# Corporate Report

Clerk's Files

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PDC NOV 14 2011

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**DATE:** October 25, 2011

**TO:** Chair and Members of Planning and Development Committee
Meeting Date: November 14, 2011

**FROM:** Edward R. Sajecki
Commissioner of Planning and Building

**SUBJECT:** **Revised Standards For Shadow Studies**

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**RECOMMENDATION:**

1. That the Report entitled "Revised Standards For Shadow Studies", dated October 25, 2011, and the accompanying document entitled, Standards For Shadow Studies, August 2011, from the Commissioner of Planning and Building, be received for information.

2. That shadow studies for all development applications that require an analysis of their shadow impact be prepared in accordance to the document entitled, "Standards For Shadow Studies", August 2011.

3. That staff report back to Planning and Development Committee in one (1) year on the effectiveness of the revised Standards For Shadow Studies, August 2011 in the review of development applications.

**BACKGROUND:** R. Bouwmeester and Associates, a firm of sun and shadow specialists, was retained by the Planning and Building Department, to review and augment the City's existing Design Reference Notes entitled "Standards for Shadow Studies". The purpose of the revision was as follows:

- to properly align the existing standards with the objectives of the Strategic Plan by addressing sun access within the public realm and pedestrian areas;

- to address the sun access challenges that have arisen as the City shifts focus from the development of green fields to intensification and infill development.

The review process culminated in a set of revised Standards For Shadow Studies with clear, measurable and implementable sun access goals. These goals address the City's vision for pedestrian comfort and sun access within the public realm and on private properties in the context of an increasingly more compact pattern of development.

**Strategic Plan**

Developing a Transit Oriented City and Building Complete Neighbourhoods, two of the five strategic pillars for change identified in the Strategic Plan, rely heavily on the development of an attractive and comfortable public realm. Appropriate sun access within the public realm and open spaces contributes to the development of enjoyable and walkable communities and promotes outdoor and pedestrian activity which in turn supports transit use, the use of open spaces and public health objectives.

**Mississauga Plan**

According to Mississauga Plan Policy 3.13.6.18, development proposals may be required to submit micro-climate studies to demonstrate how negative impacts on the public streets, public parkland, pedestrian environments and adjacent residential areas have been ameliorated with regard to the following environmental elements:

a. sun;
b. wind;
c. noise;
d. light;
e. odour.

**New Mississauga Official Plan**

Item 19.4.7 of the New Mississauga Official Plan states that proposals for buildings higher than three storeys should be designed to minimize overlook conditions; obstructions of grade level vistas and overshadowing of any adjacent properties. In this regard, sun and shadow studies, view studies and micro-climatic studies may be required to determine the impacts of the proposal. For the purpose of this policy, the above-noted studies generally would not be required for adjacent lands used for industrial purposes.

Both the Strategic Plan and Mississauga Plan lay emphasis on the quality of the public realm. Apart from references to parks, the existing standards for shadow studies do not include any protection for sun access and pedestrian comfort within the public realm. It has also been the observation of staff that the criteria included in the existing standards do not adequately protect for the amounts of sun exposure desirable for specific uses at specific times and as a result, staff have had to borrow the standards of other municipalities in order to augment the existing standards and still meet the requirements of the existing standards.

**COMMENTS:** **The project scope upon which the revision was based, included the following:**

- Review the sun and shade implications of the current Standards for Shadow Studies;
- Review and compare Mississauga practices to those of other jurisdictions namely, City of Toronto, City of New York, City of Boulder in Colorado and City of Berkely in California;
- Base analysis on key dates including the 21st of June, September and December (March and September 21 are similar since the Daylight Saving Time rule change took effect in 2007);
- Develop implementable sun access goals that are use, time of day and time of year specific;

- Specify standard latitude and longitude to be applied to all of Mississauga;
- Specify standard dates, times and corresponding sun altitude, azimuth and shadow length factor data in tabular form based on standard latitude and longitude;
- Specify angular planes for use along Mississauga's main street grid system based on the alignment of Hurontario Street and Eglinton Avenue.

The revised standards for shadow studies will form one component of a suite of tools available to the Planning and Building Department for the evaluation of the impact of proposed developments and their compatibility with the surrounding context.

