall assemblies (from cladding to interior finishes, including basement), structural floors and ceilings (not including surface finishes like paint and stain), party walls, roof assemblies, and parking structures.
    b. The following materials and features can be excluded: fixtures and appliances; mechanical, electrical, and plumbing (MEP) materials; paints and surface finishes; millwork and trim; stairs; cabinetry; decks; driveways; site development; and works (i.e., excavation).
    c. Existing structures reused as part of a renovation/rehabilitation and/or salvaged material incorporated into the project can count as embodied emissions of zero.
5. The baseline and proposed buildings must be of comparable size, function, orientation, and operating energy performance.
    a. The baseline assumptions must be based on standard design and material selections for the location and building type.
    b. The service life must be a minimum of 60 years for both buildings to account for maintenance and replacement.
    c. The same life-cycle assessment software tools and data sets (compliant with ISO-14044) must be used to evaluate the baseline building and the proposed building and report all listed impact categories.

6. Calculate embodied carbon by each housing typology and provide the total amount for all combined housing typologies in the development site using a weighted average calculated by gross floor area of the entire site.

Resources

- CAGBC Zero Carbon Building Standard and CAGBC Zero Carbon Building Embodied Carbon Reporting Template (V3 or later)—Methodology to calculate and track embodied carbon for all buildings.
- CAGBC Embodied Carbon: A Primer for Buildings in Canada (2021)—Policy primer for understanding embodied carbon in Canada.
- City of Toronto: Policy Primer for Regulating Embodied Emissions in Buildings (2022)—Policy primer for setting embodied carbon caps in buildings.
- ISO 14044: Environmental Management, Life Cycle Assessment Requirements, and Guidelines —Compliance standards for data sets for baseline and proposed buildings.
- National Research Council's National Guidelines for Whole-Building Life Cycle Assessment's Appendix A—Required methodology to calculate gross floor area.

Theme 3: Resilience

R1: EMISSIONS FREE ENERGY AND STORAGE

The Emissions Free Energy and Storage requirements are complementary features that support developers in achieving the EB1: Energy Performance requirements, and reduce the development's reliance on grid electricity during peak times. The performance requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 5.

Table 5. R1: Emissions Free Energy and Storage requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
R1: EMISSIONS FREE ENERGY AND STORAGE	Provide a minimum of 5% of building's annual energy consumption from one or a combination of acceptable renewable energy sources.	**Letter of Commitment**: Quantify percentage of energy consumption from one or combination of renewable energy sources. Design Development Stage **Energy Modeling Report**. Building elevations and floor plans: Modifications to enable renewable energy systems and storage.

Submission Specifications

1. Annual energy consumption percentages can be achieved using one or a combination of the following acceptable renewable energy sources:
    - **a.** Solar photovoltaic (PV)
    - **b.** Solar thermal
    - **c.** Biogas and biofuel systems

   d. Battery storage

   e. Wind systems

   f. Geo-exchange

   g. District Energy System

   h. Innovative Energy System or Technology (subject to city approval)

2. A third-party whole-building energy modeling tool should be used to demonstrate energy savings and energy performance.
3. Annual energy consumption percentages can be achieved based on consumption of the entire site and not on a unit-by-unit basis.
4. If the site is located within an area with high thermal energy density adjacent to a district energy system that is targeting new or future connections, the project must demonstrate one of the following requirements: plan to connect to an existing district energy system, be district-energy ready, and demonstrate less GHG emissions in the proposed design than in the district-connected reference case.

Resources

- NRCan Solar-Ready Guidelines for Domestic Hot Water and Photovoltaic Systems—Design and technical specifications for installing solar photovoltaic systems.
- Canadian Home Builders' Association: Net Zero Home Labelling Program (MURB)—Program for Net-Zero-Energy-Ready and Net-Zero-Energy MURBs integrated mechanical system technologies, design, and practices.
- City of Mississauga: District Energy in the Downtown, Feasibility Study—Study to consider the feasibility of a low-carbon District Energy System in the City of Mississauga's Downtown.

