Sun & Shadow Study

Terms of Reference

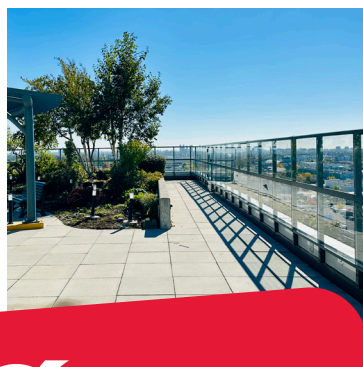
February 2023

Technical Update: September 2025









MARKHAM

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Table of Contents

1.0 Introduction

A Sun and Shadow Study (the “Study”) is a technical document that assesses potential shadow impacts of a proposed development on its surrounding context including residential, commercial, and institutional uses, as well as the public realm, such as streets, parks and open space. Adequate access to sunlight improves the usability and enjoyment of outdoor spaces for Markham residents and visitors alike, extending seasonal use while contributing to the comfort and attractiveness of outdoor environments, including parks and open spaces, pedestrian sidewalks and boulevards.

This Terms of Reference will provide guidance to applicants on how to prepare the Study. The outcome of the Study is intended to facilitate collaboration between the applicant and City Staff in finding amicable solutions to mitigate potential shadow impact and increase thermal comfort for the development application in question.

1 - Building placement and built-form plays a critical role in ensuring parks and open space are free from adverse shadow impact

1.1 Purpose

The Study document is required to ensure the proposed development conforms to applicable municipal by-laws, policies and guidelines, including policies from the City's 2014 Official Plan (the "Official Plan"), specifically Section 6.0 – Urban Design and Sustainable Development, which includes:

6.1.4.2 – *To design streetscapes that support the functional requirements of streets and blocks and create a suitable interface and compatibility with the use, height and density of abutting development by promoting:*

- *(b) pedestrian comfort and safety.*

6.1.8.4 – *To design and place buildings on a site to be compatible with adjacent or abutting development, a cultural heritage resource itself and adjacent lands, streetscape and parks and open spaces by addressing, where appropriate:*

- *(a) transitions in height and massing, including the relationship to the width of the public right-of-way, and adequate setbacks between buildings, the public realm and adjacent or abutting development;*

- *(e) comfortable microclimatic conditions including sunlight access and wind conditions, public safety, and adequate privacy conditions for residential buildings and their outdoor amenity areas; and*

- *(h) building design that: (i) incorporates architectural detailing and features to increase comfort, add interest and achieve a good relationship with neighbouring development.*

6.3 (Designing Sustainable New Communities) – *The design of these new communities should address, among other things, compatibility with the Greenway System, and the provision of an appropriate transition to established neighbourhoods and employment areas to minimize the potential adverse impact of one on the other.*

The Study ensures that new development upholds a high standard for the public realm by ensuring adequate sunlight access. Taller buildings and intensified forms of development carry an important civic responsibility to contribute positively to their surroundings.

As the City evolves and intensifies, access to natural light is fundamental to Markham's quality of life and vitality for its residents and visitors.

1.2 Who Prepares The Study

The Study should be prepared by a qualified professional such as a licensed architect or a Registered Professional Planner (RPP) and include the name of the consulting firm/ organization.

2.0 Requirements

2.1 Submission Criteria

A Sun and Shadow Study is required to support the review of development applications such as Zoning By-law Amendment and Site Plan applications.

The Study is conducted at various times of the day during the fall and spring seasons, with the summer and winter seasons conducted on a case-by-case basis.

The Study is required for all development applications meeting any of the following requirements:

- Proposed mid-rise and high-rise buildings over 20.0 metres in building height, or over 6-storeys; or
- Located near *other shadow-sensitive areas* such as parks and open spaces, outdoor amenity areas, heritage districts, etc.; or
- The City may request for a Sun and Shadow Study for unique sites on a case-by-case basis and will be identified at the pre-consultation stage.

