

Town of Oakville

Development of Guidelines for Static Electronic Signs

Final Report

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Appendix A: Synthesis of Practices

1. Introduction

Like many industries, the outdoor signage industry is embracing and applying new technologies. As technology advances, the industry is taking advantage of electronic signs, some of which are Static Electronic Signs (SES). SES use a LED display and have the ability to automatically change the message shown on the sign at regular intervals. The ability to show multiple advertisement copies on a single sign, along with their brightness, high-resolution capacities and attention-grabbing potential, appeals to the outdoor signage industry. These signs are usually controlled remotely and some can even display full-motion videos. For this study, we are considering only electronic signs showing static text and images, and video signs are not included.

The signage industry is, by nature, seeking people's attention and roadside SES can be highly conspicuous and compete for drivers' attention. While studies have proven that electronic displays have impacts on driver distraction, the actual effects of this sign technology on collision experience have been difficult to prove conclusively. As a result, many government agencies/jurisdictions are adopting guidelines or regulations for SES in response to an ever-increasing number of installation requests. To that extent, the Town of Oakville (the Town) retained CIMA+ to undertake a comprehensive review of literature with the focus on the studies and projects funded by governmental agencies, and to develop recommendations on the application and implementation of SES, which can be considered during the review of the Town's by-law. The objective of these guidelines is to control aspects of the placement and operation of these signs, such as brightness, message duration, and message change intervals, which can have impacts on the surrounding environment and traffic.

This report summarizes the steps taken to achieve the objectives of this project. The next section summarizes the findings of the literature review, focusing on research studies, manuals, sign regulations and guidelines, existing by-laws, as well as best practices from national and international jurisdictions. The literature review seeks to a) explore the range of sign design and installation variables, and b) identify the roadway safety impacts of SES. Section 3 summarizes the background materials provided by the Town. Section 4 provides an overview of human factor elements that can assist in the development of guidelines for design and installation of the SES. Finally, Section 5 presents the proposed recommendations of the report.

2. Literature Review and Jurisdictional Scan

As noted above, we conducted the literature review to identify the roadway safety impacts of SES and to provide details on sign design and installation variables including location, size, display, illumination requirements and sign placing. To address these objectives, we structured this section of the report as follows:

- Section 2.1 summarizes the sign regulations and guidelines pertaining to SES for jurisdictions in Ontario and Canada. The findings of this section are supplemented by the information provided by the Town, including the guidelines from the City of Ann Arbor, Michigan, and a number of other jurisdictions in Canada; and
- Section 2.2 presents the findings of the literature in terms of road safety impacts of SES.

2.1. Regulations and By-laws

2.1.1. City of Ottawa

The City of Ottawa has a by-law¹ for regulating permanent signs on private properties. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Message centre” is an on-premise sign that is designed to have the alpha numeric characters or images that its display changes by use of automatic, electronic or manual methods.
- “Ground sign” is a sign that is affixed to the ground by a self-supporting structure that includes a permanent foundation.
- “Wall sign” is a sign that is flat to a wall or window and may include a painted wall sign, banner sign, building canopy sign, projected image sign or window sign.

Regulations applicable to SES are included in Table 1.

Table 1: City of Ottawa Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Message Centre
Type of Installation	Ground Sign in general Wall sign for theatre and cinema
Size and Location	<ul style="list-style-type: none"> • A message centre within 45 m of a residential dwelling is not permitted • Minimum setback from a signalized intersection = 18 m • Minimum setback from another message centre or digital billboard = 60 m • Not permitted within 30 m radius setback from some buildings or structures designated under Ontario Heritage Act Size, height, and location controlled by identification ground sign regulations: <ul style="list-style-type: none"> • General Requirement <ul style="list-style-type: none"> ▪ Maximum message centre area ≤ 40% of area of ground sign (with maximum 6 m²) ▪ Height = 1.5 m – 8.0 m (based on land use, e.g. non-residential use in residential zones = 1.5 m, institutional and leisure zones = 3.0 m, transportation zones = 4.5 m – 8.0 m) ▪ Minimum setback from property line = 1.0 m – 3.0 m (based on land use zone and property line type, i.e. front, rear, or side)

¹ Permanent Signs on Private Property (By-law No. 2016-326), City of Ottawa, <http://ottawa.ca/en/permanent-signs-private-property-law-no-2016-326>, Accessed 10 October 2017

Characteristics	Description
	<ul style="list-style-type: none"> • For school, place of worship, library, university, college, hospital or recreational and athletic facility use: <ul style="list-style-type: none"> ▪ Maximum message centre sign area \leq 25% of area of ground sign (with maximum 1.75 m²) ▪ Permitted on arterial or major collectors but for scenic entry routes ▪ Minimum dwell time if directly across a residential zone = 6 minutes • For golf course, recreational, athletic facility, community centre, and sports arena: <ul style="list-style-type: none"> ▪ Minimum distance from a residential use = 60 m ▪ Maximum message centre sign area \leq 25% of area of ground sign • For a theatre or cinema (as a wall sign): <ul style="list-style-type: none"> ▪ Minimum distance from a residential use = 45 m ▪ Maximum message centre sign area \leq 75% of area of the wall sign ▪ Wall sign not to exceed 40% of the wall area of the storey where it is attached
Other Characteristics	<ul style="list-style-type: none"> • Only static alphanumeric text and images are permitted with no scrolling text or any flashing text, characters, images, video or audio • Only on-premise information can be displayed • Minimum dwell time = 20 seconds • Maximum transition time = 1 second
Illumination Regulation	<ul style="list-style-type: none"> • Illuminated sign not permitted within 30 m of a residential use, if visible from that residential use • External illumination to be downward facing • Flashing, blinking, intermittent, a strobe, rotating, changing light beam or beacon not permitted • Maximum luminance = 5000 cd/m² (between sunrise and sunset) • Maximum luminance = 220 cd/m² (between sunset and sunrise) • Maximum brightness above ambient light = 3 lux • Brightness to be controlled by automatic technology
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Animated and flashing signs
Permitted Land uses	<ul style="list-style-type: none"> • As identification ground sign for a school, place of worship, library, university, college, hospital or recreational and athletic facility • As identification ground sign golf course, recreational and athletic facility, community centre, and sports arena • As a part of wall sign for theatre or cinema

Characteristics	Description
	<ul style="list-style-type: none"> As identification ground sign for shopping centres, commercial, and industrial zones

2.1.2. City of Burlington

The City of Burlington has a by-law to regulate the size, use, location and maintenance of signs and advertising devices². Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- The by-law defines “Read-O-Graph” as any part of a sign, designed so that any identification or advertisement is readily interchangeable by manual or electronic means and includes an electronically controlled message centre. The SES falls into this category of signage. However, the by-law does not provide any specific guidelines for read-o-graphs. Instead, the general regulations for “ground sign” and “fascia signs”, as defined below, can be applicable for SES.
- “Ground sign” is a sign supported by uprights or braces embedded in a foundation in the ground to a depth of at least 1.2 m and which is not attached to any part of a building.

Regulations applicable to SES are included in Table 2.

Table 2: City of Burlington Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Read-O-Graph
Type of Installation	Ground Sign
Size and Location	<p>No specific regulation. Controlled by maximum ground sign area:</p> <ul style="list-style-type: none"> If frontage of a property on one street: <ul style="list-style-type: none"> Maximum ground sign area $\leq 0.30 \times$ frontage length If frontage of a property on more than one street: <ul style="list-style-type: none"> Maximum ground sign area $\leq 0.30 \times$ longest frontage length + $0.20 \times$ lengths of all other frontages Maximum area of one ground sign = 56 m² (maximum for each face = 28 m²) <ul style="list-style-type: none"> Sign area per face $\leq 2.7 \times$ height Maximum number of ground sign per property = 2 Maximum number of ground sign per frontage = 1 Minimum spacing = 45 m Maximum height:

² By-Law Number 34-2007, City of Burlington, <https://www.burlington.ca/uploads/91/635575154675535485.pdf>, Accessed 10 October 2017

Characteristics	Description
	<ul style="list-style-type: none"> ▪ Commercial zone = 1.2 x setback from closest Street (maximum 10.5 m) ▪ Employment zone = 3.6 m • Minimum setback from property line = 1.5 m • Minimum setback from lot line: <ul style="list-style-type: none"> ▪ Residential zone/hospital/park/school = 15 m ▪ Any other lot = 4.5 m
Other Characteristics	N/A
Illumination Regulation	<ul style="list-style-type: none"> • Illuminated signs in vicinity of residential areas to be extinguished between 2300 hours and 0700 hours
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Animated and flashing signs • Billboards cannot have automated message changes and cannot be installed in residential zones
Permitted Land uses	Based on ground signs: <ul style="list-style-type: none"> • Commercial, employment, and residential zones with minimum setback requirements as above

2.1.3. City of Waterloo

The City of Waterloo has a by-law to regulate signs and other advertising devices within the City.³ Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Changeable Copy” is the portion of a sign on which the copy of the sign is designed to be changed manually or electronically on a regular basis.
- “Copy” consists of the wording, letters, numerals, logos and/or artwork of the sign, on the sign surface either permanent or removable.
- “Freestanding sign” is a sign that has its own structural support independent of a building that has a minimum height above the adjoining ground of 1.5 metres.
- “Ground sign” is a sign that has its own structural support independent of a building that has a maximum height above the adjoining ground of 1.5 metres.
- “Variable electronic sign” is a sign on which text messages are displayed by means of light emitting diodes, liquid crystal display, plasma or other similar technology. Variable electronic signs include only messages displayed in text and do not include any images.

Regulations applicable to SES are included in Table 3.

³ By-law No. 2016-050, City of Waterloo, Being A By-Law to Prohibit and Regulate Signs and Other Advertising Devices within the City of Waterloo, http://www.waterloo.ca/uploads/94/Doc_636247556993061941.pdf, Accessed 11 October 2017

Table 3: City of Waterloo Regulations Applicable to SES

Characteristics	Description
Equivalent Signs Used	<ul style="list-style-type: none"> • Changeable copy (may include wording, letters, numerals, logos and/or artwork) • Variable electronic message signs (only text)
Type of Installation	Changeable copy – freestanding signs Variable message sign – freestanding signs and ground signs
Size and Location	Freestanding signs (general requirements): <ul style="list-style-type: none"> • Maximum area of a freestanding sign = 14 m² (maximum for each face = 7 m²) • Maximum area for changeable copy = 3m² per face up to a total of 6m² (should not exceed 50% of total area) • Maximum height = 10 m • Minimum setback from lot line = 1.5 m Freestanding signs (specific requirements): <ul style="list-style-type: none"> • For an industrial property with frontage ≤ 45 m: <ul style="list-style-type: none"> ▪ General requirements as above • For an industrial property with frontage > 45 m: <ul style="list-style-type: none"> ▪ Sign area ≤ 0.155 x frontage length per face (with a maximum of 22.5 m²) and 0.31 x total frontage length (with a maximum of 45 m²) • For an industrial property with frontage > 150: <ul style="list-style-type: none"> ▪ An additional freestanding sign is permitted
	Ground Signs: <ul style="list-style-type: none"> • Maximum area of a ground Sign = 6 m² (maximum for each face = 3 m²) • Maximum area for changeable copy = 80% of total area • Maximum height = 1.5 m • Minimum setback from lot line = 1.5 m
Other Characteristics	<ul style="list-style-type: none"> • Variable message sign one per property • Maximum variable message area = 50% of total sign area • Minimum dwell time = 10 sec
Illumination Regulation	<ul style="list-style-type: none"> • Rotating beam beacon or flashing illumination, resembling an emergency light is not permitted • Signs may be illuminated by internal lights (concealed within the sign) or gooseneck lights • Downcast of shielded light to minimize reflective impact on the night sky • Glare or shine to oncoming traffic or neighbouring premises not permitted • Lighting to be turned off between 11:00pm and 7:00am • Maximum brightness above ambient light = 3 lux

Characteristics	Description
	<ul style="list-style-type: none"> Brightness to be controlled by automatic technology
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> Animated signs Billboards except at certain locations
Permitted Land Uses	<p>The City is divided in ten zones. Variable message signs and/or changeable copy are permitted in following land uses:</p> <ul style="list-style-type: none"> Academic and major institutional Business employment and industrial Mixed use and commercial Parks/Open Space and Rural

2.1.4. City of Sault Ste. Marie

The City of Sault Ste. Marie has a by-law⁴ to regulate digital signs within the City of Sault Ste. Marie. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Changeable copy” is the part of a ground sign composed of letters and characters intended to convey a temporary message, and which can change the message mechanically or electronically.
- “Digital sign” is a sign which is remotely changed on or off site and incorporates a technology or method allowing the information displayed on the sign to be changed without physically or mechanically replacing the display surface or its components.
- “Electronic message board” is a changeable copy sign that has messages displayed by electronic means. Such signs are only capable of displaying text.

Regulations applicable to SES are included in Table 4.

Table 4: City of Sault Ste. Marie Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Changeable copy Digital sign Electronic message board
Type of Installation	Ground sign Window sign Wall sign
Size and Location	<p>Electronic message board (industrial, commercial, institutional land uses)</p> <ul style="list-style-type: none"> One electronic message board with a maximum 30% of the total area of ground sign is permitted as a part of ground sign

⁴ By-law No. 2017-35, Being a by-law for regulating or prohibiting signs and other advertising devices, City of Sault Ste. Marie, <http://saultstemarie.ca/Cityweb/media/Legal/By-laws/2017-35.pdf>, accessed October 11, 2017.

Characteristics	Description
	<ul style="list-style-type: none"> • Minimum setback from property line = 1.0 m • Maximum height = 7.5 m • Maximum area of ground sign = 0.3 m² x length of street line (maximum 15 m²) <p>Digital signs (commercial land use)</p> <ul style="list-style-type: none"> • One digital sign with a maximum 15% of the façade area or 8 m², whichever is less • Maximum area if ground sign is used = 7.5m² <p>Digital signs (for window signs)</p> <ul style="list-style-type: none"> • Maximum area for window sign = 50% of window area (with a maximum of 2.0 m²)
Other Characteristics	<p>Digital signs</p> <ul style="list-style-type: none"> • No sound • Not to be portable • Not to be used for third party signage unless it is bill board • Minimum dwell time = 15 seconds • Maximum transition time = 0.25 seconds • Remain blank during malfunction • Minimum clearance of 3 m above grade • Sign within 100 m of signalized and 50 m of an unsignalized require a safety review <p>Electronic message boards</p> <ul style="list-style-type: none"> • Minimum dwell time = 30 seconds
Illumination Regulation	<ul style="list-style-type: none"> • Light should not trespass beyond the sign support structure and the display surface area of the sign and create glare • Maximum brightness above ambient light = 3.23 lux
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Displaying visible effects, such as motion, dissolving, fading, flashing, intermittent or blinking light, scrolling are prohibited
Permitted Land uses	<p>The City is divided into sign districts, such as residential, industrial, commercial, institutional, and rural.</p> <ul style="list-style-type: none"> • Electronic message boards are permitted in industrial, commercial, institutional as part of ground signs • Digital signs are permitted in commercial sign district

2.1.5. City of Calgary

The City of Calgary has sign regulations as part of its land use bylaws. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Digital message sign” is a sign that displays a copy by means of a digital display but does not contain copy that is full motion video or otherwise gives the appearance of animation or movement and does not display third party advertising.
- “Freestanding sign” is a sign that is displayed on a permanent, non-moveable structure other than a building, may incorporate a message or a digital message sign.

Regulations applicable to SES are included in Table 5.