R2: REFUGE SPACE AND BACK-UP POWER GENERATION

The Refuge Space and Back-Up Power Generation requirements are designed to enhance building resilience by ensuring the of social, economic, and environmental systems are designed to withstand the impacts of climate change and extreme weather, and respond to these events in ways that maintain their essential function. In addition, the inclusion of a Resilience Planning Checklist identifies resilient design features that protect occupants while reducing the economic burden associated with rebuilding and recovering after these events. The performance and submission requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 6.

Table 6. R2: Refuge Space and Back-Up Power Generation requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
R2: REFUGE SPACE AND BACK-UP POWER GENERATION	Submit **Resilience Planning Checklist**. Provide a refuge area with heating, cooling, lighting, potable water, and power. Provide 24 hours of back-up power.	**Resilience Planning Checklist**. Floor plan: Identify location and size of communal indoor amenity areas or large lobbies that could adequately serve as refuge areas. **Letter of Commitment**: Identify the back-up power and thermal energy to a central refuge area and to essential building systems.

Submission Specifications

1. Submit a completed Resilience Planning Checklist identifying additional features used in the building design to withstand the impacts of climate change and extreme weather.
2. Refuge Area: minimum size should be 93 m^2 (1000 ft^2). Refuge areas must be designed with heating, cooling, lighting, potable water, and power. They may be designed to function as a building amenity during normal operations.
3. The following guidelines and recommendations for accessibility, location, and essential features should be considered in the design of refuge areas:
    a. Accessibility: Refuge areas should be accessible to all occupants and should comply with applicable accessibility codes and standards to ensure equal access for everyone.
    b. Location: Refuge areas should be located on above-grade floors away from hazards, providing a secure location until occupants can safely evacuate or receive assistance. A clear, well-lit passage must be provided to all refuge areas.
    c. Essential features: Refuge areas should be equipped with essential features such as ventilation, communication systems, emergency lighting, fire protection equipment, and emergency supplies.
4. Provide back-up power and thermal energy to a central refuge area and to essential building systems including security systems, domestic water pumps, sump pumps, one elevator, boilers, and hot water pumps. Non-fossil-fuel sources are preferred; however, both combustion-based or battery-based systems are permitted.

Resources

- LEED BD+C: New Construction, Design for Enhanced Resilience (v4)—Design recommendations for resilient buildings to withstand natural disasters and weather events.
- City of Vancouver's Resilient Neighbourhoods Toolkit—Resilience planning checklist for neighbourhoods.
- City of Toronto: Minimum Back-up Power Guidelines for MURBs (2016)—Guidelines to help improve resilience to area-wide power outages in multi-unit residential buildings.
- City of Vancouver: Resilient City (2019)—City-wide strategy that takes a comprehensive approach to addressing shocks, such as earthquakes, and stresses, such as aging infrastructure.

Theme 4: Ecology

E1: BIRD FRIENDLY GLAZING AND DESIGN

The Bird Friendly Glazing and Design requirements are designed to reduce bird collisions with buildings by using design features that have been scientifically proven to prevent or reduce risks to birds in the built environment. Mississauga's bird-friendly design measures align with the recommendations identified in the Canadian Standards Association (CSA) A460: 19: Bird-Friendly Building Design. The performance and submission requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 7.

Table 7. E1: Bird Friendly Glazing and Design requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
E1: BIRD FRIENDLY GLAZING AND DESIGN	Align bird-friendly designs with Canadian Standards Association A460: 19: Bird-Friendly Design standards for treatment of glazing materials. Treat a minimum of 90% of exterior building glazing 16 meters above grade. Visual markers with maximum spacing of 50 mm x 50 mm with a minimum 6 mm in diameter.	Building elevations, floor plan, landscape plan and roof plan (green roofs), indicating: • For bird-friendly design: treatment area and material legend showing type, density, and colour of visual markers. • For rooftop vegetation: treated area, type of treatment, surface, density, and colour of visual markers. • For ground-level ventilation grates: location of ground-level exhaust and ventilation systems with grate porosity.