2.2 Structure & Format

To deem the Study complete, the following requirements are to be met:

Study Submission Requirements	
☐	Submitted as Digital PDF
☐	SketchUp model (latest version of .skp file)
Formatting Requirements	
☐	Presented on 11” x 17" tabloid paper in landscape mode
☐	Include a north arrow and scale bar
☐	Outline the subject land(s) with a solid red line
☐	Use *Eastern Standard Time (EST)*, applying *Eastern Daylight Time (EDT)*
☐	The 3D model will depict proposed shadow impacts, subject land(s), pedestrian sidewalks, adjacent sites, streets, blocks, surrounding buildings, public parks, open spaces, private amenity spaces, natural heritage systems (if any), and water features (if any)
☐	3D Model to reflect real-world grading conditions and topography of the site to demonstrate realistic shadow analysis
☐	The Study boundary extends 250 metres beyond the longest proposed shadow
☐	Adopt the standard colour palette. Refer to Section 2.5 of this document
Technical Requirements	
☐	Apply the geo-coordinates of 43°51’22.5”N, 79°20’11.4”W
☐	If high-rise buildings are proposed where topographical variation exceeds 10 metres within the shadow impact area, the model should accurately reflect these elements
☐	Illustrate As-of-Right (AoR) shadow conditions based on the subject land(s)’ as-of-right zoning permissions to provide baseline for comparison

2.3 Written Analysis

A written evaluation of the Sun and Shadow Study can be included as part of the associated Planning Justification Report or Urban Design Brief.

At minimum, the written evaluation should include the following sections:

Analysis Methodology
Outline the approach and parameters used to conduct the shadow analysis.

Shadow Impact Summary
Summarize key findings of the shadow impacts on surrounding lands, including public sidewalks, parks and open spaces.

Mitigating Features
Describe how the proposed development has been designed to mitigate shadow impacts.

2.4 Test Times

A Sun and Shadow Study should be completed for the spring (March 21st) and fall (September 21st) equinoxes at the following hours:

- 9:18 AM
- 10:18 AM
- 11:18 AM
- 12:18 PM
- 1:18 PM
- 2:18 PM
- 3:18 PM
- 4:18 PM
- 5:18 PM
- 6:18 PM

At the discretion of the Planning and Urban Design Department, testing may be requested for the summer (June 21st) and winter (December 21st) solstices on a case-by-case basis. City staff will inform the applicant of this requirement at the pre-consultation stage.

Testing for Sensitivity Areas

As sunlight access is most limited in winter, shadows will need to be tested for the winter season for all new development in-close proximity to parks and open spaces, schools and playgrounds, community centres and its outdoor spaces to ensure adequate sunlight access is provided for public enjoyment.

2.5 Standard Colour Palette

The Study should follow a standard colour palette to demonstrate shadow impacts on the subject land(s) and surrounding areas.

Distinct colours in the model represent various shadow impacts and sources as shown in Table A.

These includes:

- Proposed massing and shadows;
- “As-of-Right” shadows;
- Existing building massing/footprints and their shadows;
- Pedestrian sidewalks;
- Roads/streets;
- Public parks/open spaces;
- Private open/outdoor amenity spaces;
- Natural heritage systems; and
- Water features.

These colours are established as “Red-Green-Blue” values or “RGB”. Table A identifies the RGB values for each of the standard colours.

A coloured legend is to be included on the Study.