Table 5: City of Calgary Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Digital message sign
Type of Installation	Freestanding sign
Size and Location	<ul style="list-style-type: none"> • Digital signs (commercial or industrial district) <ul style="list-style-type: none"> ▪ Maximum area of 5 m², if attached to a building ▪ Maximum area of 2.5m² and 30% of the window area if used in a window ▪ Maximum 50% of the sign area if used in a freestanding sign • Digital signs (low-density residential districts) <ul style="list-style-type: none"> ▪ Maximum area of 1.0 m² • Digital signs of area 2.0 m² cannot be located within 30 m of a railway crossing • Freestanding signs <ul style="list-style-type: none"> ▪ Minimum spacing between two signs = 30 m (for same direction of traffic) ▪ Maximum one sign per parcel facing each street up to 200 metres frontage, additional sign is permitted if frontage is greater than 200 metres ▪ Maximum area of freestanding signs = 5 m² – 18.5 m² (based on land use, e.g. 5 m² for low density residential areas and 18.5 m² for specified commercial district, 7 m² for commercial multi-residential land use) ▪ Maximum height = 4 m – 12 m (based on land use, e.g., 4 m for low density residential areas and 12.2 m for specified commercial district, 6 m for commercial multi-residential land use)

⁵ The City of Calgary land use bylaw 1P2007, http://www.calgary.ca/PDA/pd/Documents/Calgary-Land-Use-by-law-1P2007/bylaw_1p2007.pdf, accessed October, 11, 2017

Characteristics	Description
Other Characteristics	Digital signs <ul style="list-style-type: none"> • Digital signs not to display animation or any effects that look like animation or sequential messages • Minimum dwell time = 6 seconds • Maximum transition time = 0.25 seconds • Remain blank during malfunction • Maximum one digital sign permitted per parcel with the exception of corner parcel which can have one sign on each street • Cannot operate if located within 125 m (or visible) from a dwelling unit: <ul style="list-style-type: none"> ▪ Commercial / industrial / mixed use districts = 11 pm to 6 am ▪ Residential districts = 10 pm to 7 am
Illumination Regulation	<ul style="list-style-type: none"> • Maximum brightness above ambient light = 3.0 lux • Illumination controlled by ambient light sensor • Maximum daytime luminance = 7500 Nits • Maximum nighttime luminance = 500 Nits (industrial areas), 300 – 350 Nits in specified areas
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Digital signs not to display animation or any effects that look like animation or sequential messages • Signs in residential zones not to be internally illuminated to prevent trespass of light onto adjacent parcels
Permitted Land uses	<ul style="list-style-type: none"> • Digital signs are permitted in commercial, industrial, and, mixed use districts • Can be approved for low-density residential districts and multi-residential districts for advertising events or services offered

2.1.6. City of Edmonton

The City of Edmonton’s Sign Regulations are included in Section 59 of their Zoning Bylaw 12800⁶. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Major digital sign” is a sign remotely changed on or off site and has a varying message duration that may be less than 6 seconds. Major digital signs may include moving effects, message transition effects, and video images.

⁶ Zoning Bylaw No. 12800, City of Edmonton, https://www.edmonton.ca/documents/PDF/current_Zoning_Bylaw.pdf, accessed October 12, 2017

- “Minor digital off-premises sign” is a sign remotely changed on or off and has a message duration greater than or equal to 6 seconds. The copy of such signs is not related to content of the premises on which the sign is installed.
- “Minor digital on-premises sign” is a sign that remotely changed on or off and has a message duration greater than or equal to 6 seconds. The copy of such signs relates to the content of the premises on which the sign is installed.

Regulations applicable to SES are included in Table 6.

Table 6: City of Edmonton Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Digital signs
Type of Installation	Freestanding sign Fascia sign
Size and Location	<ul style="list-style-type: none"> • Minimum separation from other digital signs <ul style="list-style-type: none"> ▪ 100 m for signs more than 8.0 m² and less than 20.0 m² ▪ 200 m for signs more than 20.0 m² and less than 40.0 m² ▪ 300 m for signs more than 40.0 m² • Maximum number of signs on a site = 4 • Maximum height = 8 m • Maximum width = 8m • Signs not to project beyond the property line with minimum setback of 3.0 m is specified for some uses <p>Public / community zones (minor digital signs allowed)</p> <ul style="list-style-type: none"> • Maximum area of 3.0 m² for fascia signs and 8.0 m² for freestanding signs <p>Neighbourhood commercial zones (minor digital signs allowed)</p> <ul style="list-style-type: none"> • Maximum area of 10.0 m² for fascia signs (maximum 25% wall coverage) and 10.0 m² for freestanding signs <p>Commercial and pedestrian commercial zones (minor digital signs allowed)</p> <ul style="list-style-type: none"> • Maximum area of 20.0 m² for fascia signs (maximum 25% wall coverage) and 20.0 m² for freestanding signs <p>Commercial and pedestrian commercial zones (major digital signs allowed)</p> <ul style="list-style-type: none"> • Maximum area of 10.0 m² for fascia signs (maximum 25% wall coverage) and 10.0 m² for freestanding signs <p>Business zones (minor digital signs allowed)</p> <ul style="list-style-type: none"> • Maximum area of 65.0 m² for fascia signs (maximum 25% wall coverage) and 65.0 m² for freestanding signs <p>Business zones (major digital signs allowed)</p> <ul style="list-style-type: none"> • Maximum area of 20.0 m² for fascia signs (maximum 25% wall coverage) and 20.0 m² for freestanding signs <p>Medium and heavy industrial (minor digital signs allowed)</p>

Characteristics	Description
	<ul style="list-style-type: none"> Maximum area of 12.0 m² for fascia signs (maximum 25% wall coverage) and 12.0 m² for freestanding signs <p>Medium and heavy industrial (major digital signs allowed)</p> <ul style="list-style-type: none"> Maximum area of 12.0 m² for fascia signs (maximum 25% wall coverage) and 12.0 m² for freestanding signs
Other Characteristics	Minimum dwell time = 6 seconds for minor digital signs. Dwell time can be less than 6 seconds for major digital signs.
Illumination Regulation	<ul style="list-style-type: none"> illumination that competes with or dulls the contrast of traffic control devices or signals is not permitted. Maximum brightness above ambient light = 0.3 foot candles. Illumination controlled automatically to adjust levels of light at night under cloudy and other darkened conditions to reduce light pollution. Maximum nighttime luminance = 400 Nits (between sunset and sunrise) Signs abutting or adjacent to natural area of public to be energized between 12:00 am and 5:00 am.
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> Digital signs can not be roof signs, projecting signs or temporary signs
Permitted Land uses	<ul style="list-style-type: none"> Minor digital signs permitted in residential zones, public / community zones, neighbourhood commercial zones, pedestrian and pedestrian commercial zones, business zones, medium and heavy industrial zones. Major digital signs permitted in pedestrian and pedestrian commercial zones, business zones, medium and heavy industrial zones.

2.1.7. City of Vancouver

The City of Vancouver has a by-law⁷ to regulate signs within the City of Vancouver. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Electronic copy” is a copy generated, displayed or changed using electronic screens, touch screens, computer video monitors, liquid crystal displays, light emitting diode displays or any other electronic, computer generated or digital technology.
- “Electronic message sign” is a sign that displays electronic copy consisting only of text.
- “Electronic sign” is an electronic message, electronic static image or electronic video sign and does not include a projected image sign.

⁷ Sign By-law No. 11879, City of Vancouver, <http://bylaws.vancouver.ca/Sign/SignBy-law11879.pdf>, accessed on October 12, 2017

- “Electronic static image sign” is a sign that displays electronic copy that remains static on the screen for a stipulated time period.
- “Electronic video sign” is a sign that displays electronic copy consisting of video.

Regulations applicable to SES are included in Table 7.

Table 7: City of Vancouver Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Electronic static signs
Type of Installation	Freestanding sign Fascia sign Projecting sign
Size and Location	<ul style="list-style-type: none"> • Minimum 30 m from a dwelling unit facing a sign • Minimum 15 m from a traffic control signal <p>Electronic signs in residential districts</p> <ul style="list-style-type: none"> • Permitted at community centre, neighbourhood house, place of worship or school as part of freestanding signs • 60% of the sign area can be electronic copy with a maximum of 2.3 m² • One freestanding sign per site permitted normally. For frontage longer than 60 m, an additional sign can be permitted <ul style="list-style-type: none"> ▪ Freestanding sign Height = 2.0 m for area ≤2000 m² and 5.0 m for area > 2000 m² ▪ Maximum total sign area of freestanding sign 2.0 m² for area ≤2000 m² and 5.0 m² for area > 2000 m² ▪ Minimum setback from property line = 1.5 m ▪ Minimum setback from building line = 1.0 m <p>Electronic message sign</p> <ul style="list-style-type: none"> • Permitted as part of freestanding, fascia and projecting signs in commercial mixed use and industrial sign district <ul style="list-style-type: none"> ▪ Limited to one sign on each frontage of a building ▪ 80% of the sign area with a maximum of 4.0 m² for a site smaller than 0.40 ha and with a maximum of 8.0 m² for larger sites ▪ Freestanding signs <ul style="list-style-type: none"> • Freestanding sign of area greater than 5.0 m² to be 20.0 m from the intersection • Two freestanding signs on each frontage with maximum of six signs are permitted • Maximum freestanding sign height = 8.0 m • Maximum total sign area of freestanding sign = 0.3 m² x frontage length (with a maximum of 3.0 m² to 14.0 m² based on zones) • Minimum setback from property line = 1.5 m • Minimum setback from building line = 1.0 m • Minimum spacing with other freestanding sign = 45 m ▪ Fascia and projecting signs

Characteristics	Description
	<ul style="list-style-type: none"> • Site specific regulations for total area (e.g. for fascia sign total area at a site is 0.3 m² for each metre of frontage with a maximum of 4.5 m² and for projecting sign, area is in the range of 0.75 m² to 2.3 m²) <p>Electronic static image sign</p> <ul style="list-style-type: none"> • Permitted in commercial mixed use and industrial sign district <ul style="list-style-type: none"> ▪ One sign on each frontage of a building as a window sign ▪ Not permitted with any other electronic sign ▪ Limited to one sign on each frontage of a building ▪ Sign area to be less than 30% (in combination with other window signs) of the window area with a maximum of 2.5 m²
Other Characteristics	<ul style="list-style-type: none"> • Minimum dwell time = 10 • Maximum transition time = 0.5 seconds • Remain blank during malfunction • Sign to be turned off between 11:00 pm and 7: am
Illumination Regulation	<ul style="list-style-type: none"> • A sign not to be illuminate from below • Externally illuminated signs should direct the light downwards • Maximum brightness above ambient light = 3.0 Lux • Luminance to be controlled by ambient light sensor • Maximum nighttime luminance = 200 Nits (between sunset and sunrise) • Maximum daytime luminance = 5000 Nits (between sunrise and sunset) • Signs within 30 m of a residential zone to be turned off between 11.00 pm and 7:00 am.
Relevant Prohibitions of Interest	N/A
Permitted Land uses	<ul style="list-style-type: none"> • Permitted electronic sign land uses <ul style="list-style-type: none"> ▪ Residential land uses at community centre, neighbourhood house, place of worship or school as part of freestanding signs as freestanding signs ▪ Commercial mixed use and industrial sign district as part of fascia signs, freestanding, and projecting signs

2.1.8. Town of Oakville

The Town of Oakville has a by-law⁸ to regulate signs within the Town of Oakville. Relevant definitions and regulations as applicable to SES are as follows:

⁸ By-law No. 2006-005, The Corporation of Town of Oakville, http://signpermit.net/ByLaw/SignByLaw_Oakville, accessed on October 12, 2013

Definitions:

- “Electronic message board” is a sign which is electronically controlled and which displays information in a prearranged sequence.
- “Ground sign” is a sign which is freestanding in a fixed position and is supported by a sign structure attached to or affixed into the ground.

Regulations applicable to SES are included in Table 8.

Table 8: Town of Oakville Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Electronic message Board
Type of Installation	Ground sign Fascia sign
Size and Location	<ul style="list-style-type: none"> • Electronic message board permitted on ground signs at schools, university or community college, hospital, library or government institution <ul style="list-style-type: none"> ▪ Maximum area of electronic message board = 30% of ground sign area • Electronic message board permitted on ground and fascia signs in employment or commercial zone <ul style="list-style-type: none"> ▪ Only display of time and/or temperature is permitted • Ground sign <ul style="list-style-type: none"> ▪ Maximum area of one ground sign = 7.5 m² (with of schools, where maximum area = 4.0 m²) ▪ Maximum height = 6.75 m ▪ Minimum setback from property line = 1.5 m (for schools 3.0 m) ▪ Not to be erected within 3 metres of a driveway entrance or exit and within 15 m of a traffic signal
Other Characteristics	Minimum dwell time = 30 seconds
Illumination Regulation	<ul style="list-style-type: none"> • The intensity of illumination to be maintained at a constant level • Light from the illuminated sign not to be deflected from any property and the path of vehicular traffic • Lighting intensity to be dimmed or turned off between 10:00 pm and 8:00 am
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Animated signs are prohibited
Permitted Land uses	<ul style="list-style-type: none"> • Electronic message board permitted on ground signs at schools, university or community college, hospital, library or government institution • Electronic message board permitted on ground and fascia signs in employment or commercial zone

2.1.9. Town of Milton

The Town of Milton has a by-law⁹ to regulate signs within the Town of Milton. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Animated sign” is a sign which includes flashing, action or motion whether electronic action, mechanical action, colour or message change by way of a prearranged electronic or mechanical means.

Regulations applicable to SES are included in Table 9.

Table 9: Town of Milton Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Animated sign
Type of Installation	Ground sign Wall sign
Size and Location	<ul style="list-style-type: none"> • Animated Sign <ul style="list-style-type: none"> ▪ Total area if a wall sign = 20% of the architectural elevation or 6.9 m² (lesser of the two) ▪ Total area if a ground sign = 30% of total sign area per face or 6.9 m² (lesser of the two) • Ground sign <ul style="list-style-type: none"> ▪ Total area of ground signs on any property = 70% of the frontage of the property ▪ Maximum two ground signs are permitted on a property ▪ Minimum spacing between ground signs = 45.7 m ▪ Maximum height = 3.0 m – 7.6 m (based on area and land use) ▪ Minimum setback = 1.0 m to 6.0 m (based on the adjacent land use) • Wall sign <ul style="list-style-type: none"> ▪ Maximum total area in a single occupancy development = 20% of the area of architectural elevation ▪ Maximum total area (of all wall signs on an elevation) in shopping centre, plaza or mall = 20% of the area of architectural elevation
Other Characteristics	Animated sign for repetitive messages are permitted Minimum dwell time = 5 seconds
Illumination Regulation	N/A

⁹ By-law No. 086-2009, The Corporation of Town of Milton, <https://www.milton.ca/MeetingDocuments/Council/bylaws2009/086-2009%20Sign%20By-law.pdf>, accessed on October 12, 2017

Characteristics	Description
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> Animated signs are prohibited in downtown business improvement and character area
Permitted Land uses	<ul style="list-style-type: none"> Permitted in areas other than Milton downtown business improvement area and character area and Campbellsville downtown.

2.1.10. City of Mississauga

The City of Mississauga has a by-law¹⁰ to regulate signs within the City of Mississauga. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Changing copy sign” is a sign in which the message or copy can be changed by manual, electronic, or electro-mechanical means.

Regulations applicable to SES are included in Table 10.

Table 10: City of Mississauga Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Changing copy sign
Type of Installation	Ground sign
Size and Location	<ul style="list-style-type: none"> Changing copy <ul style="list-style-type: none"> Total area if a ground sign = 50% of total sign area Ground sign <ul style="list-style-type: none"> Residential areas <ul style="list-style-type: none"> Maximum height = 1.2 m for houses, 3.6 m for apartments, 4.0 m for schools Maximum area = 0.2 m² for house, 1.5 m² for apartments, 5 m² for school and religious places Minimum setback from lot line = 1.0 m One sign per property Ground sign <ul style="list-style-type: none"> Commercial, office and employment areas <ul style="list-style-type: none"> Maximum height = 7.5 m Maximum area range = 15.0 m² for commercial undertaking, hotels, and shopping centres of area less than 4.0 ha, 28 m² for shopping centre with area more than 4.0 ha, 20.0 m² for cinemas Minimum setback from lot line = 1.0 m One sign for each street

¹⁰ The Sign by-law 54-02, The Corporation of City of Mississauga, <http://www.mississauga.ca/file/COM/signcorrection2009.pdf>, accessed on October 12, 2017

Characteristics	Description
Other Characteristics	N/A
Illumination Regulation	N/A
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Flashing and animated signs are prohibited
Permitted Land uses	<ul style="list-style-type: none"> • Ground signs permitted in residential, open spaces, commercial, office and employment areas

2.1.11. City of Brampton

The City of Brampton has a by-law¹¹ to regulate signs within the City of Brampton. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Electronic variable message centre” is an illuminated sign or part thereof which is computer controlled and which displays information to the public by way of prearranged or variable sequence of electronically generated letters, words, light patterns or shapes and shall include text or graphic boards.