**Details of the revised standards**

The revised Standards For Shadow Studies (Appendix I-1) include the following:

- sun access goals for the sidewalks and boulevards of different street types and outdoor areas, at specific times of the day and year. These should result in improved pedestrian comfort, enhance the use and enjoyment of outdoor spaces within the public realm and private property;

- sun access goals that address the balance of sun and shade which is necessary for the enjoyment of open spaces;

- sun access goals that protect for sun exposure for planting areas in order to promote the healthy growth of vegetation;

- as with the existing standards, sun access goals that protect for adequate winter sun exposure on the faces of low rise buildings in order to facilitate the potential harnessing of solar energy, but in a manner that is easier to measure;

- sun angle data and information on the maximum angular planes required to achieve specific sun access goals with regard to boulevards and sidewalks;

- a check list of materials to be included in the submission of shadow studies;

The information on maximum angular planes provides the ability to verify appropriate street wall heights and setbacks in order to achieve the prescribed sun access goals along boulevards and sidewalks.

**Comparison with other municipalities**

The following are excerpts from the accompanying background report provided by R. Bouwmeester and Associates in support of the revised standards:

**City of Toronto**

Like Mississauga, the City of Toronto does not require shadow studies for all projects. They may be required, for proposals over 20 metres (6 storeys) in height that involve Official Plan Amendments, Zoning By-law Amendments and complex Site Plan Control applications. Shadow studies may also be required for projects less than 20 metres in height, particularly if a rezoning application is seeking additional height near shadow sensitive areas such as parks, cemeteries, etc. The focus of Toronto's standards is on adjacent streets, parks and properties. The standards require shadow modeling on March and September 21 at hourly intervals. Where the impacts fall on public open spaces or parks, June and December 21st must be added to the shadow analysis. The guide permits the inclusion of existing shadows, as-of-right shadowing, and shadows from approved-but-not-yet-built buildings in the analysis in order to fairly determine the additional, or incremental, shadowing due to a proposal.

**City of New York**

The City of New York (NYC) has recently updated its CEQR Technical Manual 11 which assists city agencies, proponents, and the public in reviewing proposals subject to City Environmental Quality Review (CEQR). The manual contains a chapter and an appendix dealing specifically with shadow assessments. The focus of the manual is on the environmental quality of sunlight-sensitive resources. These resources are defined to include those that depend on sunlight for growth and survival and those that require sunlight for their usability or architectural significance. As such, the criteria apply to publicly accessible open space, historic landscape or resource, and important natural features and landscaping. Some examples of architectural resources deemed in the manual to be sunlight-sensitive include historical buildings and landmarks, buildings with elaborate or carved elements that rely on sun/shadow patterns, and stained glass windows. Like Toronto, the manual permits the inclusion of existing shadows, as-of-right shadowing, and shadows from approved-but-not-yet-built buildings in the analysis in order to fairly determine the additional, or incremental, shadowing due to a proposal.

**City of Boulder, Colorado**

The City of Boulder's solar guidelines relate to both sunlight and the protection of sunlight for solar energy. The Solar Access Guide sets out the requirements of a city ordinance that guarantees sunlight for homeowners by limiting shadowing created by new construction and by requiring new buildings to be sited to provide good solar access. The protection of solar access is achieved by creating theoretical "solar fences" either 3.66 m or 7.62 m in height along the property lines of the protected building. There are exemptions for existing shade (trees are not included) and for shaded areas that fall outside of the building envelope.

**City of Berkely, California**

The Zoning Project Submittal Requirements of the City of Berkeley include the potential requirement for a shadow study. If a

shadow study is required, it must include existing and proposed shadows and clearly highlight the incremental shadows. The area of concern is windows in residential buildings.

**Testing**

The revised standards for shadow studies have been tested by staff on an existing development, and they have been applied to the proposed Pinnacle Phase 1 high density development at the northwest corner of Eglinton Avenue and Hurontario Street. However, the overall impact of the standards on built form and the public realm will become more evident as they are applied to more development proposals.

**FINANCIAL IMPACT:** No further financial implications arising from the revised Standards For Shadow Studies, August 2011 are anticipated for the City.

**CONCLUSION:** The revised Standards For Shadow Studies, August 2011, will be one of several tools employed by City staff and the Development Community in assessing the impact of proposed development on the public realm and private properties, and they will assist in the determination of the appropriate locations, form, height distribution etc. of buildings and other elements that constitute site development. Applying the revised standards to development applications over the coming year will enable staff to properly evaluate their effectiveness.