Table A - Standard Colour Palette

Components & Elements	RBG Vales	Colours
Applicant’s Proposal Massing	R = 204 G = 184 B = 236	Purple
Applicant’s Proposed Shadows (Adjust transparency approx. 70%), with Dark Orange Outline	Outline: R= 241 G = 95 B = 34 Fill: R = 248 G = 150 B = 29	Orange with solid outline
As-of-Right Shadow (Adjust transparency approx. 70%), with Turquoise Outline	Outline: R = 112 G = 203 B = 211 Fill: R = 153 G = 153 B + 153	Grey with solid outline
Existing Built Form Massing of the Surrounding Area Context	R = 255 G = 255 B = 255	White
Existing Shadows from Other Surrounding Built Form (Adjust transparency approx. 70%)	R = 115 G = 115 B = 115	Dark Grey
Public Parks & Open Spaces	R = 170 G = 204 B = 175	Green
Private Open/Outdoor Amenity Spaces	R = 249 G = 220 B = 90	Light Green
Natural Heritage Systems (ex. Rouge Valley)	R = 61 G = 137 B = 84	Dark Green
Water Features (ex. Rouge River)	R = 136 G = 215 B = 255	Light Blue
Pedestrian Sidewalks (adjacent & opposite side)	R = 250 G = 169 B = 169	Pink
Road/Street	R = 170 G = 170 B = 170	Light Grey

3.0 Evaluation Methods

To align with the objectives of the City's Official Plan, the Study will demonstrate the impacts of shadows cast by the proposed development and, determine the amount of potential sunlight exposure available to adjacent properties and the public realm.

The City's approach to evaluating shadow impacts is informed by best urban design principles and practices, and respond to different building typologies and a range of public and private outdoor spaces.

Note:

Trees and vegetations should not be considered a source of cast shadows.

3.1 Evaluation Approaches

The following approaches applies when evaluating shadow impacts:

1. Hours Approach

The Hours Approach evaluates the minimum hours of sunlight access during the Test Times to ensure public boulevards have adequate sunlight access throughout the day.

This approach is applied across all built-form typologies when evaluating their shadow impacts on public boulevards.

2. Percentage Approach

The Percentage Approach evaluates the percentage of a defined area that receives a specified amount of sunlight during the Test Times.

This approach is applied when evaluating shadow impacts for public parks and open spaces, common *private open spaces,* and *other shadow-sensitive areas.*

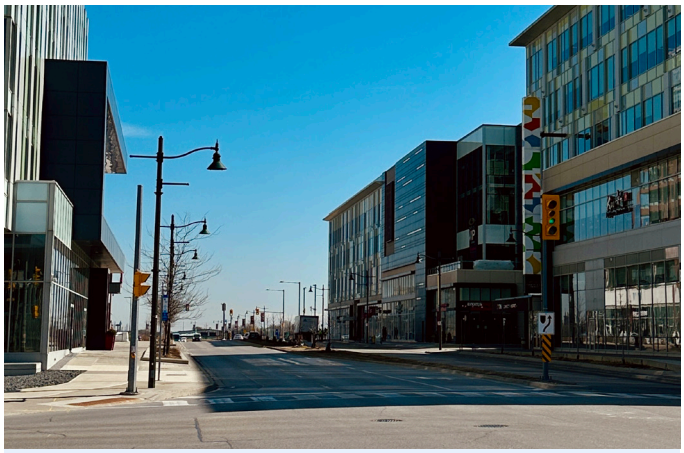
3.2 Evaluating Shadow Impacts on Public Boulevards

Access to sunlight within the City's boulevard spaces, including public sidewalks and landscaped areas, is crucial for creating vibrant, comfortable, and pedestrian-friendly public realms. Excessive shadowing of these areas diminishes warmth, visibility, and overall appeal, discouraging walking and reducing public space usage.

In high-density and mixed-use areas, maintaining sunlight in boulevard spaces helps ensure they remain active, inviting, and well-utilized throughout the year. Shadows cast on these zones can hinder their functionality and reduce opportunities for spontaneous social interaction and the economic vitality of adjacent commercial uses.

Street trees require adequate and sufficient sunlight for healthy growth, especially in early spring and late fall when sun angles are lower. Prolonged shadowing can compromise the ecological performance of street trees and undermine Markham's Tree Canopy Target, urban greening, climate resilience, and stormwater management.

Proposed developments should be designed to allow full sunlight access on the boulevard of the opposite side of the street. Generally maintain **five (5)-*consecutive hours*** of sunlight access for the boulevard space including sidewalks, landscaped areas, and other public amenities.