Regulations applicable to SES are included in Table 11.

Table 11: City of Brampton Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Electronic variable message centre
Type of Installation	<p style="text-align: center;">Ground signs Entry door windows of non-residential units</p>
Size and Location	<ul style="list-style-type: none"> • One electronic variable message permitted on the window of main entrance of a non-residential zone building <ul style="list-style-type: none"> ▪ Sign to be at a distance of 36 m from the residential lands ▪ Maximum sign area = 0.19 m² (maximum 20% of the glazed area) • Electronic variable message sign is permitted on ground sign <ul style="list-style-type: none"> ▪ Maximum electronic area = one third of total ground sign area ▪ At a minimum distance of 36 m from a residential property (not applicable if the sign is on a school) • Ground sign <ul style="list-style-type: none"> ▪ Distance from the finished grade to the bottom of sign should be less than 900 mm or greater than 2.4 m <ul style="list-style-type: none"> • Maximum height = 7.5 m • Maximum sign area range = 15.0 m²

¹¹ Sign by-law 399-2002, The Corporation of City of Brampton, <https://www.brampton.ca/EN/City-Hall/Bylaws/All%20Bylaws/Sign.pdf>, accessed on October 12, 2017

Characteristics	Description
	<ul style="list-style-type: none"> • Minimum setback from lot line = 1.5 m • One sign per site (one additional sign is permitted if combined frontage of a corner lot is greater than 150 m) • Minimum spacing between signs = 30 m
Other Characteristics	<ul style="list-style-type: none"> • If the sign is within 100 m of a residential property, it should be turned off between hours of 10:00 pm and 7:00 am
Illumination Regulation	<ul style="list-style-type: none"> • Illumination to be fully shielded and oriented downward
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Flashing messages not permitted • Scrolling script not permitted • Portable signs not permitted
Permitted Land uses	<ul style="list-style-type: none"> • Ground signs permitted in residential, open spaces, commercial, office and employment areas

2.1.12. City of Guelph

The City of Guelph has a by-law¹² to regulate signs within the City of Guelph. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Electronic variable message centre” is an illuminated sign or part thereof which is computer controlled and which displays information to the public by way of prearranged or variable sequence of electronically generated letters, words, light patterns or shapes and shall include text or graphic boards.

Regulations applicable to SES are included in Table 12.

Table 12: City of Guelph Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Electronic message sign
Type of Installation	Freestanding signs
Size and Location	<ul style="list-style-type: none"> • Every mall with minimum one frontage exceeding 280.0 metres may have one electronic message sign <ul style="list-style-type: none"> ▪ Maximum sign area = 7.5 m²
Other Characteristics	Minimum dwell time = 10 seconds
Illumination Regulation	<ul style="list-style-type: none"> • External light used to illuminate a sign to be directed away from any adjacent place or street

¹² Sign by-law 399-2002, The Corporation of City of Brampton, <https://www.brampton.ca/EN/City-Hall/Bylaws/All%20Bylaws/Sign.pdf>, accessed on October 12, 2017

Characteristics	Description
	<ul style="list-style-type: none"> Any freestanding sign greater than 1.8 metres in height to be lighted internally and to be at least 15.0 metres away from any residential zone
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> Animated signs are prohibited Any sign which as action, motion or colour change as any part of the sign is prohibited
Permitted Land uses	<ul style="list-style-type: none"> Shopping malls

2.1.13. City of Windsor

The City of Windsor has a by-law¹³ to regulate signs within the City of Windsor. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Electronic changing copy” is an electronically and/or computer-controlled sign, or that part thereof, which displays “Illuminated Copy” and graphic information in a pre-arranged sequence for continuous scrolling or flashing display or other form of “Animation”.
- “Changing copy area” means the copy area on a sign face permitted for Electronic, Manual, and/or Rotating Changing Copy.

Regulations applicable to SES are included in Table 13 .

Table 13: City of Windsor Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Electronic changing copy
Type of Installation	Permanent canopy signs Permanent fascia signs Permanent ground signs Permanent projecting wall signs
Size and Location	<ul style="list-style-type: none"> Electronic changing copy for permanent canopy signs <ul style="list-style-type: none"> Maximum permitted sign face area = 30% Maximum total sign face area for permitted land uses = 2.0 m² Electronic changing copy for permanent fascia signs <ul style="list-style-type: none"> Maximum permitted sign face area = 30% Maximum total sign face area for permitted land uses = 10% to 30% of the wall area based on different land uses Electronic changing copy for permanent ground signs

¹³ By-law 250-2004, The City of Windsor, http://www.citywindsor.ca/residents/building/Documents/Text_By-law%20250-2004_Updated%20APR242015.pdf, accessed on October 12, 2017

Characteristics	Description
	<ul style="list-style-type: none"> ▪ Maximum permitted sign face area = 30% ▪ Maximum total sign face area based on land uses
Other Characteristics	<ul style="list-style-type: none"> • Minimum dwell time = 4 seconds
Illumination Regulation	<ul style="list-style-type: none"> • Lights to externally illuminate signs to be directed away from adjacent lots and public road allowances • Flashing Illumination or electronic animation of signs located above a height of 4.5 m not to be erected within 60.0 m of a residential zone • Electronic changing copy to be programmed to dim the intensity of illumination during dusk and night hours
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Electronic Changing Copy Signs are not permitted on a scenic drive and heritage areas
Permitted Land uses	N/A

2.1.14. City of Ann Arbor

The City of Ann Arbor has a by-law¹⁴ to regulate signs within the City of Ann Arbor. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “On premises signs” are signs, which advertises only goods, services, facilities, events, or attractions on the premises where located.
- “Changeable copy” means the portion of a sign that is designed or used to display characters, letters, words, or illustrations that can be readily changed or rearranged by manual, mechanical, or electronic means without altering the face of the sign.

Regulations applicable to SES are included in Table 14.

Table 14: City of Ann Arbor Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Electronic changing copy
Type of Installation	On signs attached to buildings On ground signs
Size and Location	<ul style="list-style-type: none"> • Changeable copy portion of the sign <ul style="list-style-type: none"> ▪ Maximum permitted sign face area = 50% (with a maximum of 30 ft² and 15 ft² per face)

¹⁴ Ordinance No. ORD-13-04, The City of Ann Arbor, <https://www.a2gov.org/departments/city-clerk/Documents/ORD-13-04%20Signs%20and%20Outdoor%20Advertising%20Ordinance%20Approval%20Notice.pdf>, Accessed on October 12, 2017

Characteristics	Description
	<ul style="list-style-type: none"> ▪ Maximum total sign face area for permitted land uses = 2.0 m² • Exterior business signs <ul style="list-style-type: none"> ▪ Total area for signs = 2 ft² per linear foot of ground floor frontage (with a maximum of 200 ft²) ▪ Minimum setback from property line for ground sign = 5 ft. ▪ Maximum height = 1 foot per 3 feet of setback above • Theatre are permitted additional 200 ft² area for periodic message change
Other Characteristics	<ul style="list-style-type: none"> • Minimum dwell time = 15 minutes • Scrolling or traveling of a message on changeable copy is prohibited • Changeable copy cannot flash, undulate, pulse, blink, expand, contract, bounce, rotate, spin, twist, or otherwise move
Illumination Regulation	<ul style="list-style-type: none"> • Illumination by flashing, intermittent, or moving lights is prohibited • Maximum nighttime luminance = 100 Nits (between sunset and sunrise) • Maximum daytime luminance = 5000 Nits (between sunrise and sunset) • Automatic dimming equipment to reduce brightness • Maximum brightness above ambient light = 0.1 foot candles.
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Electronic Changing Copy Signs are not permitted on a scenic drive and heritage areas • Billboards are prohibited
Permitted Land uses	<ul style="list-style-type: none"> • Indication of business centre, and theatre, as permitted for electronic changing copy.

2.1.15. Town of Collingwood

The Town of Collingwood has a by-law¹⁵ to regulate signs within the Town of Collingwood. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Changeable copy” is a sign on which the copy can be changed manually through the use of attachable letters, numerals or pictorial panels. Any sign allowed within the by-law may use manual, automatic, or electrically or mechanically activated changeable copy.

¹⁵ By-law 2012-110, The Town of Collingwood, http://www.collingwood.ca/files/2012-110%20Sign%20By-law_CONSOLIDATED%202015-10-05.pdf, accessed on October 15, 2017

- “Readograph” means a sign composed of interchangeable letters and intended to convey a temporary message and is designed or constructed so that the message thereon may be easily rearranged or changed.

Regulations applicable to SES are included in Table 15.

Table 15: Town of Collingwood Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Changeable copy Readograph
Type of Installation	Ground signs Mobile signs
Size and Location	<ul style="list-style-type: none"> • Changeable copy only specified as part of ground signs <ul style="list-style-type: none"> ▪ Area permitted for changeable copy ≤ 50% of ground signs area • Readograph specified only as a part of mobile signs. • Ground sign <ul style="list-style-type: none"> ▪ Maximum area of ground signs = 3.5 m² to 18.5 m² (based on land use and frontage) ▪ Maximum height = 2.0 m to 6.5 m (based on land use and frontage) ▪ Minimum street line setback = 3.0 m ▪ Sign Spacing (maximum one sign per street frontage per site)
Other Characteristics	<ul style="list-style-type: none"> • Minimum dwell time = 5 minutes (for changeable copy)
Illumination Regulation	<ul style="list-style-type: none"> • Signs may be illuminated only by a shielded external source so that light is not visible off the property
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Flashing signs • Animated signs • Billboard signs
Permitted Land uses	<ul style="list-style-type: none"> • Ground signs permitted in residential, commercial and heritage district, and industrial land uses

2.1.16. City of Kingston

The City of Kingston has a by-law¹⁶ to regulate signs within the City of Kingston. Relevant definitions and regulations as applicable to SES are as follows:

¹⁶ By-law 2009-140, City of Kingston, <https://www.cityofkingston.ca/documents/10180/16904/Signs+Bylaw/1871d390-ecdb-4214-9132-775d57513fc8>, accessed on October 15, 2017

Definitions:

- “Electric spectacular sign” is a Sign having a message change more frequently than once every five seconds.
- “Readograph sign” is a permanent on-premise sign composed of manually or electronically interchangeable letters or images intended to convey a temporary message that remains unmoved or unchanged for periods of at least five seconds.
- “Ground sign” is an on-premise sign including a readograph sign permanently affixed to and supported from the ground, and not attached to or supported in any manner by a building.

Regulations applicable to SES are included in Table 16.

Table 16: City of Kingston Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Readograph
Type of Installation	Ground signs
Size and Location	<ul style="list-style-type: none"> • Maximum readograph area permitted per ground sign (this area is in addition to the area permitted for a ground sign) = 5.0 m² • Ground sign <ul style="list-style-type: none"> ▪ Maximum area of ground signs = 7.0 m² to 14.0 m² (based on the distance from the street lane) ▪ Maximum height = 5.3 m to 10.6 m (based on distance from street line) ▪ Minimum street line setback = 1.5 m to 3.0 m ▪ Sign Spacing = 100 metres (maximum one sign per 91.4 metres frontage for a site, additional sign is permitted for longer frontages)
Other Characteristics	<ul style="list-style-type: none"> • Minimum dwell time = 5 seconds
Illumination Regulation	<ul style="list-style-type: none"> • Illuminated signs not to be installed within 30 m of a residential • Light to be directed away from adjacent properties and streets and downwards • Ground signs may be illuminated internally or externally but not to be of flasher type
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Electric Spectacular Signs or any Sign where the message changes more frequently than once every five seconds • Billboard signs in some heritage areas
Permitted Land uses	<ul style="list-style-type: none"> • Ground signs permitted in commercial, industrial, agricultural, rural, development or institutional type zones

2.1.17. Township of Uxbridge

The Township of Uxbridge has a by-law¹⁷ to regulate signs within the Township of Uxbridge. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Electronic message centre” is that part of an illuminated sign which is computer-controlled and which displays information to the public in a prearranged time sequence.

Regulations applicable to SES are included in Table 17.

Table 17: Township of Uxbridge Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Electronic message centre Readograph
Type of Installation	Not specified
Size and Location	-
Other Characteristics	-
Illumination Regulation	<ul style="list-style-type: none"> • Light sources to be shielded so that the light source is not visible off the property on which a sign is located
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Signs with any flashing or moving illumination • Mobile, readograph or internally illuminated signs prohibited in the Special Sign District (Downtown Heritage Conservation District)
Permitted Land uses	<ul style="list-style-type: none"> • Readograph sign permitted in religious institutions and cinemas located in the Special Sign District for the purpose of identifying times of services and/or programs

2.1.18. City of Victoria

The City of Victoria has a by-law¹⁸ to regulate signs within the City of Victoria. Relevant definitions and regulations as applicable to SES are as follows:

Definitions:

- “Readograph sign” means a sign with a copy that is automatically or manually changeable.

¹⁷ By-law 2002-059, The Corporation of Township of Uxbridge, http://town.uxbridge.on.ca/sites/default/files/by_laws/Sign%20By-law%20No.%202002-059%20-%20CONSOLIDATED%20-%20updated%20Feb.%202017.pdf, accessed on October 15, 2017

¹⁸ By-law No. 14-097, The City of Victoria, <http://www.victoria.ca/assets/City~Hall/Bylaws/Sign%20Bylaw%2014-097.pdf>, accessed on October 15, 2017

Regulations applicable to SES are included in Table 18.

Table 18: City of Victoria Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Readograph
Type of Installation	Canopy Fascia Free-standing Noticeboard Projecting
Size and Location	<ul style="list-style-type: none"> • Readograph can be one third of the total sign area • Freestanding signs <ul style="list-style-type: none"> ▪ Maximum area = 2.8 m² to 7.43 m² (based on land use) ▪ Maximum height = 4.5 m to 7.62 m (based on land use) • Fascia signs <ul style="list-style-type: none"> ▪ Maximum area = 2.8 m² to 9.00 m² (based on land use) • Projecting signs <ul style="list-style-type: none"> ▪ Maximum area = 1.9 m² to 4.49 m² (based on land use)
Other Characteristics	-
Illumination Regulation	<ul style="list-style-type: none"> • Some material and illumination forms are prohibited (e.g., spotlights, floodlights, or other lighting fixtures, other than neon lights, unless the light is focused on the sign) • Flashing sign is only permitted in Chinatown
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Third party signs • Moving part signs • Billboards
Permitted Land uses	<ul style="list-style-type: none"> • Readograph signs permitted in specified commercial zones (Arterial, Blanshard, Chinatown, Neighbourhood) and general residential zones.

2.1.19. City of Markham

The City of Markham has a by-law¹⁹ to regulate signs within the City of Markham. Relevant definitions and regulations as applicable to SES are as follows:

¹⁹ By-law 2002-94, Town of Markham, <https://www.markham.ca/wps/wcm/connect/markhampublic/522e77a0-ece9-4c41-b914-951fe8b013df/2002-94.pdf?MOD=AJPERES&CACHEID=522e77a0-ece9-4c41-b914-951fe8b013df>, accessed October 15, 2017

Definitions:

- “Electronic Message Display” is a permanent sign electronically controlled and which displays information in a pre-arranged sequence, and on which the intensity of illumination is maintained at a constant level.
- “Readograph” is that part of a permanent sign composed of changeable letters intended to convey a temporary message and which is designed or constructed so that the message on the sign may be easily changed and rearranged mechanically or as part of an electronic message display.

