St. Albert Digital Display Guidelines

Road Safety Assessments

City of St. Albert

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1 INTRODUCTION

1.1 Background and Purpose

The City of St. Albert regulates the use of digital displays within the City's Land Use Bylaw (09/2015) Schedule C – Sign Regulations, within amendment (18/2016).

In recognition of impacts of the use of digital displays to the road right of way and potential impacts on road safety, these guidelines are intended to provide consistency and confidence in the evaluation of digital display permit applications and the assessment of impacts to roadway safety, while formally providing proactive acknowledgement to criteria and requirements to the commercial industry.

These Guidelines follow the Transportation of Canada (TAC) Digital and Projected Advertising Display (DPAD): Regulatory and Road Safety Assessment Guidelines (2014), that are designed to encourage a consistent practice in implementation of DPADs and promote transparency, reasonableness, and safety in regulating and permitting DPADs. TAC Guidelines referenced in this document are:

DPAD Guidelines
Digital and Projected Advertising Displays: Regulatory and Road Safety Assessment Guidelines, 2014.

MUTCDC
Manual of Uniform Traffic Control Devices for Canada (5th Edition), 2014.

Geometric Design Guide
Geometric Design Guide for Canadian Roads, 2017.

1.2 Scope

The Guidelines consider urban, suburban, and rural geographic areas in St. Albert and road safety impacts on all road users that includes motorists and pedestrians. They are limited to digital displays as defined in *Schedule C – Sign Regulations* of the Land Use Bylaw (amendment 18/2016) as follows:

> "Digital Display – means a device intended to display copy (text or graphics that comprise the message on a sign face) using electronic screens, projection, television, computer video monitors, liquid crystal displays (LCD), light emitting diode (LED) displays, or any other similar electronic, computer generated, or digital technology. Digital displays were previously known as electronic message signs, which now refer to signs with changeable, text-only copy." – *C.3(p)*

Digital displays, referred to as DPADs (Digital and Projected Advertising Displays) in the TAC DPAD Guidelines, can be stand-alone billboards or freestanding signs that display third-party advertising or freestanding and facia signs that advertise the businesses on-site that own the sign. In general, the Land Use Bylaw regulates signage on private property, while the Traffic Bylaw (18/2005) regulates signage

within the road right-of-way. The Traffic Bylaw specifically prohibits any sign that is “self-illuminated or employs the use of electricity” from placement within the road right-of-way.

These guidelines focus on the road safety impacts of digital displays and criteria of the assessment in efforts to minimize the potential change in collision risk resulting from digital displays distracting drivers from their driving task. The transportation related assessment of a digital display application is one component of the full review required for any application of placement of a digital display, and the final response to any application may be influenced by other factors that include additional criteria established within the Land Use Bylaw (LUB). For example, digital displays are prohibited outside of CC and CIS land-use districts in St. Albert. Therefore, the final approval decision for digital display permit applications is not dependant on road safety alone.

These guidelines only consider digital display characteristics that differ from traditional advertising signs because as much as possible, digital displays should be governed by the same regulations as other signs. Unique digital display characteristics include brightness, frame duration, message sequencing, text scrolling, animation, transition time and effects, digital display spacing and density, and proximity to traffic control devices and decision-making areas.

Common characteristics between digital display and traditional advertising signs that are not included in these guidelines are sign size, message content, and colour. Schedule C of the Land Use Bylaw (City of St. Albert 18/2016) regulates traditional sign characteristics where Section C.5 is specific to digital display characteristics.

1.3 Abbreviations

The following are abbreviations used in this Guide.

DPAD	Digital and Projected Advertising Displays
DSD	Decision Sight Distance
DST	Decision Sight Time
FOV	Field of View
LUB	Land Use Bylaw
MUTCDC	Manual of Uniform Traffic Control Devices for Canada
SSD	Stopping Sight Distance
TAC	Transportation Association of Canada

2 FUNDAMENTAL CONCEPTS

This chapter describes fundamental concepts for assessing digital display permit applications from a road safety perspective. These concepts are utilized in the development of these *Guidelines* and are key considerations in generating criteria for the placement and operation of digital displays in St. Albert.

2.1 Road Safety Impacts of Digital Displays

By design, roadside advertising signs attract the attention of passing road users. In general, transportation professionals are comfortable with the road safety impact of traditional static advertising signs while the road safety impact of digital displays is relatively unknown. Digital displays have additional functionalities from static signs, like content motion and brightness, that increase the conspicuity of their content to further attract the attention of passing drivers. Thus, a driver's attention may be consciously or subconsciously drawn to these displays, and attract additional, longer glances away from the roadway, which may increase the risk of collision. Considered in isolation, collision risk increases from a single digital display may be negligible; however, the cumulative effect of several digital displays in succession has the potential to increase collision risk materially.

Existing research has not reached a definitive conclusion regarding the impact of digital displays on collisions frequency. The lack of conclusion is primarily due to the limitations in testing methods and data availability and not necessarily the actual impact of these signs on road safety. For example, analyzing historical collision data does not provide information about the presence of a digital display, it's operational characteristics at the time of the collision (e.g., brightness, frame duration, video, etc.), and/or the extent that the digital display contributed to a collision (e.g., information about whether distraction from the sign was the only cause of the collision or one of many causes). In the absence of a definitive conclusion, human factors and road safety engineering principles can be applied to understand the collision risk attributed to digital displays, as described in the *TAC DPAD Guidelines*. These principles indicate that driver distraction caused by digital displays is the result of increased glance frequency and duration; where glance frequency is a form of visual distraction and glance duration is a form of cognitive (mind or attention) distraction.