2 - The mid-rise buildings are appropriately scaled to the street right-of-way width to ensure sun access on the boulevard space on the opposite side of the street

3 - Pedestrian sidewalks should remain as shadow-free throughout the day to support a vibrant, comfortable, and pedestrian-friendly public boulevard

3.3 Evaluating Shadow Impacts on Public Parks & Open Spaces

All proposed development should be designed to avoid shadowing existing and planned public parks and open spaces. Sun access on parks and open spaces should be maintained.

The following criteria applies when evaluating shadow impact on public parks and open space.

Intensification Areas

Parks and open spaces will receive a **minimum or the greater average of 50%** sunlight access between 9:18 am to 6:18 pm.

Non-Intensification Areas

Parks and open spaces will receive a **minimum or the greater average of 70%** sunlight access between 9:18 am to 6:18 pm.

Refer to Appendix C: Glossary which provides the Official Plan definition of *Intensification Areas* and *Non-Intensification Areas*.

Use the following formula to calculate the total minimum average of the parkland area that receives sunlight during the day:

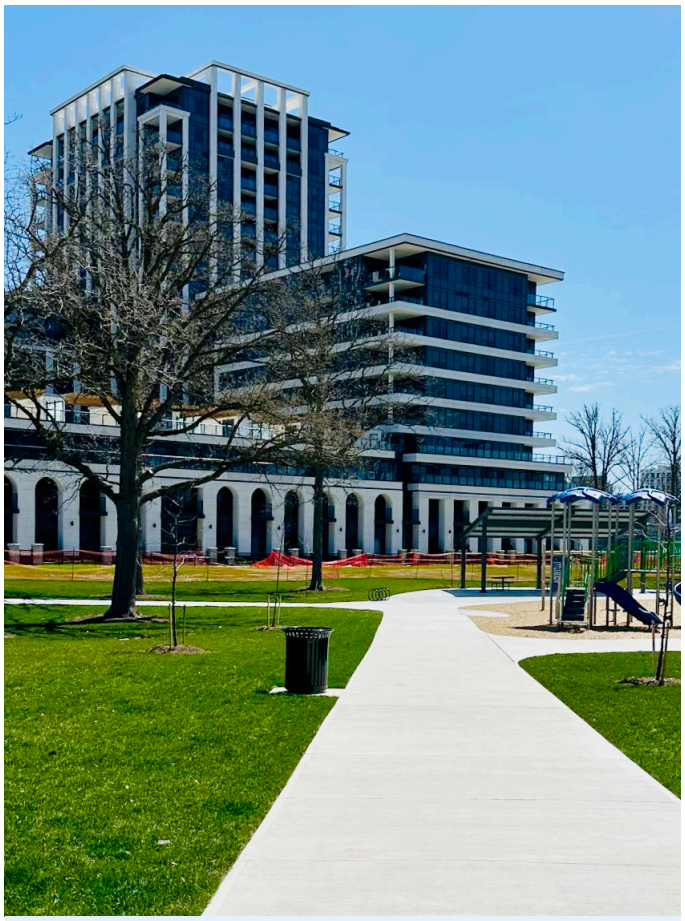
1. *Measure the total percentage area of the parkland that receives sunlight for each of the Test Times (ie. 9:18 am to 6:18 pm).*

$$\text{Percentage} = \left[\frac{\text{Sunlight Area(s)}}{\text{Total Park Area}}\right] \times 100$$

2. *Calculate the average of all ten (10) Test Times.*

3. *The final result will represent the average percentage of sunlight exposure that the parkland receives throughout the day.*

4 - Playgrounds and sports facilities are strategically placed to maximize sun access throughout the day



5 - The location of a high-rise building relative to a park is crucial in minimizing shadow impacts; placing buildings farther away helps preserve sunlight access and the usability of parks and open spaces for families and children

3.4 Evaluating Shadow Impacts on Common *Private Open Spaces* & *Other Shadow-Sensitive Areas*

Access to sunlight within *private open spaces* is a vital aspect of residential design, ensuring outdoor areas remain functional and enjoyable for residents. Adequate sunlight enhances usability by supporting outdoor activities, social interaction, relaxation, and a stronger connection to nature.