Regulations applicable to SES are included in Table 19.

Table 19: City of Markham Regulations Applicable to SES

Characteristics	Description
Equivalent Terminology Used	Electronic message display Readograph
Type of Installation	Ground signs
Size and Location	<ul style="list-style-type: none"> • Readograph or electronic displays are allowed maximum 50% of ground signs • Ground signs <ul style="list-style-type: none"> ▪ Maximum distance from a traffic light = 15.0 m ▪ Minimum spacing between two ground signs = 45.0 m ▪ Maximum one sign permitted per frontage unless. Additional sign permitted, if: <ul style="list-style-type: none"> • More than one building on a lot and lot fronts on single street and minimum frontage is 100 m ▪ Maximum height = 2.0 m to 7.5 m (based on land use) ▪ Maximum area = 2.0 m² to 18.0 m² (per face based on land use)
Other Characteristics	-
Illumination Regulation	<ul style="list-style-type: none"> • Light sources to be shielded so that the light source is not visible off the property on which a sign is located
Relevant Prohibitions of Interest	<ul style="list-style-type: none"> • Flashing and animated signs • A video display and billboard
Permitted Land uses	<ul style="list-style-type: none"> • Residential zones, commercial zones, shopping centres, industrial and institutional

2.1.20. Summary of Regulations and By-Laws

Common Aspects of SES

Based on the review of SES sign guidelines and regulations of other jurisdictions, the following is a list of the most common and practical aspects of SES operation and placement that could be included in SES regulations:

- Location of SES:
 - Minimum distance from the roadway or the right-of-way
 - Minimum distance to intersections
 - Minimum distance to roadway characteristics that have a higher attention demand for drivers
 - Restrictions on the angle of SES related to the roadway
 - Restrictions on installation of SES on specific land uses or in specific districts
 - Minimum distances between two SES and between an SES and another electronic sign
 - Restrictions on location based on visibility of traffic signs and traffic controls
 - Restrictions on location based on sight distances at intersections
 - Restrictions on location based on speed limit of the roadway
- Size of SES:
 - Height
 - Width
 - Area of sign
- Luminance:
 - Daytime maximum
 - Night time maximum
 - Maximum in relation with the ambient lighting level
 - Requirement for SES to be equipped with automatic light sensor
 - Restrictions on hours of operation
 - Requirements in case of the SES malfunction
- SES Content:
 - Requirement for static images
 - Minimum dwell time
 - Maximum transition time
 - Restrictions on transition effects
 - Restrictions on content resembling traffic signs and traffic signals
 - Restrictions on content providing driving instructions
 - Approval of message format
 - Provisions limiting the amount of information

- Prohibition of sequential messages
- Impacts on Safety:
 - Provisions for a safety study prior to approval of SES
 - Provisions for cancelling SES permit if it is found the SES negatively impacts safety

Synthesis of Practices

This section provides a summary of the existing practices by municipalities in Ontario, Canada, and internationally obtained from the review of their by-laws or regulations, as well as the inputs from the Town. The summary table is **Appendix A** is categorized based on key aspects of regulations or guidelines, including types of installation; size and location; content; and luminance.

2.2. Road Safety Impacts of SES

The objective of this section of the report is to present the findings of the literature in terms of road safety impacts of SES as well as driver distractions related to commercial signage. The majority of the studies have focused on the impact of digital third-party signs, including billboards. Given the similar functionality of third-party signage and SES, we found the findings of such research studies were relevant to the current study.

2.2.1. Impact of roadside advertising on road safety, Austroads Research Report²⁰

General Study Information

In 2013, The Association of Australian and New Zealand road transport and traffic authorities (Austroads) initiated a project on the Impacts of roadside advertising, including SES, on road safety. The published report reviewed the existing literature on the followings:

- Distraction risk associated with roadside advertising and the guidelines across road agencies;
- Guidelines, practices adopted by road and planning agencies for the management of roadside advertising; and
- Guidelines for the placement of outdoor advertising signs.

Description of Study

The authors conducted an extensive literature review on roadside advertising devices, general human factors considerations, and the safety impact of roadside advertising. Following the completion of the literature review, a workshop was held to disseminate and discuss the outputs of these reviews and to come to general agreements about their implications.

The final recommendations of the Austroads research report are in line with the scope of this project. Researchers reviewed the current guidance provided by each state and territory road and/or planning authority, as well as the main industry representative in Australia, the Outdoor Media Association (OMA). The review included sign design and sign placement criteria derived from the best practice principles. The sign design criteria were sign movement, flashing lights, dwell time, transition time, message sequence, quantity of information, information presentation,

²⁰ Boddington and Rodwell “Impact of roadside advertising on road safety, Austroads Research Report”, 2013

colours, luminance, and dimensions. The sign placement criteria were longitudinal placement, lateral placement, vertical placement, orientation/viewing angle, sight distance/visibility, and speed limit/speed environment. Based on the considerations discussed above, the sign design and sign placement guidelines were developed.

The recommended sign design and sign placement guidelines derived from the adobe-noted study are summarized as follows:

- Sign Design Guidelines:
 - **Movement:** Roadside advertising devices should not contain motion, changes in luminance or any effects that create the illusion of movement.
 - **Flashing lights:** Roadside advertising devices should not contain flashing, blinking, revolving, pulsating or intermittent lights.
 - **Dwell time:** This should take into account (1) visibility distance [VD]: the maximum distance from the sign at which the sign face becomes visible to drivers, and (2) speed environment [SE].
 - All drivers will see at least one change if
$$dwell\ time\ (sec) < VD\ (m) \div \{SE\ (km/h) \times 0.28\}$$
 - Ideally, the proportion of drivers (PD) who see a change should be much less than 1. Therefore: $dwell\ time\ (sec) > VD\ (m) \div \{SE\ (km/h) \times 0.28\}$
 - For a desired PD: $dwell\ time = VD\ (m) \div \{SE\ (km/h) \times 0.28 \times PD\}$
 - **Transition time:** Message should change instantaneously. That is, no 'fade', 'zoom' or 'fly-in' effects and no blank screen between messages.
 - **Message sequencing:** Sequencing of messages should be prohibited.
 - **Quantity of information:** For text, this should be consistent with the number of words that can be read during the approach interval and also the number of words that can be read in a 2 second interval (the 'eyes off the road' interval at which the crash rate doubles). This can be achieved by (1) estimating the legibility distance [LD]: the distance at which the text first becomes legible, (2) taking into account approach speed – the speed environment [SE], (3) estimating the comprehension rate [CR], and (4) ensuring that attention of more than 2 seconds is not required to comprehend the message. Therefore:
 - Number of words < $LD\ (m) \div \{SE\ (km/h) \times 0.28\} \times CR\ (sec)$.
 - Number of words < $CR\ (sec) \times 2$.
 - In general, a typical comprehension rate would be approximately three words per second, but this will vary for different text sizes, fonts and formats. As a result, the CR may need to be tested and demonstrated in the application process.
 - **Information presentation:** Not applicable to advertising devices.
 - **Colour:** Advertising devices should not be coloured like an official traffic sign or traffic signals.
 - **Information content/meaning:** Advertising devices should not imitate traffic control devices or give instructions to traffic to 'stop', 'halt' or other (e.g. give way, turn left or merge). Also, advertising devices should not contain extreme emotional material, especially content which could be threatening or anxiety provoking.

- *Luminance*: Luminance levels should not exceed those of static signs in typical ambient light conditions.
- *Dimensions*: Advertising devices should not be shaped like an official traffic control sign/device.
- Sign Placement Guidelines
 - *Longitudinal Placement*:
 - Advertising devices should not be located in such a way that they might interfere with the effectiveness of a traffic control device (e.g. by restricting sightlines or distracting from traffic control devices via proximity or as a background).
 - Advertising devices should not be located so that they are visible at the approach to, or from, an intersection, pedestrian crossing, tram stop or in any location that is likely to be highly demanding of attention.
 - Only one advertising device should be visible to drivers at any time.
 - *Lateral Placement*: Without conflicting with clear zone requirements (e.g. installation of post in a hazardous location), advertising devices should not be placed such that drivers must divert their gaze away from the forward roadway in order to comprehend the sign message.
 - *Vertical placement*: Advertising devices should not be placed at a height that coincides with the normal 'hazard viewing window' that drivers scan. That is, they should be elevated above the height of vehicles, pedestrians and traffic control devices, but not so high that they draw the gaze away from the forward roadway.
 - *Orientation/viewing angle*: Advertising devices should be oriented to facilitate legibility from the maximum legibility distance and across the full approach distance.
 - *Sight distance/visibility*: Advertising devices should be placed so that enough time is available on approach for drivers to comprehend the message. That is, the sight distance must correspond to the required legibility distance.
 - *Speed limit/speed environment*: The speed environment on its own is likely to be less important than the overall risk profile of the road and driving demand characteristic of the road section that should be carefully reviewed.

Conclusions Relevant to the Town

The authors recommended several design guidelines with respect to SES as noted in the previous section.

2.2.2. Effects of Outdoor Advertising Displays on Driver Safety²¹

General Study Information

California Department of Transportation (Caltrans) conducted a comprehensive literature review to identify existing or in-progress research about the safety impacts of static signs, digital billboards and other displays, including the effects of brightness/illumination, font size and visual complexity of signs.

Description of Study

The study collected the information in three areas: Federal guidance on digital displays, related research, and state regulations. The findings of the study are as follows.

Federal Guidance on Digital Displays

In 2007, a Federal Highway Administration (FHWA) memo recommended the following:

- Duration of each display is generally between 4 and 8 seconds – 8 seconds is recommended;
- Transition between messages is generally between 1 and 4 seconds – 1-2 seconds is recommended; and
- Adjust brightness in response to changes in light levels so that the signs are not unreasonably bright for the safety of the motoring public.

Related Research

The Wachtel Report and Pre-2009 Literature on Outdoor Advertising Safety

This report entitled “Safety Impacts of the Emerging Digital Display²²”, which was prepared for NCHRP, presented a thorough review of the literature on digital display safety for outdoor advertising signs including third party advertising signs until 2009. The report is relevant to this study as the functioning of the SES is not different from the functioning of digital third-party signs. Both types are digital signs with only one difference: the signs utilized for third party advertising applications are known as billboards. Similar features, such as message duration, message interval, brightness levels, spacing, and type of visual effects, characterize all digital signs. The report concluded that:

- Advertising signs and digital billboards distract drivers because these signs increase driver glance duration and the driver’s gaze is automatically drawn to objects of different luminance in the visual field;
- There are various recommendations of brightness, message duration, change interval, and other factors;
- There is no definitive research showing increased crashes due to the presence of digital billboards, there is an increased risk crash risk based on the research on the effects of billboards on driver attention and the effects of driver distraction on safety;
- Digital billboard attracts more attention than regular billboards, with larger number and longer glances. Shorter the message duration, the longer the driver’s glance in anticipation of the next message;

²¹ Caltrans Division of Research and Innovation “Effects of Outdoor Advertising Displays on Driver Safety”, 2012

²² Safety Impacts of the Emerging Digital Display Technology for Outdoor Advertising Signs, NCHRP 20-07, 2009

- Drivers engaging in visually demanding tasks have a three times crash risk than attentive drivers; and
- Studies have not been able to establish a statistical relationship between the presence of digital billboards and collision occurrence. More research is needed.

Following recommendations were made with respect to digital billboards:

- *Message Duration*: A minimum display duration of sight distance to the digital billboard (metre/speed limit);
- *Message Interval*: An interval between successive displays that is close to instantaneous as possible;
- *Display Brightness*: Brightness, luminance and illuminance limits based on the ambient light conditions of digital billboards;
- *Digital Billboard Spacing*: Spacing between digital billboards that does not face a driver with two or more displays within driver's field view at the same time; and
- *Other*: The prohibition of visual effects, message sequencing, and the placement of digital billboards near traffic control devices and driver decision and action points.

Literature on Outdoor Advertising Safety Post Wachtel Report

The Caltrans study has provided the findings of the post Wachtel Report 2009 research, with respect to digital billboards, as follows:

- Billboards affect driver's ability to detect changes in road scenes and increase the amount of time needed for drivers to respond to road signs, which may increase driving error
- s.
- Video billboards draw longer and more frequent glances than static advertisements with drivers showing greater variation in lateral lane position, driving more slowly and braking harder. Video billboards lead to more rear-end collisions.
- Preventing distraction by digital billboards requires controlling lighting at nighttime, lengthening message duration time, simplifying message information and prohibiting message sequencing.
- Drivers should not be subjected to brightness levels greater than 10 to 40 times the brightness level to which their eyes are adapted for the critical driving task. As roadway lighting and automobile headlights provide lighting levels of about one nit, the signage should not be brighter than about 40 nits.

State Regulations

The following are some of the findings from the state regulations as provided by the Caltrans study:

- Minimum message duration is between 4 and 10 seconds with 6 and 8 seconds most common;
- The maximum interval between messages is 1 to 4 seconds; and
- Spacing is most commonly 150 m (500 feet).

Gaps in Findings

The Caltrans Study noted the following gaps in findings:

- Little research on the effects of outdoor advertising on crash rates and limited number of studies on digital billboards specifically; and

- Little research justifying common regulations and design recommendations for digital billboards, including brightness/illumination, font size and visual complexity.

Conclusions Relevant to the Town

The study provides specific recommendations for different elements of digital signs, such as message duration, message interval, display brightness, and sign spacing.

2.2.3. The Effects of Commercial Electronic Variable Message Signs (CEVMS) on Driver Attention and Distraction: An Update²³

General Study Information

In 2009, Molino and his colleagues, Jerry Wachtel, John E. Farbry, Megan B. Hermosillo, Thomas M. Granda, completed a study for the Federal Highway Administration (FHWA) in which they discussed the various types of studies that can be undertaken to identify the impacts of Commercial Electronic Variable Message Signs (CEVMS) on traffic safety and their respective weaknesses. The study was based in the United States.

Description and Assessment of Study

This government agency-sponsored study discusses the types of studies potentially undertaken to understand the impacts of commercial electronic variable message signs (CEVMS) on safety, and the conclusions drawn from the experience of the authors, discussing the various study types.

For the challenges of laboratory and simulation type studies, the authors argued that the participants need to adapt to driving in a simulator, which would be substantially different from driving a real vehicle, and that there are limitations in reproducing the visual effects of a CEVMS on a simulator screen. The authors also discuss the “spare attentional capacity” theory, according to which drivers can look at CEVMS and other advertising signs when the driving task is not demanding. This theory has led to some restrictions on the placement of CEVMS in some countries. The authors also identified weaknesses for post-hoc collision studies as follows:

- A large amount of collisions is not reported to the police;
- Causes of collisions are not always reported, especially when driver distraction or inattention is a factor;
- The police rarely have time to complete a full investigation to identify the true causes of the collision; and
- Data needs to be collected for long periods, and for comparable locations.

The authors identified several key independent and dependent variables that to consider in future impact studies. The recommended independent variables were billboard, roadway, driver, vehicle, and environment attributes. The vehicle behaviour, driver and vehicle interactions, as well as driver attention and distraction were considered as dependent variables. Finally, the authors suggested a future research program in three stages. The first two stages relate to impacts on driver distraction: Stage 1 determines the potential for distraction of CEVMS, and Stage 2 determines the basis for

²³ Molino, J.A., Wachtel, J., Farbry, J.E., Hermosillo, M.E., Granda., T.M., *Effects of Commercial Electronic Variable Message Signs (CEVMS) on Driver Attention and Distraction: An Update*, Report No. FHWA-HRT-09-018, February 2009

CEVMS regulations based on eye glance and safety surrogate evaluations. Stage 3 is the determination of the relationship between CEVMS and collisions.