**ATTACHMENTS**: Appendix I-1: Standards For Shadow Studies, August 2011

Edward R. Sajecki
Commissioner of Planning and Building

*Prepared By: Erinma Chibututu, Urban Designer*

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MISSISSAUGA
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# STANDARDS FOR SHADOW STUDIES



August 2011

City of Mississauga: Planning and Building Department

**Revised Standards for Shadow Studies** **File: CD.21.SHA**

# STANDARDS FOR SHADOW STUDIES

Shadow Studies illustrate the impact of development in terms of sun and daylight access to the surrounding context including surrounding buildings, the public realm, public and private open space.

Shadow Studies may be required in support of development applications to demonstrate that the location and height of a proposed building if greater than 10.7m, will not cause undue shade on the subject lands, and on surrounding context including building facades, private and public outdoor amenity and open spaces, public parkland, sidewalks and other components of the public realm.

Shadow Studies and Analyses will be conducted for the following dates:

- **June 21**
- **September 21** (similar to March 21, and therefore, criteria for Sept. 21 are deemed to apply to March 21)
- **December 21**

At the following times:

- **Solar Noon (SN)**
- **Hourly intervals before and after Solar Noon (SN), up to and including 1.5 hours after sunrise and 1.5 hours before sunset**

**Hourly solar data are specified for each date**

See Tables 2, 3 and 4: Mississauga Sun Angle Data

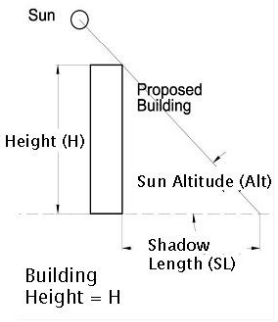
Sun Angles:
Sun Angles are based on the latitude and longitude of the Mississauga Civic Centre at 300 City Centre Drive, Mississauga ON L5B 3C1

- Latitude: 43 deg. 35' 20" N
- Longitude: 79 deg. 38' 40" W

Time Zone: Eastern
Standard Time: UT - 5 hours
Daylight Time : UT - 4 hours
UT denotes Universal Time i.e. Greenwich Mean Time

Shadow Length (SL) = Building Height (H) x Shadow Length Factor (SLF). See Fig. 1

**FIG. 1: DETERMINING SHADOW LENGTH**




Shadow Length Factor (SLF) = 1/tan(Alt)

Shadow Length (SL) = H x SLF

## Ensure Adequate sunlight on the following:

### 1. Residential Private Outdoor Amenity Spaces

To maximise the use of private residential amenity spaces during spring, summer and fall, shadow impacts from proposed developments should not exceed one hour in duration on areas such as private rear yards, decks, patios and pools of surrounding residential dwellings on each of the following dates:

- **June 21**
- **September 21** (Mar. 21 shadow patterns are similar but occur 14 minutes later)

This criterion is met if there is shadow impact for no more **than two consecutive hourly test times** within the space between the exterior wall of the dwelling that abuts the amenity space and the line of impact assessment **("No Impact Zone").**

The line of impact assessment shall be, a line **7.5m** minimum from the rear wall or other appropriate exterior building wall of the dwelling that abuts the private amenity space. See Fig. 2 and 3

New shadows shall not result in less than 2 hours of direct sunlight. Where less than 2 hours of sunlight already exists within the **"No Impact Zone"**, no new shade may be added.

Balconies are not considered "residential private outdoor amenity spaces" unless they are the only outdoor living area available to the dwelling unit, are unenclosed, and project 4m or more from the exterior wall of the building.