The minimum requirement provides flexibility for private outdoor amenity spaces within the proposed development as potential building height, envelope and orientation may prevent access to sunlight on these areas throughout the day.

Examples of common private outdoor amenity spaces includes ground-related courtyards, vehicular courtyards (not for pedestrian recreation or gathering), pedestrian mews, playgrounds, mid-block connections, and rooftop amenities.

City staff will evaluate sunlight and shadows on these spaces using the following criteria:

- Maintain **at least 50% of sunlight access** on these spaces throughout the day between 9:18 am to 6:18 pm for residents to enjoy in natural light.

Other shadow-sensitive areas refers to locations or uses that are sensitive to the presence of shadows, even though they may not fall under the most commonly category of the public realm. Examples includes school yards, playgrounds, daycares, places of worship, green roofs, community gardens, outdoor seating, long-term care facilities and hospitals.

City staff will evaluate sunlight and shadows on these spaces using the following criteria:

- Ensure that new developments maintains **at least 50% of sunlight access** between 9:18 am to 6:18 pm on sites that holds visual, cultural, or historical significance, and *other shadow-sensitive areas*.

6 - Rooftop outdoor amenities should be designed to maximize natural sunlight for residential enjoyment

7 - Playgrounds can be consider as a shadow-sensitive area where sunlight is essential for comfort and usability for families and children

Appendices

Appendix A: Demonstration Plan

The following Demonstration Plan illustrates how the Study is to be conducted, with key information showing how the Sun and Shadow Study model meets the City's submission requirement.

- Subject site is outlined in red.
- The proposed development in purple.
- As-of-Right shadows are identified.
- Shadows cast by the proposed development are depicted in semi-transparent orange, while existing shadows from surrounding buildings are also shown in dark grey for context.
- Pedestrian sidewalks adjacent to the proposed development and on the opposite side of the street are in pink. This overlay of proposed shadows and pedestrian sidewalks facilitates the evaluation of shadow impacts on the public realm, providing City staff with a comprehensive understanding of the sun and shadow effects associated with the proposed development.

* Refer to the Appendix B to view the Study Template as visual guidance.