Submission Specifications

1. Reference the CSA A460:19 Bird-Friendly Design Standards (2019 or later) to design treatment of glazing materials, building integrated permanent structures, and overall building and site design.
2. Use a combination of the following strategies to treat a minimum of 90% of all exterior glazing within the first 16 m of the building above grade or to the height of the mature tree canopy, whichever is greater:
    a. Apply visual markers to the first surface of glass with a maximum spacing of 50 mm x 50 mm and with a minimum 6 mm in diameter. Visual markers must have a strong contrast under a wide range of daylight conditions. Non-linear pattern options and duotones are acceptable. Patterns that are too dense will minimize or eliminate the effectiveness of the markers.
    b. Mute reflections on glass surfaces with permanently fixed building-integrated structures, including opaque awnings, sunshades, exterior screens, shutters, grilles, and overhangs or balconies that provide shading below a projection (assume a 1:1 ratio of treatment below a projection).
    c. Use non-reflective glass including acid etch, full cover ceramic frit, or texture.
3. Implement visual markers in the following areas:
    a. Balcony railings and fly-through conditions and
    b. Elevations facing natural areas, parks, and other open space areas.
4. For rooftop vegetation features, treat the first 4 m of glazing above the feature and a buffer width of at least 2.5 m on either side of the feature using strategies from Bird-Friendly Glazing.
5. Ensure ground-level ventilation grates have a porosity of less than 20 mm X 20 mm.

Resources

- Canadian Standards Association CSA A460:19 Bird-Friendly Design Standards (2019)—Required standards for treatment of glazing materials, building integrated permanent structures, and overall building and site design.
- City of Toronto Bird-Friendly Design Guidelines (2016)—Design guidelines from the City of Toronto.
- LEED BD + C: New Construction, Bird Collision Deterrence Credit—Design guidelines from LEED.
- Bird-Safe Canada and Fatal Light Awareness Program: Bird-Safe Design and Standards (2021)—Design guidelines from FLAP.
- City of Ottawa: Bird-Safe Design Guidelines (2021)—Design guidelines from the City of Ottawa.
- American Bird Conservancy: Guidelines to Reduce Bird Collisions with Buildings—Downloadable resources for architects and designers to minimize bird collisions in building design.

E2: EXTERIOR LIGHTING

The Exterior Lighting requirements are designed to minimize glare and reduce light trespass and skyglow, and reduce impacts on nocturnal animals through the use of the International DarkSky Association's Fixture Seal of Approval. Additional non-mandatory practices to manage exterior lighting and protect the night environment include using motion-sensor-controlled lighting and turning off non-essential exterior lighting between 10:00 p.m. and 6:00 a.m. The performance and submission requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 8.

Table 8. E2: Exterior Lighting requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
E2: EXTERIOR LIGHTING	All exterior fixtures must be Dark Sky Compliant and all rooftop and exterior facade architectural illumination must be directed downward.	Engineer certified lighting plan to identify: • Location of all exterior lighting and illumination direction; • DarkSky compliance of all exterior lighting.

Submission Specifications

1. All exterior fixtures must be DarkSky Compliant, a third-party certification for lighting to minimize glare, reduce light trespass, and reduce light pollution.
2. All rooftop and exterior facade architectural illumination must be directed downward (no up-lighting).
3. When possible, the use of continuous green, blue, and white light should be avoided to reduce impacts on nocturnal migrating birds.