**FIG. 2: SHADOW IMPACT ON PRIVATE RESIDENTIAL OUTDOOR AMENITY SPACES (PLAN VIEW)**

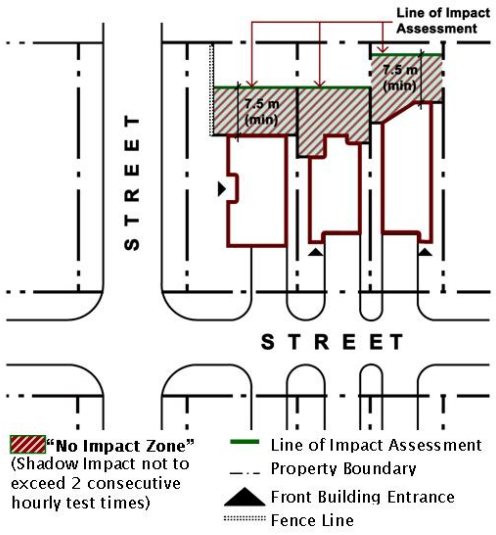
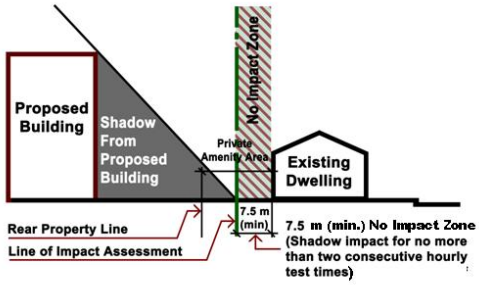



**FIG. 3: SHADOW IMPACT ON PRIVATE RESIDENTIAL AMENITY SPACES (SECTION)**



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## Ensure Adequate sunlight on the following:

**2. Communal outdoor amenity areas including, children's play areas, school yards, tot lots, and park features such as sandboxes, wading pools etc., and outdoor amenity areas used by seniors and those associated with commercial and employment areas during spring, summer, fall and winter.**

Shadows from proposed developments should allow for full sun on the above places at least half the time, or 50% sun coverage all the time, on each of the following dates:

- **June 21**
- **September 21**
- **December 21**

This criterion is met if the "sun access factor" is at least 50% or 0.5 on each of the test dates ($A_{S(ave)}/A_T = 0.5$ or more)

**See 2a for Calculation of Sun Access Factor**

This criterion applies to public amenity areas and common outdoor amenity areas that are part of a proposed or existing development.

**2a) Calculating Sun Access Factor:**

- Measure the total Area ($A_T$) of the space or feature
- Measure the area in sunshine ($A_S$) for each of the test times from 1.5 hours after sunrise to 1.5 hours before sunset both inclusive
- Find the average of the $A_S$ values ($A_{S\,(ave)}$)
- Sun Access Factor = $A_{S(ave)}/A_T$

**3. Public realm including sidewalks, open spaces, parks and plazas to maximize their use during the shoulder seasons (spring and fall)**

**a) Low and Medium Density Residential Streets**

Developments should be designed to allow full sunlight on the opposite boulevard including the full width of the sidewalk on September 21 as follows:

For a total of at least **4 hours** between **9:12 a.m.** and **11:12 a.m.** and between **3:12 p.m.** and **5:12 p.m.**

This criterion is met if there is no incremental shade from the proposed development at **9:12 a.m., 10:12 a.m. and 11:12 a.m.**, and at **3:12 p.m., 4:12 p.m. and 5:12 p.m.**
**See Fig. 4, 5, 6 and Table 1.**

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**b) Mixed Use, Commercial, Employment and High Density Residential Streets**

Developments should be designed to allow full sunlight on the opposite boulevard including the full width of the sidewalk on September 21 as follows:

For a total of at least 5 hours that must include the 2 hour period between 12:12 p.m. and 2:12 p.m., and an additional 2 hour period from either 9:12 a.m. to 11:12 a.m. or from 3:12 p.m. to 5:12 p.m.

This criterion is met if there is no incremental shade from the proposed development at 12:12 p.m., 1:12 p.m. and 2:12 p.m., and three consecutive times either 9:12 a.m., 10:12 a.m. and 11:12 a.m. or 3:12 p.m., 4:12 p.m. and 5:12 p.m.

**See Fig. 4, 5, 6 and Table 1for angular planes that will achieve this criterion for Hurontario Street, Eglinton Avenue and streets with a similar alignment.**

**c) Public Open Spaces, Parks and Plazas**

Developments should be designed to provide a sun access factor of at least 50% on public open spaces, parks and plazas on September 21.