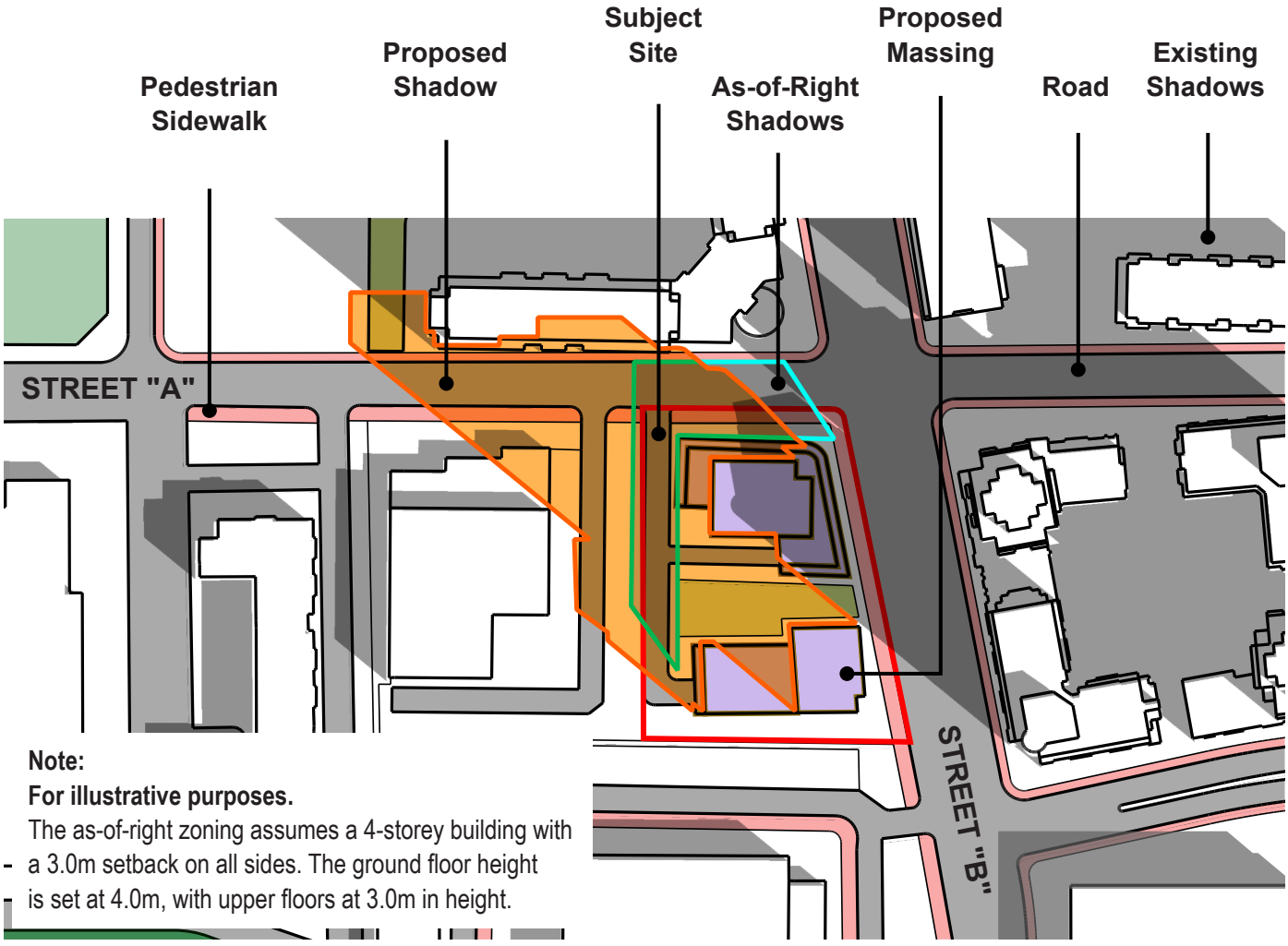


Figure 1: Demonstration Plan

Appendix B: Template of a Typical Sun & Shadow Study

Individual blocks are set-up to show the proposed shadow impacts for each of the defined Test Times.

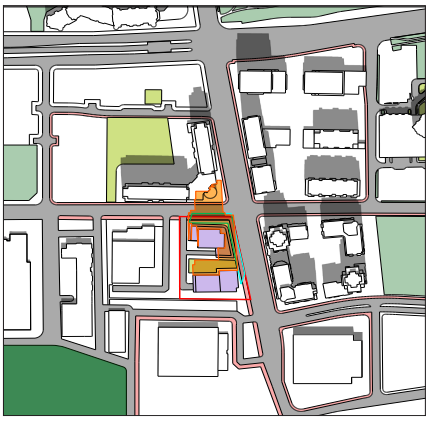
As outlined in Section 2.4 of this document, sun and shadow tests are required for the spring (March 21st) and fall (September 21st) equinoxes, with the summer (June 21st) and the winter (December 21st) solstices required on a case-by-case basis only.

Test scenarios for each season should be presented on a single sheet, as illustrated in Figure 2.

See section 2.2 for more information.