4. Applicants are encouraged to install motion-sensor activated lighting and to dim rooftop and exterior facade architectural illumination between 10:00 p.m. and 6:00 a.m.
5. Developments can apply for the following exemptions:
    a. If a DarkSky Fixture Seal of Approval is not available, fixtures must be full-cutoff (e.g. dark sky, all light is down, and comply with the glare requirement between 80° and 90°) and with a colour temperature rating of 3000 K or less.
    b. DarkSky Compliant does not apply to exterior lighting that is required by NAV Canada and traffic control lighting.
    c. Architectural illumination, including uplighting and event lighting, may be permitted through a heritage designation provided lighting is turned off year-round between 10 p.m. and 6 a.m.

Resources

- City of Toronto Best Practices for Effective Lighting (2017)—City of Toronto guidelines for CPTED.
- The Royal Astronomical Society of Canada: Canadian Guidelines for Outdoor Lighting (2020) —Canadian guidelines for outdoor lighting.
- International DarkSky Association, Fixture Seal of Approval—Provides DarkSky Compliant resources, retailers, and database.

Theme 5: Natural Systems

NS1: HEAT ISLAND EFFECT

The Heat Island Effect requirements are designed to reduce heat island effect through a combination of the following strategies:

- **Solar Reflectance Index (SRI):** Indicator of a surface's ability to return solar energy to the atmosphere—materials with a higher SRI value reduce the surface temperature.
- **Permeable paving and landscaping:** Improves stormwater management and reduce surface temperature by allowing for more evapotranspiration.
- **Tree shading and shading from architectural structures:** Reduces surface and air temperatures by providing shading to reduce the peak summer temperatures.

The performance and submission requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 9.

Table 9. NS1: Heat Island Effect requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
NS1: HEAT ISLAND EFFECT	Use combination of the following strategies to treat at least 75% of the site's (non-roof) hardscape: • High-albedo paving materials. • Open grid pavement and/or permeable surfaces. • Shade from existing or new tree canopy. • Shade from energy generation structures.	**Site Statistics Template** indicating the percentage of urban-heat island-treated areas to total non-roof hardscape area. Materials list includes SRI of high-albedo paving. Landscape plan indicating location of treated hardscape and soft landscaping.

Submission Specifications

1. Non-roof hardscape includes driveways, walkways, courtyards, surface parking areas, artificial turf, and other on-site hard surfaces.
2. Use one or a combination of the following strategies to treat the site's non-roof hardscape:
    a. High-albedo paving materials with an initial solar reflectance of at least 0.33 or an SRI of 29.
    b. Permeable open-grid pavement with a minimum of 50% perviousness.
    c. Tree shading from existing tree canopy or new tree canopy within 10 years of landscape installation, completed using a shade study.[1]
    d. Shading from architectural structures that are vegetated or have high reflectivity (initial solar reflectance of at least 0.33 at installation or an SRI of 29).
    e. Shading from structures with energy generation systems consisting of solar photovoltaics or solar thermal collectors that provide shade.
3. Using the Site Statistics Template, calculate the area in metres squared that is treated by each strategy and determine the percentage of urban-heat-island-treated areas to total non-roof hardscape area.
4. Other design considerations:
    a. Shade cast by buildings is not considered an eligible heat island strategy.
    b. Open-grid pavement consists of concrete or hard plastic grid systems with large pore spaces filled with a planted growing medium or light-coloured aggregate.
    c. Wherever possible, use high-albedo, low-carbon concrete mixtures with a minimum of 25% supplementary cementitious material (SCM) and biobased materials for decorative stonework, retaining walls, walkways, or other landscape or architectural elements.

Resources

- City of Toronto: Design Guidelines for Greening Surface Parking Lots—Strategies and measures for developers, designers, and reviewers of surface parking lots.

[1] Note: For surface parking areas, projects may plant one tree per five parking spaces distributed within or along the border of the parking area. This method can be used in lieu of completing a shade study.

- LEED ND and BD+C: New Construction, Heat Island Reduction (V4)—Requirements for non-roof and roof surfaces.
- Green Infrastructure Ontario—Resources for infrastructure planning and policy development to enhance green infrastructure.
- Toronto and Region Conservation Authority: Sustainable Technologies Evaluation Program (STEP)—Resources for implementing technologies that protect water resources and reduce our carbon footprint.