Conclusions Relevant to the Town

The authors indicated that “distraction from a roadside billboard may be unconscious” and that drivers are not always aware of the fact that they are being distracted. They also implied that CEVMS with frequently changing messages can be more distracting, and can be distracting for a longer distance, as drivers may look at the sign to try to read each message until they are able to do so.

2.2.4. Investigating Driver Distraction: the Effect of Video and Static Advertising²⁴

General Study Information

In 2009, a study conducted in London, UK, for Transport for London (TfL), using a driving simulator and integrated eye-tracking system compared driving behaviour across a number of experimental static and video advertising conditions, namely advert type, position of adverts and exposure during adverts. M. Chattington, N. Reed, D. Basacik, A. Flint, and A. Parkes completed the study in the United Kingdom.

Description and Assessment of Study

The main purpose of this government-sponsored study is to provide guidance on the relative level of distraction caused by roadside billboard advertising with reference to advertising type (static vs. video/dynamic), the placement of the sign relative to the road, and exposure time.

Two simulated driving routes were created in a dense, urban simulation environment, CarSim. The study recruited 48 participants, mixed by age and gender, to drive each route in both directions. Each route contained seven adverts plus some additional blank advertising boards. Participants’ subjective opinions, collected using questionnaires, supplemented the objective data collected through the simulator and eye tracker. The questionnaires tested the participants’ recall of advertising, their mental workload during hazardous situations, how distracting they found video advertising, and whether they felt such advertising billboards would have an effect on safety.

The study found that participants were aware that the presence of video adverts, rather than static adverts, impaired their driving.

Conclusion or Positions Relevant to the Town

Trial results indicated that when passing roadside adverts, drivers:

- Spent longer looking at video adverts than static adverts and glanced at them more frequently;
- Tended to show greater variation in lateral lane position with video adverts;
- Braked harder on the approach to video adverts; and
- Drove more slowly past video adverts.

²⁴ Chattington, M, Reed, N., Basacik, D., Flint, A., & Parkes, A. *Investigating driver distraction: the effects of video and static advertising*. TRL Limited., 2009

2.2.5. Studies of the Relationship between Digital Billboards and Traffic Safety²⁵, ²⁶

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General Study Information

In 2010, the authors, M.W. Tantala and A.M. Tantala Sr., conducted three research studies for the Foundation of Outdoor Advertising Research and Education (FOARE), an arm of the Outdoor Advertising Association of America (OAAA). They completed the studies for locations in New Mexico, Pennsylvania, and Virginia, respectively. The purpose of these studies was to examine the statistical relationship between digital billboards and traffic safety.

Description and Assessment of Study

For the first study, in Albuquerque, the authors completed a statistical analysis of collision based on collision reports. The authors analyzed up to 7 years of collision information, with a minimum of two years of 'before' and two years of 'after' data for each location, for 17 locations on local roads where billboards were converted to digital billboards and summarized the data in two parts. The first part included an aggregated temporal analysis, which showed the numbers and rates of collisions before and after the installation of the billboards. The second part consisted in a spatial analysis, described by the authors as: "This establishes statistical correlation coefficients between the digital billboards and accidents. Correlation coefficients are statistical measures of the "association" between two sets of data. The results are analyzed for various scenarios accounting for accident density and billboard proximity." Although the authors do not further discuss their methodology, and do not provide any numerical results for these coefficients, they found that, "Correlation coefficients were calculated and indicated a very strong correlation of accident patterns near digital billboards when compared with the accident patterns prior to conversion."

The second study located in the Greater Reading Area, Berks County, Pennsylvania. The authors analyzed up to eight (8) years of collision information, with a minimum of less than one year of 'before' and less than one year of 'after' data for each location, for 20 locations with 26 digital billboard faces, where billboards were converted to digital billboards. The third study was located in Henrico County and Richmond, Virginia, and the authors analyzed up to seven (7) years of collision information, with a minimum of less than one year of 'before' and less than one year of 'after' data for each location, for 10 locations with 14 digital billboard faces, where billboards were converted to digital billboards. For these studies, the authors conducted an analysis in three parts.

The first two parts are similar to the first study: a temporal analysis and a spatial analysis. The third part consisted in a before and after analysis using the Empirical Bayes (EB) method and comparison sites. Safety performance functions were developed and used in the determination of the index of effectiveness.

These studies show weaknesses. In all three studies, the authors used short before and after periods on some sites. For the first study the minimum period was approximately two years, where

²⁵ Tantala, A. M., & Tantala, M. W. A study of the relationship between digital billboards and traffic safety in Albuquerque, NM, The Foundation for Outdoor Advertising Research and Education (FOARE), Washington, DC, 2010a.

²⁶ Tantala, A. M., & Tantala, M. W. *A study of the relationship between digital billboards and traffic safety in the Greater Reading Area, Berks County, Pennsylvania*, The Foundation for Outdoor Advertising Research and Education (FOARE), Washington, DC, 2010b.

²⁷ Tantala, A. M., & Tantala, M. W. *A study of the relationship between digital billboards and traffic safety in Henrico County and Richmond, Virginia*, The Foundation for Outdoor Advertising Research and Education (FOARE), Washington, DC, 2010c.

for the second and third studies, some sites had less than one year of ‘before’ data and less than one year of ‘after’ data. The authors do not seem to have eliminated any of the data for the period shortly after the installation to eliminate the collisions due to the novelty of the digital signs. Additionally, although the second and third studies use a before and after study with EB method and comparison sites, the methodologies used in the first study and in the first two parts of the second and third studies show weaknesses. Temporal statistics such as the change and percent change in the number of collisions, the change in the average number of collisions per month, or the peak, minimum or average number of collisions per month do not consider any other factors and are not necessarily representative of the impact of the installation of digital billboards. The change and percent change in the rate of collisions per million vehicles does provide consideration for traffic volumes. The temporal statistics calculated by the authors do not control for the regression-to-the-mean phenomenon. The before and after study with EB methodology does, however, account for this phenomenon, used in the later two studies. The authors did not describe the analysis completed in terms of “spatial statistics”, and no information was provided, other than the description provided above. It is therefore impossible to assess and comment on the methodology used.

Conclusions or Positions Relevant to the Town

For all three studies, the authors concluded that the installation of digital billboards had no statistically significant impact on the number of collisions near the signs. They also found that the age of the driver (younger vs. older driver) and the time of day (daytime vs. nighttime) had no impact on the number of collisions near the digital billboards. For the later two studies, the authors also mentioned that the before and after study with EB method showed no statistically significant increases in collisions after the installation of the digital billboard, and “that the safety near this location are consistent with the model benchmarked” by the comparison sites.

When considering these conclusions, the Town should take into consideration that some of the authors’ analyses do not consider any other factors, such as traffic volumes, and some consider traffic volumes but not the regression-to-the-mean phenomenon. Some of their briefly explained analyses make it difficult to understand the specific completed analysis.

2.2.6. Assessing the Empirical Evidence on the Safety Impact of Electronic Static Displays” and “Are Roadside Electronic Static Displays a Threat to Safety?”

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General Study Information

In 2011, Friswell and her colleagues completed an international literature review on electronic static displays, documented in two separate conferences (Friswell et al., 2011a & 2011b). They undertook the study to summarize some of SES’ safety implications for policy makers to establish a regulatory balance between protecting public safety and satisfying the interests of businesses. Both papers were authored by R. Friswell, E. Vecellio, R. Grzebieta, J. Hatfield, L. Mooren, M.

²⁸ Friswell, R., Vecellio, E., Grzebieta, R., Hatfield, J., Mooren, L., Cleaver, M., & DeRoos, M. *Assessing the empirical evidence on the safety impact of Electronic Static Displays*. In Australasian College of Road Safety Conference, 2011, Melbourne, Victoria, Australia, 2011a.

²⁹ Friswell, R., Vecellio, E., Grzebieta, R., Hatfield, J., Mooren, L., Cleaver, M., & De Roos, M. *Are roadside electronic static displays a threat to safety?*. In Proceedings of the Australasian road safety research, policing and education conference (Vol. 15). Monash University, 2011b.

Cleaver, and M. DeRoos. The first one was presented at the Australasian College of Road Safety Conference in September 2011, and the second one was presented at the Australasian Road Safety Research, Policing and Education Conference in November 2011.

Description and Assessment of Study

The study sponsor is unknown, but the study provided a broad basis for critical analysis of research findings, in the past decade, on the safety impact of electronic static displays and the nature of driver distraction. The study highlighted the limitations of various study types. They mentioned that real-world studies conducted under normal traffic conditions have the benefit of incorporating real-world driving conditions, but that capturing all of the relevant information and its complexity is difficult. Laboratory studies of simulated driving typically can better detect and document drivers' responses, as they are much more precise in their instrumentation. However, these studies have limitations in terms of realism, as the driving environment may be simplified and different from a real driving environment. On-road condition studies require a comparison of conditions before and after the installation of an SES, but also require that no other variable changes. Comparison sites used in the analysis are helpful in terms of controlling for the changes in other variables, but it is very difficult to find comparison sites that are "truly comparable". These studies also need to cover lengthy periods of time to have sufficient data, and the full distance where SES are visible, as well as some distance after passing the sign should be used. The authors also warn to consider carefully the study sampling, as different driver types may have different driving behaviours and process information at different speeds. Moreover, advertisements often target certain groups, and therefore may have a larger distracting impact on those groups than others.

Studies of surrogate measures, such as gaze, driving behaviour and collisions also have limitations. Measuring gaze behaviour does not account for cognitive distraction, when a driver gaze directs their gaze towards the road, but the driver's attention is elsewhere. s Driver distractions may not affect different driving behaviours in the same way, and such studies can lead to biased results. Collision analyses study rare events (collisions) that are caused by a multitude of factors and cannot be only attributed to the installation of SES. Additionally, collisions are often under-reported. Collisions analysis should take into account collision trends and compare collisions prior to and after the installation of SES. Bayesian estimation techniques are therefore preferred for this type of analysis as they yield conclusions that are more accurate.

The authors reviewed 11 studies directly related to SES, six of which were completed by Tantala and Tantala. The authors also mentioned that most of the studies reviewed analyzed collision data across various sites, and that most SES were replacing pre-existing static advertisement signs.

Conclusions or Positions Relevant to the Town

The study found that factors that are likely to affect the relationship between SES, distraction and safe driving are: the extent to which images changes, the perceptual quality of the images, the physical dimensions and location of the image relative to the driver, the dwell time, the transition time, the speed limit of the road, the spacing between signs on the roadway, the sign luminance, the sign size, lateral position and elevation, the salience of the images, the extent to which SES resemble other important information such as traffic signs and signals, characteristics of the driver (age, experience, etc.), the complexity of the driving task, and the ability of the driver to ignore SES or adapt their driving (Friswell et al., 2011a).

The study also provided some guidelines to investigate the effect of electronic static displays relating to the length of roadway over which the effects of signs are measured. According to the authors, an accurate estimate of the impact of an electronic static display would require measures

over the entire distance from which the sign may be seen and this distance will vary according to the size and location of each sign.

The authors also concluded that “there does seem to be evidence that ESDs [SES] can have a negative impact on attention, driving performance and safety” and recommend that SES be prohibited.

2.2.7. Statistical Analysis of the Relationship between On-Premise Digital Signage and Traffic Safety³⁰

General Study Information

The authors of this study completed a statistical analysis of the relationship between first party digital signage and traffic safety, with the objective of conducting “a robust statistical analysis of the safety impacts of on-premise digital signs” (Hawkins et al., 2012). This study was sponsored by the Signage Foundation, Inc., and the Texas Engineering Extension Service. This paper was authored by H.G. Hawkins, Jr., P-F Kuo, D. Lord.

Description and Assessment of Study

This United States-based industry-sponsored study evaluated the impacts on safety of first party digital signs using sites in four states: California, North Carolina, Ohio and Washington. The authors used a very sound methodology, completing a before and after study with Empirical Bayes, using Safety Performance Functions (SPFs) and calibration factors for each location. The report also presents a thorough description and discussion of various before and after methodologies, demonstrating the understanding of the authors. The authors used a sample size of 135 treated sites on major roads, in four states.

The collision and road characteristics information were found in the FHWA Highway Safety Information System (HSIS). The SPFs were selected from the Highway Safety Manual (HSM) (roads with 2 to 5 lanes) and from a Texas Transportation Institute study (Bonneson and Pratt, 2008) for roads with 6 and 8 lanes. Calibration factors were calculated and used for each site and each year of the study using the HSM methodology. Sign information was obtained from two sign manufacturing companies. Data sets were merged, and sign locations were verified through online digital images (Google Streetsview). A total of 135 sites were chosen for the study, all located on major roadways (for which collision information was available through the Highway Safety Information System (HSIS)). All signs were installed in 2006 or 2007, providing enough information in both the before and the after period. Only first party digital signs were included in this study.

The authors used the Empirical Bayes methodology for their analysis, and the Naïve before and after methodology for comparison purposes only. They calculated the index of effectiveness, θ , which shows the impact of the installation of SES on the number of collisions. A positive value of θ shows an increase in the number of collisions, a negative value of θ shows a decrease in the number of collisions, and a value of $\theta=1$ shows that there is no change in the number of collisions. They also calculated and showed lower bound and upper bound values, which represent the 95% confidence interval. A confidence interval for the value of θ which includes the value 1.0 shows that there is insufficient evidence to conclude that the index of effectiveness, θ , is different from 1. For example, a value of $\theta=1.25$, with a lower bound of 0.00 and an upper bound of 2.53 would suggest

³⁰ Hawkins, G.H., Kuo, P., Lord, D., *Statistical Analysis of the Relationship between On-Premise Digital Signage and Traffic Safety*, FTISResearch, December 2012.

that it is impossible to conclude that θ is different from 1. In this case, it would be impossible to conclude that the installation of a SES would have a negative or positive impact on the number of collisions.

Conclusions or Positions relevant to the Town

Using the Empirical Bayes methodology, the authors found that for all four states combined or for each state individually, all of the intervals included a safety effect of 1.0 and it was impossible to conclude that the index of effectiveness, θ , is different from 1. The authors therefore concluded that there was no statistically significant change in the number of collisions after the installation of first party digital signs.

The authors also analyzed collisions by type and found no changes in multi-vehicle collisions. They also found no changes in single-vehicle collisions, except in California where there was a statistically significant decrease in the number of collisions. However, the authors only used 6 sites in California, therefore the results for all states combined have not been impacted.

The authors also analyzed the impacts of signs with different characteristics, using an “ANOVA analysis method to evaluate whether the means of the safety index (θ) among the different characteristics of signs are equal”, and found no statistically significant differences between the means of safety indexes for the following characteristics:

- Colour: single colour vs. multiple colour;
- Sign dimensions: less than 10 ft², 10-15 ft², more than 15 ft²; and,
- Business type: restaurant, pharmacy or retail store, hotel, gas station, auto shop, other.

2.2.8. A Statistical Analysis of the Impact of Advertising Signs on Road Safety³¹

General Study Information

In 2012, Yannis and his colleagues completed a statistical analysis of the impact of advertising signs on road safety in the greater Athens area, Greece (Yannis et al., 2012)³². Although this study was not specifically completed on SES, the methodology and results can identify correlations between the placement or removal of static advertising signs and the number of collisions. This paper was authored by G. Yannis, E. Papadimitriou, P. Papantoniou, and C. Voulgari.

Description and Assessment of Study

The sponsors to this study are unknown. The authors completed a before and after study with comparison group, using one comparison site for each treated site. The analysis was performed for nine treated sites with various characteristics (installation vs. removal of sign, segment length, number of lanes, traffic separation) in peri-urban and urban areas. The authors weighted the safety effects using an odds-ratio for the before and after periods.

The authors followed a sound methodology; however, the sample size is rather small, especially as characteristics vary from one site to the other. Additionally, the results should be used with caution

³¹ Yannis, G., Papadimitriou, E., Papantoniou, P., & C. Voulgari. A statistical analysis of the impact of advertising signs on road safety, *International Journal of Injury Control and Safety Promotion*, Vol. 20, No. 2, 111–120, April 2012.