Figure 2: Template of a Typical Sun & Shadow Study

11:18 AM



12:18 PM

3:18 PM

4:18 PM

0 50 100 200 300

Edge of Paper

1/2"

Edge of Paper

1/2"

MIN. 5.0"

TRUE NORTH ARROW

PROJECT NORTH ARROW

MIN. 3.0"

KEY PLAN

KEY PLAN TO SHOW MAJOR INTERSECTIONS AND STREET NAMES

LEGEND:

- Application Boundary
- Proposal Massing
- Proposed Shadows
- As-of-Right Shadows
- Existing Built Form Massing of the Surrounding Area Context
- Existing Shadows from Other Surrounding Built Form
- Public Parks & Open Spaces
- Private Open/Outdoor Amenity Spaces
- Natural Heritage Systems
- Pedestrian Sidewalks
- Road/Street

NOTES (IF REQUIRED):

For illustrative purposes.
The as-of-right zoning assumes a 4-storey building with a 3.0m setback on all sides. The ground floor height is set at 4.0m, with upper floors at 3.0m in height.

No.	DESCRIPTION	DATE
4.		
3.		
2.		
1.		

REVISIONS

MARKHAM

THE CORPORATION OF THE CITY OF MARKHAM
PLANNIGN AND URBAN DESIGN DEPARTMENT

PROJECT ADDRESS

LOGO, NAME, AND CONTACT DETAILS OF THE CONSULTING FIRM

NAME OF THE DRAWING
(E.G. "SUN SHADOW STUDY - MARCH 21ST")

DESIGN BY: X.X.	CHECKED BY: X.X.	PROJECT NO. ABC
DRAWN BY: X.X.	CHECKED BY: X.X.	
SCALE: 1 : XXXX		DRAWING NO. XYZ
DATE: MONTH/DATE (XX)/YEAR (XXXX)		

CITY FILE No.: XX.XXXXXX.SPC/PLAN

Appendix C: Glossary

Building Setbacks

Building setbacks are the minimum distances between a building and a property line, adjacent buildings, or other specific site features, as defined by zoning by-laws, planning regulations, or urban design guidelines.

Building Stepbacks

Building stepbacks are the horizontal distance measured in metres of the upper floors of a building from the edge of its lower floors.

Consecutive Hours

Consecutive hours refer to the continuous and uninterrupted sequence of hours during which the sun's shadow is tracked to evaluate its impact on specific areas, such as the public realm including sidewalks and open spaces.

Eastern Daylight Time (EDT)

Eastern Daylight Time (EDT UTC−4:00) is the standard time zone used in North America.

It is observed from the second Sunday in March to the first Sunday in November when clocks are adjusted forward by one-hour to maximize evening daylight.

Eastern Standard Time (EST)

Eastern Standard Time (EST UTC-5:00) is the time observed during the non-Daylight Saving Time period.

Intensification Areas

Intensification Areas means lands identified on Map 1 - Markham's Structure, Map 2- Centres and Corridors and Transit Network, and Map 3 - Land Use on the City's Official Plan that are prioritized for accommodating intensification within the urban area shown on Map 12 - Urban Area and Built-Up Area.

Intensification areas may include all or a portion of a Regional Centre, Regional Corridor/Key Development Area, Local Centre and Local Corridor.

Non-Intensification Areas

Non-Intensification Areas are lands that are outside of Intensification Areas identified on Map 1 - Markham's Structure, Map 2- Centres and Corridors and Transit Network, and Map 3 - Land Use of the City's Official Plan that are prioritized for accommodating intensification within the urban area shown on Map 12 - Urban Area and Built-Up Area.

Non-Intensification Areas are lands outside of a Regional Centre, Regional Corridor/Key Development Area, Local Centre and Local Corridor.

Other Shadow-Sensitive Areas

Other shadow-sensitive areas are locations where sunlight is important for comfort, safety, usability, or environmental function, even if they are not part of the typical public realm.

Examples includes school yards, playgrounds, daycares, places of worship, green roofs, community gardens, outdoor seating, long-term care facilities and hospitals.

Private Open Spaces

Private open spaces are outdoor areas on private property that are reserved for the use and enjoyment of specific individuals or population, such as residents, rather than being accessible to the general public.

These spaces are integral to the urban setting within a private development, providing dedicated outdoor spaces that support recreation, relaxation, and other activities in a controlled and private setting.

Markham Civic Centre

101 Town Centre Blvd., Markham, ON, L3R 9W3