**See 2a for calculating Sun Access Factor**

Please note the following:

- **Solar Noon in Mississauga on September 21 is 1:12 p.m.**
- **Shadow Patterns for September 21 and March 21 are similar**
- **Criteria for September 21 are deemed to apply to March 21**

| TABLE 1 | Criterion 3a Low and Medium Density Residential Streets | Criterion 3b Mixed use, Commercial, Employment and High Density Residential Streets |
|---|---|---|
| | **Maximum Angular Plane** | **Maximum Angular Plane** |
| **Eglinton Avenue** | | |
| Proposed building on north side of Eglinton Ave. | 38.6 degrees | _ |
| Proposed building on south side of Eglinton Ave. | 22.7 degrees | 48.9 degrees |
| | | |
| **Hurontario Street** | | |
| Proposed building on west side of Hurontario Street | 23.4 degrees | 47.4 degrees |
| Proposed building on east side of Hurontario Street | 44.6 degrees | _ |

**NOTES:**

1. Angular planes given above apply to the alignment of Eglinton Avenue and Hurontario Street and streets with equivalent orientation.
2. Angular planes are measured from the closest edge of the opposite curb (see Fig. 5).
3. Angular planes are measured beginning at grade.
4. Angular planes are measured perpendicular to the street.
5. See Figures 4, 5, 6 for graphical representations of the angular plane limits.

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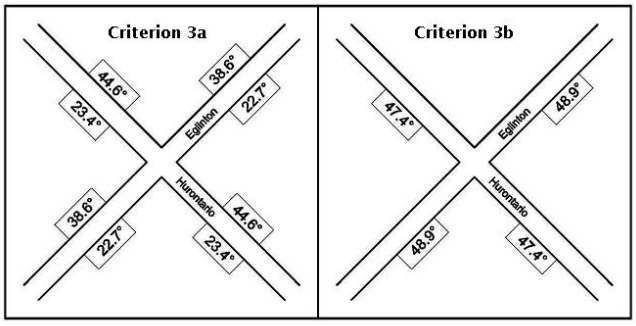
FIG. 4:
MAX. ALLOWABLE ANG. PLANES TO PROTECT OPPOSITE BOULEVARDS AND SIDEWALKS




ANGULAR PLANE SECTION VIEWS

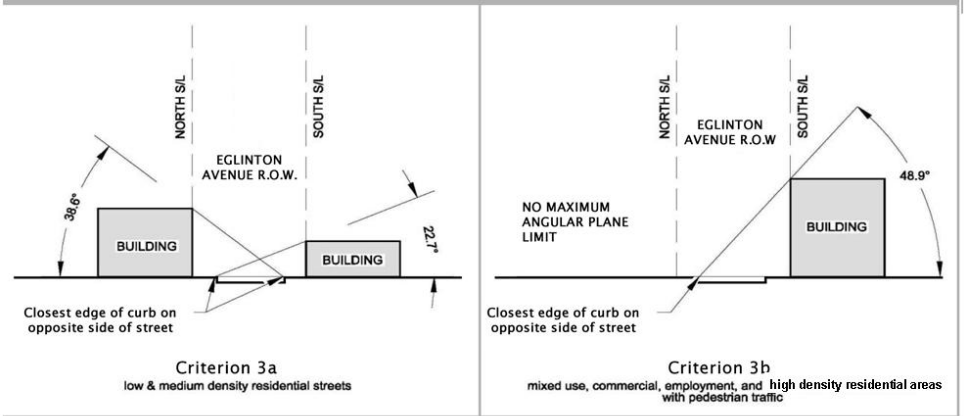



FIG. 5: EGLINTON AVENUE

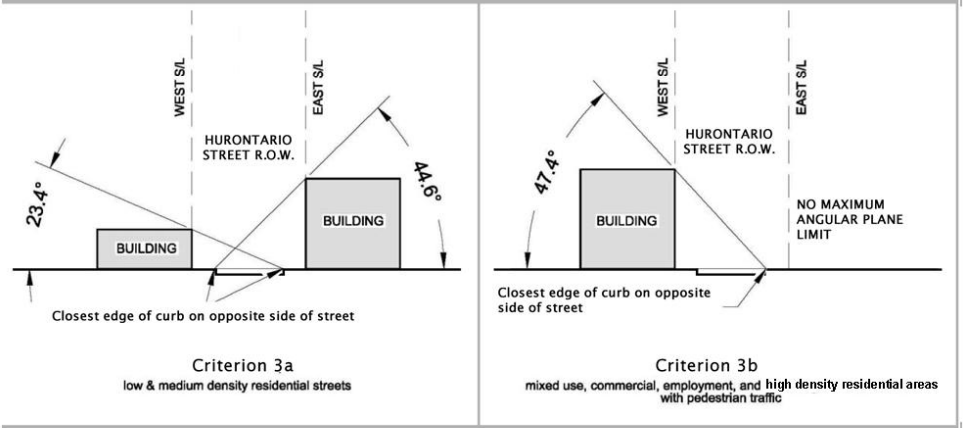



FIG. 6: HURONTARIO STREET

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## Ensure Adequate sunlight on the following:

### 4. Turf and flower gardens in public parks

Proposed developments should allow for adequate sunlight during the growing season from March to October by allowing for a minimum of **6 hours of direct sunlight on September 21**.

This criterion is met if full sun is provided on any 7 **test times** on September 21, from 1.5 hours after sunrise to 1.5 hours before sunset.

### 5. Building faces to allow for the possibility of using solar energy

Shadow impacts from proposed developments should not exceed **one hour** in duration on the **roofs, front, rear and exterior side walls** of adjacent **low rise** (one to four storeys) residential buildings including townhouses, detached and semi-detached dwellings on **September 21.**

The line of impact assessment shall be a line at grade, 3m from the front, rear and exterior side wall of the adjacent low rise residential building.

This criterion is met if there is shadow impact for no more than two consecutive hourly test times in the "No Impact Zone" i.e. the space between the front, rear and exterior side walls of the adjacent low-rise residential buildings and the respective lines of impact assessment.

**See Fig. 7 and 8**

**Incremental shadows do not necessarily represent adverse or undue impacts, and each proposal will be assessed on its own merits.**

**FIG. 7: PLAN**

**Line of Impact Assessment to be 3m from the front, rear and exterior side walls of existing dwelling**

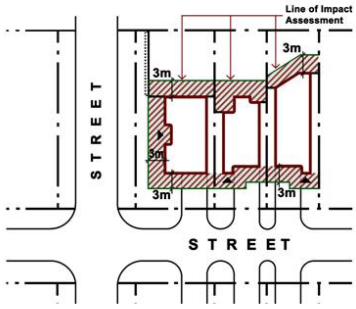
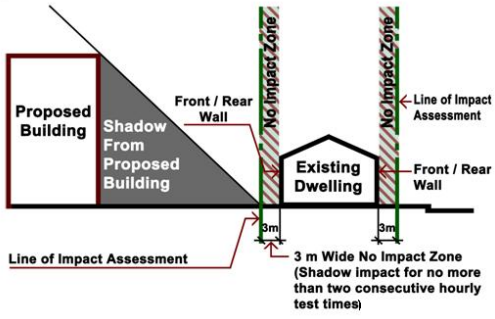



**FIG. 8: SECTION**



**Revised Standards for Shadow Studies** **File: CD.21.SHA**

## Material to be submitted with Development Application:

1. Complete set of shadow drawings for the dates and times shown in **Tables 2, 3, and 4: Mississauga Sun Angle data**, from **1.5 hours after sunrise to 1.5 hours before sunset**

2. Base mapping must include a minimum coverage area as follows:

a) 4.0 times the building height to the north, east and west
b) 1.5 times the building height to the south

3. Shadow drawings may be based on 2D mapping or air photos showing shadows from only the proposal, or they may be based on 3D mapping and include shadows from the proposed building and all buildings within the coverage area.

4. Shadow drawings shall include the following:

a) North arrow and scale bar
b) Reference bearing for at least one street adjacent to the subject site
c) A scale suitable to show the entire shadow coverage area
d) Existing and incremental shadows differentiated by hatching or colour
e) Approved but not yet constructed buildings identified in contrasting colour.
f) The name of the individual who has prepared the shadow drawings

5. Shadow drawings must be submitted with a written analysis which shall include the following information:

a) Confirmation of site latitude and longitude used in shadow drawings
b) A statement describing how astronomic north was determined
c) Origin/source of base plan
d) Description of all locations/uses of areas not meeting the shadow impact criteria (include a key plan for reference)
e) Quantification and assessment of the impact in the areas listed in 5(d)
f) Summary outlining how the shadow impact criteria have been met and describing any mitigating features that have been incorporated into the site and building design

g) The shadow drawings and reports shall be prepared by individuals qualified and/or experienced in this field.