³² Yannis, G., Papadimitriou, E., Papantoniou, P., & C. Voulgari. A statistical analysis of the impact of advertising signs on road safety, *International Journal of Injury Control and Safety Promotion*, Vol. 20, No. 2, 111–120, April 2012.

as this study was completed for the installation and removal of static signs as opposed SES. It is however believed that the results are consistent with other studies, completed for SES signs.

Conclusions and Positions Relevant to the Town

The authors found no statistically significant impacts on the number of collisions from either placement or removal of an advertising sign, for each specific site and for the group of sites as a whole. It was argued that drivers are already overloaded with distracting information, such as traffic signs, direction signs, on-site advertisement, presence of pedestrians, and traffic, and the advertising signs do not further distract the drivers. The authors also mention that in previous researches “it has been proved that in-vehicle distraction factors are more dangerous than external ones”.

2.2.9. Effects of Electronic Billboards on Driver Distraction³³

General Study Information

Following the installation of some SES along a four-lane motorway in central Stockholm, the Swedish Transport Administration sponsored a study in 2012 to evaluate the effects of electronic billboards on the attention of drivers.

Description and Assessment of Study

The objective of this government-sponsored study was to evaluate, in a field setting, the effects of electronic billboards on the visual behaviour and driving performance of drivers. The study included 41 experienced drivers, between 35 and 55 years old. Twenty participants drove during daytime, while 21 drove during nighttime. The experimental freeway route was 40 km long and took approximately 40 min to complete. Navigational instructions were provided by an experimenter present in the vehicle. The route included 4 electronic signs, with static messages changing every 7 seconds, one large static billboard, and 7 traffic signs, including 3 overhead gantries with navigation information, 2 guide signs and one bus lane sign. The visual behaviour of drivers was measured with a head-mounted eye tracker in an instrumented vehicle. Following the field data collection, statistical analyses were completed with a two-way analysis of variance for time-of-day and sign type. The authors defined that “a driver is considered to be visually distracted when looking at a billboard for more than two seconds with a single long glance or if the driver looks away from the road for a high percentage of time”.

The author found a statistically significant increase in the indicators studied for electronic billboards as compared to other signs. The confidence level used for the analysis was 0.95, and results showed increases both during daytime and nighttime. The indicators studied by the authors were:

- The dwell time, which is the “accumulated total time that the participants looked at a sign”;
 - The visual time sharing, which is the “percentage of time that the driver looked at a sign, defined as the dwell time divided by the exposure time”;
 - The number of fixations, which is the “total amount of fixations directed towards a sign”;
- and

³³ Dukic, T., Ahlstrom, C., Patten, C., Kettwich, C., & Kircher, K. *Effects of electronic billboards on driver distraction*. Traffic injury prevention, 14(5), 469-476, 2013.

- The maximum fixation duration, which is the “duration of the longest fixation directed towards a sign”

Conclusions and Positions Relevant to the Town

The authors found that drivers may be glancing at electronic signs in different ways. Drivers can perform routine scanning leading to identification of the electronic sign, followed by a glance to read and understand the sign after ensuring the traffic conditions allow time to do so, in which case the glance is planned and unlikely to result in a dangerous situation. However, the drivers’ attention can also be absorbed by the electronic sign, or be involuntary attracted to the sign, leading to the driver being distracted from the driving tasks.

The authors concluded that “Overall, the electronic billboards attract more visual attention than the other traffic signs included in the study. Dwell times are longer, the visual time-sharing intensity is higher, very long single glances are more frequent, and the number of fixations is greater for the electronic billboards”. However, the comparison results indicated that there was no evidence to conclude that the number of times drivers looked at electronic signs during daytime and nighttime were statistically different. The authors also concluded that “No consistent significant changes in driving behaviour with respect to speed, lateral placement of the vehicle or headway could be found between the phases before the billboard was visible, while it was visible and after it was passed.”

2.2.10. Conclusions

Key conclusions from the studies reviewed by CIMA+ are as follows:

Driver Distraction

- “Distraction from a roadside billboard may be unconscious” and drivers are not always aware of the fact that they are being distracted (Molino et al., 2009);
- SES are generally more distracting than other static billboards or traffic signs (Molino et al., 2009; Dukic et al., 2013);
- Driver distraction from SES is affected by various characteristics of the SES (content, format, location), speed limit of the roadway and characteristics of the driver (Friswell et al., 2011a and 2011b);
- Driver distraction should be measured for the entire length for which the sign can be seen (Friswell et al., 2011a and 2011b);
- There is evidence that SES can be distractive and have a negative impact on safety, and they should be prohibited (Friswell et al., 2011a and 2011b);
- Driver attention can be diverted to SES in an intentional, planned way when drivers consciously decide to look at SES after ensuring the traffic conditions allow time to do so. Driver may also be distracted when their attention is involuntary attracted to the sign (Dukic et al., 2013); and
- There is no evidence to conclude that the number of times drivers looked at electronic signs during daytime and nighttime were statistically different (Dukic et al., 2013).

In summary, it was found that roadside advertising is distracting and can increase the risk of collisions. In addition, visual clutter has a negative effect on driving performance. Having said that, driver distraction from SES can be affected by various characteristics of the SES (content, format, location), speed limit of the roadway and characteristics of the driver.

Collisions

- No statistically significant impact of SES on collisions was found by Tantala and Tantala (Tantala and Tantala, 2010a, 2010b, 2010c);
- In a sound industry-sponsored study, first party digital signs were not found to have a statistically significant impact on the number of collisions (Hawkins et al., 2012);
- In the same sound industry-sponsored study of first party digital signs, it was found that the following attributes do not have a statistically significant impact on the means of safety indexes: sign colours, sign dimensions, and type of business advertised (Hawkins et al., 2012); and
- A study of placement and removal of static advertising signs in Greece found no statistically significant impacts on the number of collisions from either placement or removal of an advertising sign, for each specific site and for the group of sites as a whole (Yannis et al., 2012).

In summary, there has been no study proving a statistically significant proof of causation between roadway advertising and collisions.

3. Review of Background Information

The objective of this section of the report is to summarize the background information relevant to SES provided by the Town.

3.1. Online Survey Results of Residents

The preliminary results of the online survey conducted by the Town indicates that more people are against “Animated (Video) Signs” (68.1%) than “Electronic Message Boards” (42.3%). “Animated Signs” appear to have more comments reflecting public concerns related to roadway safety. This is based on the number of comment themes for each type of sign. The list of comment themes for Electronic Message Boards contains only one item related to road safety concerns (i.e. distracting), whereas, the list of comment themes for “Animated Signs” contain four items related to road safety concerns (i.e. distracting, accidents, visual clutter, driving hazard).

3.2. Livable Oakville Official Plan

According to ‘Section 6; Urban Design’ of the Town’s Official Plan³⁴ policies direct that:

- The signs should be compatible with the scale and architectural design of the building, the site features and activities. Signage should be tailored to the size, type and style of a development;
- To ensure that the character of residential areas is maintained, the use of exterior signs and other exterior advertising devices should be minimized; and
- Signs on cultural heritage properties or within Heritage Conservation Districts or cultural heritage landscapes shall be compatible with the architecture and character of the property or district.

³⁴ Livable Oakville Plan, Town of Oakville, <https://www.oakville.ca/townhall/livable-oakville-official-plan.html>, accessed on October 12, 2017

3.3. Zoning By-Law 2014-014 and 2009-189

The signs are not regulated in the Town's Zoning By-laws. Therefore, the location of signs should not be based on the location of buildings and current zoning system.

3.4. Livable by Design Urban Design Manual

According to the Town's Urban Design Manual³⁵, the design direction requires that signage:

- Be proportionate with the scale of the building and its surroundings, communicates a clear message and be oriented towards intended viewers;
- Incorporate illumination from a shielded external light source, concealed lighting, moderate ambient back-lit lighting, or low accent lighting to prevent glare and spillover onto adjacent properties;
- Not obscure, detract from or dominate the form, character or details of the building(s), site or adjacent properties;
- Complement and creatively enhance the building(s) and overall site design. Avoid applying signage to create visual interest on an otherwise blank wall;
- Create a coordinated image and provides uniformity in business identification and advertising on a mixed-use or multi-unit commercial/employment building or site. Where possible, share signage among tenants to reduce visual clutter;
- Represent the type, materials and styles appropriate to the heritage attributes of the character of the building and site, as well as its current function for heritage properties. Install signage that does not obstruct the heritage attributes of the property; and
- Clearly identify the site and building entrances and provides orientation and wayfinding to key access points and amenities for large sites. Strategically place signage to prevent compromising pedestrian and motorist sight lines, paths of travel, or views into buildings.

4. Human Factors Guidelines

Human factors (or ergonomics) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design to optimize human well-being and overall system performance.

Important human factors considerations with respect to SES include: distraction, sign size and sign location, viewing distance and viewing angle, legibility, information format, amount of information, message comprehension, brightness, glare, and use of colour.

4.1. Driver Limitations and Impacts of Distraction

Driving is a demanding visual and cognitive task, with numerous sub-tasks, such as lane-keeping, maintaining a safe following distance, reading traffic signs, navigating a route, etc. Drivers must divide their attention among these various tasks as they move along the road at high speeds.

³⁵ Urban Design Manual, Town of Oakville, <https://www.oakville.ca/assets/2011%20planning/LBDMPartAFinalMay23.pdf>, accessed on October 12, 2017

4.1.1. Information Processing

Human attention and abilities in information processing are limited. These limitations can create difficulties because driving requires the division of attention between control tasks (e.g., staying in the lane), guidance tasks (e.g., merging with other vehicles), and navigational tasks (e.g., looking for street name signs). It has been estimated that out of over 1 billion bits per second of information directed at the sensory system, roughly 16 bits per second are consciously recognized (the answer to a single yes/no question provides 1 bit of information)³⁶. In short, the human information processing system is essentially a single channel system with limited capacity^{37, 38}. Given the limitations in driver information processing, it is not surprising that drivers are more likely to make errors when they are faced with high demands from more than one information source (e.g., attending to a navigation task while simultaneously changing lanes).

4.1.2. Visual Search

Studies on visual search illustrate that driving is a visually demanding task. The visual field of the human eye is large – approximately 55 degrees above the horizontal, 70 degrees below the horizontal and 90 degrees to the left and to the right. However, only a small area of this allows accurate vision. This area is called the fovea and covers a cone of about 2 to 4 degrees. The quality of vision falls off rapidly as the target is seen in peripheral vision, away from the fovea.

Studies have been carried out using eye movement cameras to record driver's visual search patterns. Search is generally concentrated at or below the horizon, and approximately 5 degrees to the right of the focus of expansion (the point in the distance where parallel lines appear to merge). In the car following situation, fixations are much more concentrated, focusing on the vehicle in front. About 90% of eye fixations fall in a narrow region within four degrees of the point in the moving visual field straight ahead of the driver, with more to the right side where traffic signs are found³⁹. Drivers make 3 fixations a second on average and fixations last for 1/10 sec up to a second or more.

Because controlling the vehicle within the lane and keeping a safe distance from other traffic is visually demanding, if a task is complex, like reading a sign, drivers will complete the task by using a series of short glances. Individual glances at the roadway and at the lane markers are generally short. Individual glance durations for other types of driving tasks are related to task complexity and can be as long as a couple of seconds. According to Rockwell, drivers are loath to go for more than 2 seconds without getting some information from the roadway⁴⁰.

Glance duration is related to driver workload. Bhise and Rockwell examined driver sign reading behaviour in low and high-density traffic. In low-density traffic, drivers spent a total of 2.6 seconds (total time due to 2 to 3 fixations) on average looking at each guide sign that they needed to use to

³⁶ Grandjean, E. *Fitting the Task to the Man: A textbook of Occupational Ergonomics*. Taylor & Francis Ltd., London. 1988

³⁷ Grandjean, E. *Fitting the Task to the Man: A textbook of Occupational Ergonomics*. Taylor & Francis Ltd., London. 1988

³⁸ Kantowitz, B. and Sorkin, R.D. *Human Factors: Understanding People-system Relationships*. New York, Wiley. 1983

³⁹ Mourant, R.R., Rockwell, T.H., and Rackoff, N.J. Drivers' eye movements and visual workload. *Highway Research Record*, 292, 1-10. 1969

⁴⁰ Rockwell, T.H. Spare visual capacity in driving - revisited. *Vision in Vehicles II*. A.G. Gale et al., Elsevier Science Publishers B.V. (North Holland). 1988

follow a route⁴¹. The guide signs were legible for 8 to 10 seconds. In high-density traffic, drivers reduced total glance duration considerably, to an average of 0.9 seconds.

4.2. Attracting Drivers' Attention

Drivers are limited in the amount of attention available to devote to non-driving-related tasks. In general, the more strongly our attention is focused in one area, the less we notice and the slower we are to respond to other areas. A study by Cole and Hughes examined what properties, and driving circumstances, made signs conspicuous⁴². They defined conspicuity as "the property of an object that causes it to attract attention or to be readily located by search" and looked at attention and search conspicuity of signs in an on-road study. Attention conspicuity refers to the capacity of an object to attract attention when it is unexpected. Search conspicuity refers to the capacity of an object to be found when it is searched for.

One group of subjects was asked to report whatever objects they noticed as they drove. The other group was asked to search for and report disc targets that had been set up by the experimenters along the roadway. The disc targets were considerably more likely to be located when subjects were asked to search for them specifically (approximately 40% of those in a shopping area were located rising to approximately 80% of those in a residential area). When subjects merely reported what attracted their attention and were not asked to search for the disc targets, they only noticed about 6% of them in the shopping area and about 40% of them in the residential area.

The more intentional the drivers were in looking for particular targets, the more likely they were to notice them. Nonetheless, even though they were searching for the targets, many of them were missed, especially in visually cluttered urban areas. Other findings were that objects tended to be first noticed when they were relatively small in angular size (less than 1 degree) and at small angular eccentricities (less than 10 degrees off the driver's line of sight).

Based on this study, advertising displays in an uncluttered visual environment are most likely to be noticed. Furthermore, displays are most likely to first attract attention when they are within 10 degrees of the driver's line of sight.

Other studies show that what attracts attention in peripheral vision are areas with high information content (e.g., concentrations of signs, cars, people), objects that differ greatly from their backgrounds in terms of brightness, colour, texture, etc., objects of large size, and objects that are moving. With respect to motion, we are "hard-wired" to detect motion in peripheral vision as a defensive mechanism, and cannot easily resist looking towards a moving object, particular if that movement occurs in a relatively still background. With respect to lighted displays, they will be most likely to attract drivers' attention at night, when contrast with the background is greater than during the day.

Research reviewed by Roberts suggests that in typical everyday driving environments attention is likely to be captured involuntarily⁴³. In addition, this fundamental research also suggests that motion and luminance changes in digital billboards are likely to be highly effective in capturing

⁴¹ Bhise, V.D. and Rockwell, T.H. Development of a driver-information-acquisition based operational tool for the evaluation of highway signs. Presented at the 1973 Annual Meeting of the Highway Research Board, Washington, D.C. 1973

⁴² Cole, B.L. and Hughes, P.K. A field trial of attention and search conspicuity. *Human Factors*, 26(3), 299-313. 1984

⁴³ Roberts, P. Designing evidence-based guidelines for the safe use of digital billboard installations: Experience and results from Australia. 16th Road Safety on Four Continents Conference, May 15 to 17, Beijing, China. 2013

attention involuntarily. Such luminance changes can arise from “the appearance of a new object or motion in a previously immobile object”.

In order to limit the number of message changes that drivers are exposed to, an Australian guideline recommends that dwell time be calculated as follows:

$$\text{Dwell time} = \text{Legibility Distance [m]} / (\text{Operating Speed } [\frac{\text{km}}{\text{h}}] \times 0.28 \times \text{proportion of drivers})$$

Proportion of drivers refers to the proportion who see a change in message on the approach. Thus, if only 10% of drivers see a change, the visibility distance is 200 m, and the speed is 60 km/h, then the dwell time is 120 seconds.