NS2: TREE GROWTH

The Tree Growth requirements are designed to achieve the following objectives:

- Reduce urban-heat island effect and provide protection during heatwaves;
- Incorporate drought-tolerant and climate-resilient species that can withstand the impacts of climate change;
- Provide habitat and food sources for native insects, birds, and other wildlife; and
- Promote healthy tree growth by providing adequate soil volumes that support tree growth and structure, nutrient and water absorption, and promote stable root systems.

The performance and submission requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 10.

Table 10. NS2: Tree Growth requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
NS2: TREE GROWTH	Plant 'shade trees' 6-8 m (20- 27 ft.) apart along the street frontages, and should be drought tolerant and non-invasive. Provide adequate rooting space to support tree health and growth, through the minimum soil volume of 30m^3 for each new tree.	Landscape plan indicating location of all new tree plantings and a species list. **Soil Volume Breakdown Template**.

Submission Specifications

1. Refer to the City of Mississauga's Terms of Reference Arborists Reports, Tree Inventory/ Survey & Tree Preservation Plans for guidance on arborists reports, tree inventory, and tree preservation guidelines.
2. A completed Soil Volume Breakdown Template must be submitted indicating the soil depth used to calculate soil volume. Root ball may be factored into soil volume calculation. Provide a minimally compacted topsoil layer/upper horizon.
    a. Ensure each separate new or retained tree planting area has access to a minimum volume of 30 m^3 of soil.[2]
    b. Plant large-growing shade trees with appropriate spacing that accommodates the minimum volume requirement of 30 m^3 per tree and the mature trunk and root flare growth of each tree.

[2] If minimum soil volume requirements cannot be met due to site restrictions,a Qualified Professional must identify the minimum soil volume that will support the species' root growth and structure, nutrient and water absorption, and ensure structural stability. All soil volumes must be approved by the City of Mississauga staff.

c. A minimum depth of 0.9 m, maximum depth of 1.6 m and minimum width of 2.0 m. shall be used to calculate the soil volume provided. Root ball may be factored into soil volume calculation.

4. Species must comply with the NS3: Climate-Resilient Landscape requirements.

Resources

- City of Mississauga: Arborist Report, Tree Inventory/Survey, and Tree Preservation Terms of Reference —Required reference materials.
- City of Mississauga: Tree Planting Continuous Soil Trench (02950-17)—City of Mississauga guide for tree planting.
- City of Toronto: Continuous Soil Trench With Soil Cells Drawings and Green Infrastructure Drawings—Sample guidelines for soil cells.
- Trees Ontario—Resource for tree planting and conservation techniques and native tree species and drought-tolerant species lists.

NS3: CLIMATE-RESILIENT LANDSCAPES

The Climate-Resilient Landscapes requirements are designed to each the following objectives:

- Adapt to local climate conditions by incorporating native plant species and drought-tolerant plant species;
- Support biodiversity by providing habitat and food for pollinators, wildlife, and birds; and
- Reduce future landscape maintenance requirements.

The performance requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 11.

Table 11. NS3: Climate-Resilient Landscapes requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
NS3:CLIMATE-RESILIENT LANDSCAPES	In all landscaped areas, including green roofs, plant a minimum of 50% native plants and comply with Ontario Invasive Plant Council Guidelines, including: • Minimum of 2 native flowering species to provide continuous bloom throughout the growing season to support pollinators. • Preference for drought tolerant native species. For vegetated buffer areas, adjacent Significant Natural Features, plant 100% native plants.	Landscape plan indicating: • Location and percentage of native plantings. • Plant list including information about common name, scientific name, size, quantity, stock type, native or non-native, drought-tolerance, and pollinator-friendly species. • Irrigation requirements. • Compliance with Ontario Invasive Plant Council Guidelines. Natural heritage restoration plan and/or enhancement plan identifying natural heritage restoration, design specifications, and ecological restoration.