**Additional study times and analyses may be required to properly determine the degree of impact.**

**The intent and objectives of the Standards For Shadow Studies are as interpreted by the Development and Design Division of the Planning and Building Department.**

**Revised Standards for Shadow Studies** **File: CD.21.SHA**

TABLE 2: MISSISSAUGA SUN ANGLE DATA (JUNE 21)

| | SHADOW DIRECTION AND LENGTH | | |
|---|---|---|---|
| **DATE: JUNE 21** | **Az** (deg) | **SLF** (ratio length/height) | **COMMENTS** |
| LOCAL TIME EDT | | | |
| 5:37 | 235.73 | | Rise |
| 7:07 | 250.48 | 4.1230 | Rise + 1.5 hr. |
| 7:20 | 252.58 | 3.5045 | SN - 6 hr. |
| 8:20 | 262.02 | 2.0048 | SN - 5 hr. |
| 9:20 | 272.04 | 1.3106 | SN - 4 hr. |
| 10:20 | 283.79 | 0.8976 | SN - 3 hr. |
| 11:20 | 299.52 | 0.6203 | SN - 2 hr. |
| 12:20 | 323.67 | 0.4375 | SN - 1 hr. |
| 13:20 | 0.00 | 0.3670 | Solar Noon (SN) |
| 14:20 | 36.32 | 0.4375 | SN + 1 hr. |
| 15:20 | 60.47 | 0.6203 | SN + 2 hr. |
| 16:20 | 76.21 | 0.8975 | SN + 3 hr. |
| 17:20 | 87.96 | 1.3105 | SN + 4 hr. |
| 18:20 | 97.98 | 2.0047 | SN + 5 hr. |
| 19:20 | 107.42 | 3.5042 | SN + 6 hr. |
| 19:33 | 109.41 | 4.0852 | Set - 1.5 hr. |
| 21:03 | 124.27 | | Set |
| | | | |
| | | | |
| | | | |

TABLE 3: MISSISSAUGA SUN ANGLE DATA (SEPT. 21)

| | SHADOW DIRECTION AND LENGTH | | |
|---|---|---|---|
| DATE: SEPTEMBER 21 | Az (deg) | SLF (ratio length/height) | COMMENTS |
| LOCAL TIME EDT | | | |
| 7:05 | 268.27 | | Rise |
| 8:35 | 284.22 | 3.6329 | Rise + 1.5 hr. |
| 9:12 | 291.23 | 2.5132 | SN - 4 hr. |
| 10:12 | 304.14 | 1.6445 | SN -3 hr. |
| 11:12 | 319.68 | 1.2181 | SN -2 hr. |
| 12:12 | 338.54 | 1.0011 | SN -1 hr. |
| 13:12 | 0.00 | 0.9329 | Solar Noon (SN) |
| 14:12 | 21.45 | 1.0022 | SN + 1 hr. |
| 15:12 | 40.28 | 1.2205 | SN + 2 hr. |
| 16:12 | 55.79 | 1.6495 | SN + 3 hr. |
| 17:12 | 68.68 | 2.5255 | SN + 4 hr. |
| 17:48 | 75.63 | 3.6493 | Set - 1.5 hr. |
| 19:18 | 91.46 | | Set |
| | | | |
| | | | |

TABLE 4: MISSISSAUGA SUN ANGLE DATA (DEC. 21)

| | SHADOW DIRECTION AND LENGTH | | |
|---|---|---|---|
| DATE: DECEMBER 21 | Az (deg) | SLF (ratio length/height) | COMMENTS |
| LOCAL TIME EST | | | |
| 7:49 | 302.37 | | Rise |
| 9:19 | 319.05 | 4.8874 | Rise + 1.5 hr. |
| 10:17 | 331.25 | 3.1643 | SN -2 hr. |
| 11:17 | 345.21 | 2.5293 | SN -1 hr. |
| 12:17 | 0.00 | 2.3589 | Solar Noon (SN) |
| 13:17 | 14.79 | 2.5293 | SN + 1 hr. |
| 14:17 | 28.75 | 3.1644 | SN + 2 hr. |
| 15:15 | 41.06 | 4.9172 | Set - 1.5 hr. |
| 16:45 | 57.63 | | Set |
| | | | |