4.3. Human Memory for Sign Information

Short-term human memory resources for sign information are limited. A driver passes many vehicles, signs, and buildings during a trip. These all compete for the driver's attention. However, only a fraction of what is seen will be remembered. Even commuters who drive the same route every day will be unaware of many of the signs or buildings that they pass and would not recognize them if tested.

Eye movement recording studies in rural areas show that drivers look briefly at almost every traffic sign they pass. A brief look is long enough to determine sign colour and shape, which in turn cues the driver as to what information is likely on the sign. However, if drivers are stopped after passing a particular traffic sign, and asked to identify it, their memory of it is often poor. Such studies show that drivers stopped just after passing a sign, remember the last sign best if it was of immediate importance to them, e.g., speed signs more than general warning signs⁴⁴. Memory fades with time. Unless there is some motivation to remember a sign, it is unlikely it will be remembered at the end of a trip.

In a study of Ontario tourist signs⁴⁵, subjects were given target destinations, and then viewed a series of traffic signs, each with 3, 4 or 5 names. Subjects then reported whether the target destination was present and its distance and direction. Occasionally, subjects were asked to report what other types of destinations were on the signs they had just seen. Recall tested within a minute of the last slide being seen was poor: out of 9 possible destination types, participants remembered an average of 1.4 – 2.3 types. In addition, an average of 0.3 – 0.7 other destination types which were not present were incorrectly remembered as being present. Recall performance would deteriorate even more over time and after exposure to more signs on a trip.

The findings above suggest that SES messages are unlikely to be remembered unless a driver is particularly motivated to look for and remember them or unless the driver passes the message many times. Given the finite limitations of driver information processing and memory, the more signs there are, the less likely a given sign is to be seen or remembered. The more of visual clutter there is around the SES, the less likely drivers are to read the sign messages and remember them. The more engaged the driver is in demanding driving tasks, the less likely that a given message will be noticed and remembered. This information will assist our team in determination of the placement of the SES.

⁴⁴ Johanssen, G. and Rumar, K. Drivers and road signs: A preliminary investigation of the capacity of car drivers to get information from road signs. *Ergonomics*, 9(57), 62. 1966

⁴⁵ Smiley, A., MacGregor, C., and Dewar, R.E. Evaluation of prototype highway tourist signs. Final report prepared for the Ministry of Transportation in Ontario. 1996

4.4. Driver Distraction Related to Commercial Signage

As noted earlier, most of studies have focused on the impact of digital third-party advertising signs on driver distraction, with limited number of studies focusing on the SES.

An on-road study examined distraction related to commercial signs along the Gardiner Expressway through Toronto^{46, 47}. Distraction was examined in relation to various sign characteristics: small vs. large, static vs. moving, and left vs. right side of road. Twenty-five subjects wearing eye-tracking equipment drove a 6 km stretch of freeway. Subjects were not informed of the true purpose of the experiment. Some 905 glances were recorded at a total of 61 advertising signs of which 2/3 were static signs and 1/3 were signs with moving parts, ranging from roller bar signs that rotate to show one of 3 displays, changing every 15 seconds or so, to full video screen signs displaying moving images. On average, subjects glanced at commercial signs once every 12.5 seconds. Number of glances was significantly lower for passive signs (0.64 glances per subject per sign) when compared to active signs (greater than 1.31 glances per subject per sign). Number of long glances was also greater for active signs compared to the passive signs.

An FHWA sponsored study used eye movement recorders to observe driver response to Commercial Electronic Variable Message Signs (CEVMS) on arterials and highways in two cities⁴⁸. Gazes to the road ahead were high under all conditions but were reduced for the CEVMS and billboards condition as compared to the no-off-premise advertising condition. Average and maximum fixations to CEVMS and standard billboards were similar, with mean fixations of about 0.4 seconds and maximum fixations of 1.3 seconds. Four long dwell times (duration of back-to-back fixations to same region of interest) were recorded, exceeding two seconds, three to commercial billboards and one to a CEVMS.

A study in the Boston area involved 74 older and younger drivers driving a two-hour route on freeways in an instrumented vehicle using FACELab cameras to observe eye movements. Drivers passed an electronic billboard (42 ft. x 14 ft., no description of content) which was generally isolated from other signage and visual clutter. Driver attention was modified by the presence of the sign, with significant shifts in the number and length of glances toward the billboard. Older drivers were particularly affected⁴⁹. A review of glance durations found few glances of two seconds or longer (six in one direction and five in the other). As discussed elsewhere, glances longer than two seconds away from the forward view are associated with a doubling of crash risk.

4.5. Message Attribute Guidelines

4.5.1. Font

Font affects legibility. New fonts to be used on new Variable Message Signs (VMS) on Ontario highways were developed based on selecting the most legible fonts from an initial set of 134 fonts

⁴⁶ Beijer, D.D., Smiley, A., and Eizenman, M. Driver distraction due to roadside advertising. Final report to the Ministry of Transportation in Ontario. 2001

⁴⁷ Beijer, D.D., Smiley, A., and Eizenman, M. Observed driver glance behavior at roadside advertising signs. Transportation Research Record, 1899, 96-103. 2004

⁴⁸ Perez, W.A., Bertola, M.A., Kennedy, J.F., and Molino, J.A. Driver visual behavior in the presence of commercial electronic variable message signs (CEVMS). SAIC, Federal Highway Administration Office of Real Estate Services. Report No. FHWA-HEP-11-014, Washington, D.C. 2011

⁴⁹ Belyusar, D., Reimer, B., Shoup, A., Jokubaitis, B., Pugh, B., Mehler, B., and Coughlin, J.F. A preliminary report on the effects of digital billboards on glance behavior during highway driving. Presented at the 2014 Annual Meeting of the Transportation Research Board. 2013

including existing MTO fonts, FHWA fonts, VMS vendor fonts, among others⁵⁰. Four font styles (wide upper case, wide mixed case, narrow upper case, narrow mixed case) were evaluated for each font. For each font style, the process of developing font options followed the methodology to identify an optimum “hybrid” fonts⁵¹. The best characters from each font source/style, were selected using two main criteria:

- Legibility, across various font styles; and
- Confusion, within the same font style.

With respect to legibility, the new font did better than the MTO fonts for two of the three formats (wide mixed case and narrow upper case). There was no difference in legibility between the two versions of wide upper-case fonts. With respect to wide upper case, the existing MTO version (DD) had a legibility index of 5.81 m/cm, whereas the new version (WUC) had a legibility index of 5.79 m/cm, a difference of less than 1%. For wide mixed case, the existing MTO version (DDM) had a legibility index of 5.12 m/cm. By comparison, the new version (WMC) had a legibility index of 5.42 m/cm, a difference of 5.5%. With respect to narrow upper case, the existing MTO version (3) had a legibility index of 4.70 m/cm. By comparison, the new version (NUC) had a legibility index of 5.12 m/cm, a difference of 9%. Thus, maximum legibility distance (legibility index of 5.81 m/cm) was obtained with the wide upper case MTO font.

4.5.2. Letter Heights

Letter heights that are sufficiently large so as to be easily read will be less distracting to drivers than letter heights that make reading difficult.

Average legibility distances for aluminum indium gallium phosphide (or equivalent) LED signs, using a font with height equal to width, based on a large subject sample including both young and older drivers, was found to range from 166 m for backlit and nighttime conditions to 241 m for sun midday and washout conditions for 45 cm letter heights⁵². This gives a legibility index of 3.7 to 5.3 m/cm of letter height. This letter height would thus provide 10 to 14 seconds legibility distance at 60 km/h and 7.5 to 14 seconds at 80 km/h.

A review of VMS legibility of MTO signs determined that increases in letter height over 45 cm do not result in proportional increases in legibility distances⁵³. For letter heights over 45 cm, the authors recommend increasing letter height by 150% to obtain a legibility distance increase of 100%.

Conversely, a study of VMS legibility with shorter letter heights 23 cm found that the 85th percentile legibility index was only 39% (rather than 50%) of the 45 cm 85th percentile letter legibility index⁵⁴.

⁵⁰ Smiley, A. and Smahel, T. MTO bilingual variable message signs: Results - Phase 2. Final report prepared for IBI Group for the Ministry of Transportation, Ontario. 2012

⁵¹ Dudek, C.L., Huchingson, R.D., Williams, R.D., and Koppa, R.J. Human factors design of dynamic visual and auditory displays for metropolitan traffic management. Vol. 2. Dynamic visual displays. Report No. FHWA/RD-81/040. Report prepared by Texas Transportation Institute for the Federal Highway Administration, Washington, DC. 1980

⁵² Ullman, G.L. and Dudek, C.L. Maximum VMS legibility distances for day and night operations. Contribution to Variable Message Signs Operation Manual. Report No. FHWA-NJ-2001-10 for New Jersey Department of Transportation. 2001

⁵³ Garvey, P.M. and Mace, D.J. Changeable message sign visibility. Federal Highway Administration, Report No. FHWA-RD-94-077, Washington, D.C. 1996

⁵⁴ Ullman, G.L. and Dudek, C.L. Development of a field guide for portable changeable message sign use in work zones. Report No. FHWA/TX-06/0-4748-2. Texas Transportation Institute, Texas A & M University. 2005

4.5.3. Message Length

Driving is a visually demanding task and drivers moving past a dynamic billboard at high speeds have little time to spend on reading signs. Guidance on reading time and appropriate message length for dynamic signs originates from an on-road study involving drivers on a highway in light traffic reading VMS messages. The 85th percentile reading time was one major word per second or two seconds per unit of information⁵⁵. A unit of information answers a question such as “What happened? Or where did it happen?” For example, “Express Moving Slowly” is one unit of information. In this study “reading time” refers not specifically to fixation time, but to the whole time during which the driver is traveling towards the sign while it is visible – it includes both the time the driver is actually fixating on the sign as well as the time drivers must look back at the traffic.

The maximum message length is dependent on the length of time the message is legible, which in turn depends on letter height and operating speed. As discussed above, an average legibility index for LED signs can be assumed to be 4.5 m/cm.

A typical comprehension rate would be approximately 3 words per second, but this will vary based on word length, text size, font, and format⁵⁶. As described above, research suggests that glances away from the road should not exceed 2 seconds⁵⁷. Therefore, the number of words that can be read on the approach is depending on the legibility distance, the approach speed, the amount of words that can be read per second (i.e. comprehension rate).

An Australian guideline recommends that the maximum message length be calculated as follows:

$$\text{Max number of words} = \text{Legibility Distance [m]} / \left(\text{Operating Speed} \left[\frac{\text{km}}{\text{h}} \right] \times 0.28 \right) \times \text{Comprehension Rate}$$

For example, based on a legibility index of 4.5 m/cm, the legibility distance of text with a letter height of 20 cm is 90 m (4.5 m/cm x 20 cm). Assuming a comprehension rate of 3 words per second and an operating speed of 60 km/h, a maximum of 16 words could be included on an SES (90 / [60 x 0.28] x 3). If the same assumptions were made with 10 cm letter heights, the legibility distance would be reduced to 45 m and a maximum of 8 words could be used.

5. Recommendations

The objective of this section of the report is to provide recommendations on the application and implementation of SES, which can be considered during the review of the Town’s by-law. The recommendations listed in this section were developed using the following resources:

- Literature review and jurisdictional scan;
- Human factors guidelines;
- Review of best practices and survey from the Safety Impacts and Regulations of SES for City of Toronto⁵⁸; and
- Feedbacks received from the Town project team.

⁵⁵ Mast, T.M. and Ballas, J.A. Diversionary signing content and driver behaviour. Transportation Research Record, 600 1976

⁵⁶ Roberts, P. Designing evidence-based guidelines for the safe use of digital billboard installations: Experience and results from Australia. 16th Road Safety on Four Continents Conference, May 15 to 17, Beijing, China. 2013

⁵⁷ Klauer, S.G., Dingus, T.A., Neale, V.L., Sudweeks, J., and Ramsey, D. The impact of driver inattention on near-crash/crash risk: An analysis using the 100-car naturalistic driving study data. Report No. DOT HS 810 594. National Highway Traffic Safety Administration, Washington, DC. 2006

⁵⁸ Safety Impacts and Regulations of Electronic Static Roadside Advertising Signs. 2013. City of Toronto, Ontario

5.1. Content

Criteria	Recommendation
Definitions	<ul style="list-style-type: none"> • Static Electronic Sign (SES): SES is an on-premise ground sign that is designed to have the alphanumeric characters and digital images that can be readily changed or rearranged by electronic means without altering the face of the sign and displays information to the public in a prearranged time sequence. • SES does not contain copy that is full motion video or otherwise gives the appearance of animation or movement and does not display third party advertising. • SES does not include Outdoor Digital Menu Boards, which can include digital images, installed at drive-through. The applications of these signs are different from the SES. • Message Unit: Each of the following equals 1 message unit: a word, an abbreviation, a number, a symbol, a geometric shape, a person's or firm's initials, a web site, an electronic mail address. When a business has a sign with identical sign messages facing opposite directions, only the message units on 1 side of each such pair shall be counted in computing the permitted number of message units.
Application	<ul style="list-style-type: none"> • SES can only be used on ground signs and within specific land-use designations. SES are prohibited on all other sign types regulated by the by-law. • Ground sign in an on-premise sign which is permanently affixed to and supported from the ground, and not attached to or supported in any manner by a building. • The Town would require an amendment if the SES is to be installed on other types of signs (e.g. freestanding).

Criteria	Common Practices / HF Guidelines	Recommendation
Type of content	<ul style="list-style-type: none"> • Characters, letters, words, illustrations 	<ul style="list-style-type: none"> • Static alphanumeric text and digital image
Prohibited content	<ul style="list-style-type: none"> • Animations, scrolling content, motion, fading, flashing, or blinking light, or any effects that create the illusion of movement 	<ul style="list-style-type: none"> • Animations, scrolling content, motion, fading, flashing, or blinking light, or any effects that create the illusion of movement • Do not allow SES to include directional elements. • Do not allow signs to imitate, resemble or be confused with official traffic control devices. • Do not allow SES to display sequential messages either on the same sign or on subsequent signs. • All advertising must comply with and not contravene the Canadian Code of Advertising Standards⁵⁹.

⁵⁹ The Canadian Code of Advertising Standards, <http://www.adstandards.com/en/standards/canCodeOfAdStandards.aspx>, Accessed 10 January 2018

<p>Minimum dwell time</p>	<ul style="list-style-type: none"> • 5-6 sec (Kingston, Windsor, Milton, Edmonton, Calgary) • 10 sec (Waterloo, Vancouver) • 15 sec (Sault Ste. Marie) • 20 sec (Ottawa) • 30 sec (Oakville) • 5 min (Collingwood) • 15 min (Ann Arbor) 	<ul style="list-style-type: none"> • 30 seconds.
	<p><i>Minimum Dwell time</i> = <i>Legibility Distance [m]</i> / (<i>Operating Speed</i> [$\frac{km}{h}$] \times 0.28 \times <i>proportion of drivers</i>)</p> <p>Dependant on sight distance and travel speed. Ideally not all drivers should be exposed to a message transition. Assuming a legibility distance of 90 m, an approach speed of 60 km/h, and a desire for no more than half of drivers will be exposed to a transition, the minimum dwell time should be at least 11 seconds.</p>	
<p>Maximum transition time</p>	<ul style="list-style-type: none"> • 0 to 1 second 	<ul style="list-style-type: none"> • Limit to instantaneous transitions only, with no effects.
<p>Message height</p>	<ul style="list-style-type: none"> • Use sufficient heights to allow the whole sign message to be read. • Minimum font heights from literature: 15 cm • Minimum font heights from site visits: 20 cm • Assume an average legibility index of 4.5 m/cm • Maximum legibility distance based on message height of 20 cm: 90 m • Maximum legibility distance of VMS: 166 m (nighttime) and 241 m (daytime) (<i>Ullman & Dudek, 2001</i>) • As expected, the legibility distance of SES is less than the distance required for VMS. 	<ul style="list-style-type: none"> • Minimum message heights of 20 cm.
<p>Criteria</p>	<p>Recommendation</p>	
<p>Maximum message size</p>	<ul style="list-style-type: none"> • Maximum message size is calculated using the following equation: <i>Max message size</i> $= \text{Legibility Distance [m]} / (\text{Operating Speed } [\frac{km}{h}] \times 0.28)$ $\times \text{Comprehension Rate}$ • Comprehension rate (assume average of 3 words/sec, based on human factors criteria). • For example, if it was assumed that the text was legible at a distance of 90 m, at an operating speed of 60 km/h the maximum number of units would be 16 (assuming 	

	the letter heights were sufficiently large to be read at a distance of 90 m and the sign was sufficiently large to accommodate 16 units at this letter height).
Font	<ul style="list-style-type: none"> • Use monospaced fonts for maximum legibility. Examples: <ul style="list-style-type: none"> • CONSOLAS • LUCIDA CONSOLE • COURIER NEW
Colour	<ul style="list-style-type: none"> • Mono colour for text messages (e.g. amber or red on black LED). • The colour and shape of digital images should not mimic official traffic control devices.
Safety effects on collisions	<ul style="list-style-type: none"> • Require a traffic safety assessment as part of the permit application. Have the right to revoke a permit and remove a sign that is found to have adverse impacts on safety. • From an application perspective, the Town may have additional requirements for the permission of this technology, which can increase the permit fees and possibly building in an inspection fee for measuring the sign luminance.