Submission Specifications

1. Landscape plans must include the location and percentage of all native plantings, and a plant list including information about the common name, scientific name, size, quantity, stock type, native or non-native, and pollinator-friendly species.
2. Native plant species are plants that are indigenous to Southern Ontario, are adapted to the local conditions, and occur naturally within the region. Native planting requirements apply to trees, shrubs, and herbaceous plants.
3. Preference for drought-tolerant native species. If potable water is used for irrigation, all native and non-native plants must be drought tolerant.
4. Comply with the Ontario Invasive Plant Council Guidelines by avoiding the use of all invasive species in the landscape design. Invasive species are species that reproduce aggressively and become established in a natural area by displacing native species.
5. Pollinator plants should provide continuous bloom throughout the growing season to support pollinators. These can be maintained by an irrigation system to provide supplemental watering and should include a maintenance plan for year-round support of native pollinators.
6. Non-potable irrigation is preferred to support plantings and may include potable water supplies to make up irrigation sources for non-potable systems during drought conditions. The irrigation requirements must be completed by a Water Smart Irrigation Professional.
7. For specific sites abutting Natural Heritage Features, provide a Natural Heritage Restoration and/or Enhancement Plan with the proposed location(s) of the natural heritage restoration as well as the design specifications and the ecological function.

Resources

- City of Mississauga: Natural Heritage and Urban Forestry Strategy —Resource for planning and management of Mississauga's Natural Heritage System.
- City of Toronto: Pollinator Protection Strategy—Guiding principles and priorities to protect pollinator communities.
- City of Toronto: Pollinators Resources—Resources for pollinator-friendly gardens, native flowers, trees, and shrubs.
- Credit Valley Conservation: Native Plants for Pollinators Guide (2017)—Planting guidelines to support pollinators.
- Credit Valley Conservation: Plant Selection Guideline - Species List for Planing within the Credit River Watershed—Planting guidelines for the Credit River Watershed.
- Conservation Halton: Native Species List—Native planting guidelines.
- Ontario Invasive Plant Council—Resource and guidelines for planting native species and managing invasive species.
- Ontario Native Plants—Resources for native plants, design guidelines, and native flora.
- Pollinator Partnership Canada—Resources for pollinator-friendly habitats.
- Toronto and Region Conservation Authority: Flora Species Native to the TRCA Jurisdiction (2022)—Resources native species.

NS4: SUSTAINABLE ROOFS

The Sustainable Roofs requirements are designed to improve climate resilience, stormwater management, biodiversity, and occupant comfort. These objectives can be achieved using the following sustainable roof features:

- **Green Roof:** Designed with a root repellent system, a drainage system, a filtering layer, a growing medium, and plants. Green roofs are typically installed on flat roofs; however, sloped roofs can accommodate them with additional considerations. There are two types of green roofs:
- **Cool Roofs:** Designed to lower surface temperatures and minimize radiant heat transfer to the building and outdoor spaces.
- **Blue Roofs:** Designed to temporarily retain rainwater on the rooftop and release it slowly into the stormwater system to reduce flood risk and contribute to water conservation by allowing capture of rainwater for non-potable applications. There are four types of blue roofs: integrated design, modular tray design, roof dams and roof checks, and actively controlled systems.

The performance and submission requirements summary for mid-rise and high-rise multi-unit residential buildings are provided in Table 12.

Table 12. NS4: Sustainable Roofs requirements for mid-rise and high-rise multi-unit residential development.