5.2. Location and Size

Criteria	Common Practices / HF Guidelines	Recommendation
Allowance within Right-Of-Way (ROW)	<ul style="list-style-type: none"> • Not allowed in ROW 	<ul style="list-style-type: none"> • Not allowed in ROW.
Minimum allowance from a residential dwelling	<ul style="list-style-type: none"> • 30 m (Kingston, Vancouver) • 36 m (Brampton) • 45 m (Ottawa) 	<ul style="list-style-type: none"> • 90 m.
Minimum setback from a signalized intersection	<ul style="list-style-type: none"> • 15 m (Markham, Oakville, Vancouver) • 18 m (Ottawa) 	<ul style="list-style-type: none"> • 20 m. • Limit SES in proximity to intersections. Do not allow SES to interfere with intersection signs or signals.
Minimum setback from another SES	<ul style="list-style-type: none"> • 30 m (Calgary, Brampton) • 45 m (Burlington, Milton, Markham) • 60 m (Ottawa) • 100 m (Kingston) 	<ul style="list-style-type: none"> • 90 m.
Minimum setback from property line	<ul style="list-style-type: none"> • 1 m (Sault Ste. Marie, Mississauga) • 1.5 m (Ann Arbor, Burlington, Waterloo, Vancouver, Oakville, Brampton) • 3 m (Edmonton, Collingwood) • 1 m to 3 m (Ottawa, Kingston) • 1 m to 6 m (Milton) 	<ul style="list-style-type: none"> • 1.5 m
Maximum setback from the roadway	<ul style="list-style-type: none"> • Not to be placed such that drivers must divert their gaze away from the forward roadway in order to comprehend the sign message. 	

Criteria	Common Practices / HF Guidelines	Recommendation
	<ul style="list-style-type: none"> Sign should be legible within 10 degrees of the driver's central line of sight for the entire legibility distance. Assuming a legibility distance of 90 m, the maximum setback of a sign from the roadway would be 16 m ($90 \times \tan(10^\circ) \cong 16m$). 	
Restrictions based on land use	<ul style="list-style-type: none"> Common to restrict to specific land uses and not allow in residential areas 	<ul style="list-style-type: none"> Restrict SES to commercial, industrial, and employment areas. In addition, SES can be installed at community centers, institutional centers, and places of worships, within residential areas.
Sight distance / visibility	<ul style="list-style-type: none"> Sight distance must correspond to the required legibility distance Not allowed at decision points of drivers and in high attention demand areas Restrict on curvature Not to obstruct the view of roadways The visibility assessment of the locations will be undertaken on a case-by-case basis via a traffic impact study. 	
Maximum permitted percentage and area of SES	<ul style="list-style-type: none"> 40% / 6 m² (Ottawa) 80% / 4.8 m² (Waterloo) 30% / 5 m² (Sault Ste. Marie, Brampton, Kingston) 30% / 2.5 m² (Oakville) 30% of total sign area (Victoria, Windsor) 50% / 7.5 m² – 14 m² (Ann Arbor, Mississauga) 50% / 1.5 m² – 9 m² (Collingwood, Markham) 	<ul style="list-style-type: none"> 30% of the total sign area (ground-mounted) Maximum area of SES per side: <ul style="list-style-type: none"> Commercial and industrial: 5 m² Residential area for community centers, institutional centers, and places of worships: 2.5 m² Maximum message unit based on SES area: <ul style="list-style-type: none"> Commercial and industrial: 16 units Residential: 8 units A ground-mounted sign can only have two sides.
Maximum height of ground-mounted signs with SES	<ul style="list-style-type: none"> 1.5 m (Waterloo) 1.5 m to 8 m (Ottawa) 2 to 6.5 m (Collingwood) 2 to 7.5 m (Markham) 3 to 7.6 m (Milton) 3.6 m to 10.5 m (Burlington) 5.3 to 10.6 m (Kingston) 5 m (Vancouver) 6.75 m (Oakville) 7.5 m (Sault Ste. Marie, Edmonton, Mississauga, Brampton) 	<ul style="list-style-type: none"> 6.75 m Signs should be placed above the height of pedestrians, traffic control devices, and vehicles, but not too high that they require drivers to tilt their head upwards to read the SES (see the next criterion) Min height of SES from the ground: <ul style="list-style-type: none"> Commercial and industrial: 2 m Residential: 0 m
Vertical placement	<ul style="list-style-type: none"> Based on an accurate vision cone of 4 degrees (i.e. fovea area) and legibility distance of 90 m, the maximum vertical placement of SES would be 6.30 m ($90 \times \tan(2^\circ)$). Given the maximum height of ground-mounted sign (6.75 m), an offset of 45 cm would be in place between the SES and the top of the ground-mounted sign. 	

5.3. Illumination

The following illumination criteria (or appropriately modified, as needed) will be utilized for all sign types (other than SES), with internal or external illumination sources.

Criteria	Common Practices / HF Guidelines	Recommendation
Daytime Luminance	<ul style="list-style-type: none"> 5000 Nit (Ottawa, Vancouver, Ann Arbor) 	<ul style="list-style-type: none"> 5000 Nit Restrict daytime luminance so that SES can be seen and read but are not overly distracting
Night Time Luminance	<ul style="list-style-type: none"> 100 Nit (Ann Arbor, Toronto) 200 Nit (Vancouver) 220 Nit (Ottawa) 	<ul style="list-style-type: none"> 100 Nit Restrict night time luminance so that SES are not overly distracting and blinding
Luminance Relative to Ambient Light	<ul style="list-style-type: none"> 3 Nit 	<ul style="list-style-type: none"> 3 Nit Restrict luminance relative to ambient light so that SES are not overly distracting and blinding
Automatic Illumination Control	<ul style="list-style-type: none"> The SES should include automatic illumination control. 	<ul style="list-style-type: none"> The SES requires an ambient light sensor that will automatically adjust the sign luminance according to the environmental conditions.
Hours for Dimming/Turning Off	<ul style="list-style-type: none"> 11 pm to 7 am (Burlington, Waterloo, Vancouver) 10 pm to 7 am (Brampton) 10 pm to 8 am (Oakville) 	<ul style="list-style-type: none"> Between 10 pm to 8 am, signs within 90 m of residential dwelling to be turned off. Between 10 pm to 8 am, signs beyond 90 m of residential dwelling to be dimmed. For such locations, the Delegated Official may require the illumination to be turned off on a case-by-case basis to mitigate any issues.
Malfunction	<ul style="list-style-type: none"> Divided: some have no provisions, some require the SES to be turned off or display of a black screen until SES is repaired 	<ul style="list-style-type: none"> Require SES to be turned off or display a black screen until repaired

APPENDIX A: SYNTHESIS OF PRACTICES

Characteristic	Ottawa	Burlington	Waterloo	Sault Ste. Marie	Calgary	Edmonton	Vancouver	Oakville	Milton	Mississauga	Brampton	City of Guelph	Windsor	Ann Arbor	Collingwood	Kingston	Uxbridge	Victoria	Markham
Equivalent Terminology for Static Electronic Signs (SES)	Message Centre	Read-O-Graph	<ul style="list-style-type: none"> Changeable copy Variable electronic message signs 	<ul style="list-style-type: none"> Changeable copy Digital sign Electronic message board 	Digital message sign	Digital signs	Electronic static signs	Electronic message board	Animated sign	Changing copy sign	Electronic variable message centre	Electronic message sign	Electronic changing copy	Electronic changing copy	Changeable copy Readograph	Readograph	Electronic message centre Readograph	Readograph	Electronic message display Readograph
Type of Installation	<ul style="list-style-type: none"> Ground Sign Wall sign 	Ground Sign	<ul style="list-style-type: none"> Freestanding signs Ground sign 	<ul style="list-style-type: none"> Ground sign Window sign Wall sign 	Freestanding sign Can be attached to a building Can be used in window	<ul style="list-style-type: none"> Freestanding sign Fascia sign 	<ul style="list-style-type: none"> Freestanding sign Fascia sign Projecting sign 	<ul style="list-style-type: none"> Ground sign Fascia sign 	<ul style="list-style-type: none"> Ground sign Wall sign 	Ground sign	<ul style="list-style-type: none"> Ground signs Entry door windows of non-residential units 	Freestanding signs	<ul style="list-style-type: none"> Permanent canopy signs Permanent fascia signs Permanent ground signs Permanent projecting wall signs 	<ul style="list-style-type: none"> Attached to buildings Ground signs 	<ul style="list-style-type: none"> Ground signs Mobile signs 	<ul style="list-style-type: none"> Ground signs 	-	<ul style="list-style-type: none"> Canopy Fascia Free-standing Noticeboard Projecting 	<ul style="list-style-type: none"> Ground signs
Size and Location																			
Minimum Allowance from a Residential Dwelling	45 m	-	-	75 m (specified for billboards)	-	-	30 m	-	-	-	36 m	15 m	60 m	-	-	30 m	-	-	-
Minimum Setback from a Signalized Intersection	18 m	-	-	A setback less than 100 m requires a safety review	-	-	15 m in general and 20 m if total sign area is greater than 5.0 m ² for freestanding signs	15 m	-	-	-	-	-	-	-	-	-	-	15 m
Minimum Setback from Another SES	60 m	45 m	-	Controlled by area of sign per frontage length	30 m when used with a freestanding sign	100 m – 300 m based on area of signs	-	-	45.7 m	-	30 m	Mall with frontage greater than 280 m can have a sign	-	-	-	100 metres	-	-	45 m
Maximum Permitted Area of SES	40% of ground sign (max 6 m ²)	-	<ul style="list-style-type: none"> 6m² (50% of total sign area for freestanding signs) 4.8 m² (80% of total sign area for ground signs) 	<ul style="list-style-type: none"> 30% of ground sign area 15% of façade area or 8m² for wall sign 50% of window area or 2.0m² 	<ul style="list-style-type: none"> 5m² if attached to a building 2.5m² if used in window 50% of a freestanding sign 	<ul style="list-style-type: none"> 20.0 m² for freestanding signs. 65.0 m² for fascia signs 	60% of the sign area with maximum 2.3m ²	30% of a ground sign	6.9 m ²	50% of total sign area of a ground sign	One third of total ground sign area	7.5 m ²	30% of total sign area	50% of total sign area	50% of ground signs area	5.0 m ²	-	One third of total sign area	50% of total ground sign area
Maximum Ground Sign Area (where applicable)	Varies based on land use (range 2.0 m ² to 14.0 m ²)	56 m ²	6 m ²	15 m ²	-	-	-	7.5 m ²	70% of the frontage of the property	15.0 m ² – 28.0 m ²	15.0 m ²	-	Based on land uses	2 ft ² per linear foot of ground floor frontage (with a maximum of 200 ft ²)	3.5 m ² to 18.5 m ² (based on land use and frontage)	7.0 m ² to 14.0 m ² (based on the distance from the street lane)	-	-	2.0 m ² to 18.0 m ² (per face based on land use)

Characteristic	Ottawa	Burlington	Waterloo	Sault Ste. Marie	Calgary	Edmonton	Vancouver	Oakville	Milton	Mississauga	Brampton	City of Guelph	Windsor	Ann Arbor	Collingwood	Kingston	Uxbridge	Victoria	Markham
Maximum Freestanding Sign Area (where applicable)	-	-	14 m ²	-	5 m ² – 18.5 m ²	-	5.0 m ²	-	-	-	-	7.5 m ²	-	-	-	-	-	2.8 m ² to 7.43 m ² (based on land use)	-
Maximum Wall Sign Area (where applicable)	-	-	-	25% of facade area	-	-	-	-	20% of the area of architectural elevation	-	-	-	10% to 30% of wall area based on land uses	-	-	-	-	Fascia signs - 2.8 m ² to 9.00 m ² (based on land use) Projecting signs - 1.9 m ² to 4.49 m ² (based on land use)	-
Maximum Height	1.5 m – 1.8 m	3.6 m - 10.5 m	<ul style="list-style-type: none"> 10.0 m freestanding sign 1.5 m ground sign 	7.5 m	4 m – 12 m	8 m	5.0 m	6.75 m	3.0 m – 7.6 m	7.5 m	7.5 m	-	-	1 foot per 3 foot of setback	2.0 m to 6.5 m (based on land use and frontage)	5.3 m to 10.6 m (based on distance from street line)	-	-	2.0 m to 7.5 m (based on land use)
Minimum Setback from Property Line	1.0 m – 3.0 m	1.5 m	1.5 m	1.0 m	-	3.0 m	1.5 m	1.5 m	1.0 m – 6.0 m	1.0 m	1.5 m	-	-	5 ft.	3.0 m	1.5 m to 3.0 m	-	-	-
Content																			
Type of Content	Alphanumeric text and images	-	<ul style="list-style-type: none"> Changeable copy (may include wording, letters, numerals, logos and/or artwork) Variable electronic message signs (only text) 	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Characters, letters, words, or illustrations	-
Prohibited Content	Scrolling text or any flashing text, characters, images, video or audio	-	Animations	Motion, dissolving, fading, flashing, intermittent or blinking light, scrolling	Animation or any effects that look like animation or sequential messages	-	-	Animated signs	Animated signs prohibited in downtown	Animated signs	Scrolling script and flashing messages	Animated signs	-	Scrolling or traveling of a message on changeable copy is prohibited	-	Message changes more frequently than 5 seconds	-	-	-
Minimum Dwell Time	20 seconds	-	10 seconds	15 seconds for digital signs and 30 seconds for electronic message board	6 seconds	6 seconds	10 seconds	30 seconds	5 seconds	-	-	-	4 seconds	15 minutes	5 minutes	5 seconds	-	-	-
Maximum Transition Time	1 second	-	-	0.25 seconds	0.25 seconds	-	0.5 seconds	-	-	-	-	-	-	-	-	-	-	-	-
Illumination																			
Daytime Luminance	5000 cd/m ² (Nits)	-	-	-	7500 cd/m ²	-	5000 cd/m ²	-	-	-	-	-	-	5000 cd/m ²	-	-	-	-	-
Night Time Luminance	220 cd/m ²	-	-	-	500 cd/m ²	400 cd/m ²	200 cd/m ²	-	-	-	-	-	--	100 cd/m ²	-	-	-	-	-
Luminance Relative to Ambient Light	3 lux	-	3 lux	3.23 lux	3.0 lux	0.3 foot candles	3.0 lux	-	-	-	-	-	-	0.1 foot candles	-	-	--	-	-



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