METRIC	TIER 1 MANDATORY REQUIREMENTS	SUBMISSION REQUIREMENTS
NS4: SUSTAINABLE ROOFS	Buildings with an available roof area larger than 500m^2 must include one or a combination of green roof, cool roof, blue roof and/or solar PV: • Green roof and/or blue roof for at least 50% of Available Roof Space. • Cool roof installed for 100% of Available Roof Space. • Use a combination of a green, blue, cool roof or solar PV for at least 75% of Available Roof Space.	On floor and roof plans indicate green roof, cool roof, and/or blue roof locations identified on elevations and roof plan. • Notations include green roof, blue roof, and/or solar PV locations identified on elevations and roof plans. • Notations include SRI of cool roof on roof plan and location of solar panels. For green roofs: On a landscape plan, indicate the potable irrigation systems servicing the green roof and submit maintenance plan. For blue roofs: On stormwater management report and stormwater management plan quantify blue roof storage and run-off. **Site Statistics Template** indicating sustainable roofs portion copied directly onto the roof plan.

Submission Specifications

1. Available roof spaces are calculated according to the following guidelines:
    - For green roof and blue roof areas, the available roof space is the total roof area of the building, excluding areas designated for renewable energy devices and mechanical equipment, rooftop outdoor amenity areas, and private terraces abutting residential units at the roof level.
    - For cool roofs, the available roof space consists of the total roof area of the building, excluding private terraces no greater than the floor of the abutting residential unit at the roof level.
2. Green roof assemblies must consist of a root repellent system, a drainage system, a filtering layer, a growing medium, and plants. Green roofs are typically installed on flat roofs; however, sloped roofs can accommodate them with additional considerations. Green roof assemblies are categorized into two types:
    - Intensive Green Roofs require deeper substrates capable of supporting a wide range of plant species. If pursuing, the minimum requirements are a growing medium with a minimum depth of 150 mm and a diverse mix of native plants suitable for the depth of growing medium and roof height (e.g., sedums, grasses, drought-tolerant perennials, and, where appropriate, larger trees and plants)
    - Biodiverse Green Roofs aim to support pollinator species and are installed at or below the 8th storey of the building.
3. Green roofs should follow the Credit Valley Conservation Native Plants for Pollinators Guide.
4. Blue roofs are categorized into four primary types:
    - Roof-integrated designs intentionally store standing water for extended periods of time using a roofing membrane or a waterproofing system.
    - Modular tray designs are plastic trays that are physically attached to the roof or held in place with a ballast to temporarily detain water during rainfall.
    - Roof dams and roof checks are similar to roof-integrated design in that they are impermeable or semi-permeable dams/checks that break surface flow and pool water behind as a temporary detention. Dams are designed with an overflow or outlet that slowly releases stored water.
    - Actively controlled systems use a valve and controller to regulate discharge of flows from rooftops.
5. If installing blue roofs, the system can be designed to meet the NS5: Stormwater Management requirements.
6. Green roofs and blue roofs require a maintenance plan to ensure optimal performance. Applicants must submit a five-year maintenance plan outlining the installation of the permanent irrigation system to supply supplementary water (green roofs), the access locations for roof maintenance, and a green roof and/or blue roof maintenance contract with qualified professionals.

7. Cool roofing material and coating systems must meet the following requirements:
    - Low slope (flat) roofs with a surface slope less than 16.7% or 9.5 degrees should have an SRI rating of 78 or higher and an emissivity equal to or greater than 0.9.
    - Steep slope (pitched) roofs with a surface slope greater than 16.7% or 9.5 degrees should have an SRI rating of 25 or higher and an emissivity equal to or greater than 0.9.
8. Applicants may seek an exemption under the following circumstances:
    - There is architectural detailing on the roof, making such installations impossible.
    - There is architectural detailing on the roof that features building materials that cannot support such installations.

Resources

- Green Roofs for Healthy Cities—Resources and guidelines for green roof design, installation, and maintenance.
- TRCA Low Impact Development Stormwater Management Planning and Design Guideline—Resources and guidelines related stormwater planning and practices.
- City of Toronto: Biodiverse Green Roofs—Design guidelines for biodiverse green roofs.
- City of Toronto: Green Roof Bylaw—Green roof construction requirements for new development and available roof space calculations.
- Cool Roof Rating Council: LEED Resources—Primer for cool roof construction requirements.