Driver glance frequency and duration toward a digital display are a function of illumination (i.e., display brightness), motion (i.e., animation or the number of frame changes of the display), and placement (i.e., how many digital displays are within a driver's field of view). The safety impact of display illumination and motion are discussed in Section 2.3 of this Guide. The number of frame changes a driver observes within their field of view can be controlled by regulating the spacing/density of digital displays and the frame duration. Regardless, digital displays should be located away from signalized intersections and other key decision-making areas in the transportation system.

Digital display density refers to the concentration of digital displays in a driver's field of view. Figure 1 illustrates an example of three digital signs in the driver's field of view. Spacing is the longitudinal distance between signs. Density is the number of digital displays within a defined longitudinal distance. In this

context, density is used to determine if a particular area has capacity for adding a new digital display and spacing is used to determine the minimum distance between off-site digital displays. All things being equal (e.g., frame duration, brightness), glance frequency and duration to digital displays (i.e., distraction), generally increases as digital display density increases and spacing decreases.

Density: 3 Digital displays per field of view

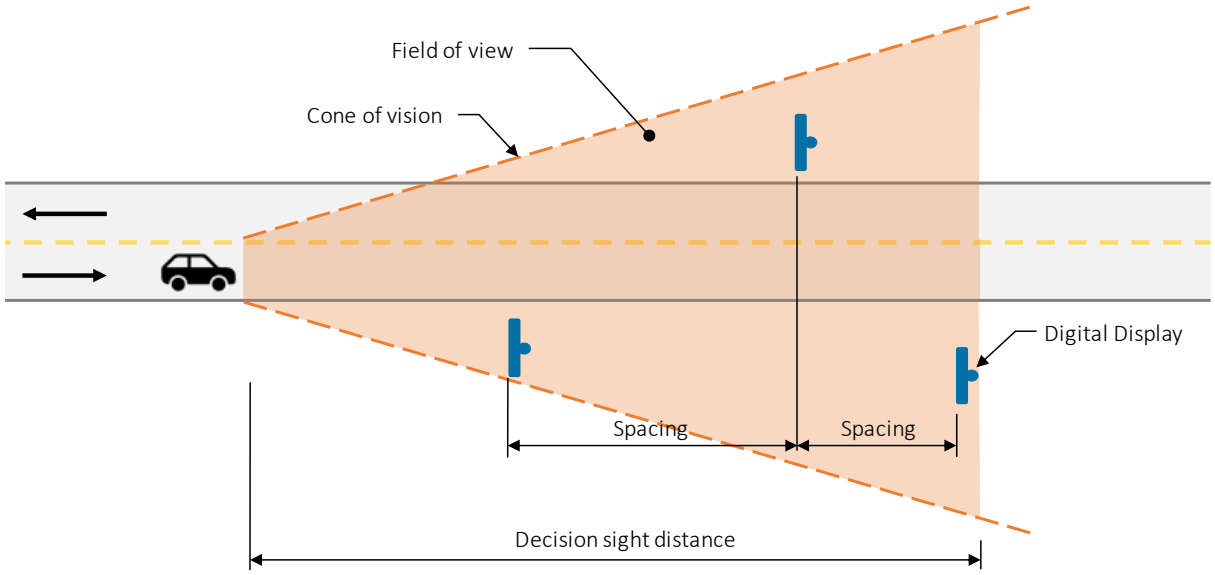


Figure 1: Digital display density and spacing

Frame duration is the elapsed time that a single static message is shown on a digital display before changing to the next static message. It is a major factor that impacts the distracting effects of an individual digital display. The combination of frame duration and sign density/spacing determines how many frame changes will occur as a driver passes by digital displays. Glance frequency and duration towards digital displays tend to increase as the number of frame changes that occur increases. Therefore, frame duration must be simultaneously considered with sign density and spacing.

Road safety research indicates that drivers should not observe more than three frame changes within their field of view. Frame duration, sign density, and sign spacing can be defined to control how many frame changes a driver observes. Generally, increasing frame duration can allow more digital displays within a driver's field of view, and vice versa.

2.2 Digital Display Types and Owners

Digital displays are illuminated using electronic screens, computer video monitors, LCD displays, LED displays, or any other similar electronic, computer generated, or digital technology. Compared to traditional advertising signs that comprise a static image, digital displays can display different types of animation that include full motion video, text scrolling, transition effects between frames, and instantaneous frame transitioning.

There are many types of signs permitted for use by *Schedule C: Sign Regulations* of St. Albert's Land Use Bylaw (18/2016) but only three sign types may have a digital display. As of July 2017, digital displays may be permitted on billboards, freestanding signs, and fascia signs defined in the Land Use Bylaw as follows:

> **Billboards** – "means a sign displaying only third-party advertising." – *C.3(g)*
>
> **Freestanding signs** – "means a sign anchored into the ground and not attached to a building." – *C.3(w)*
>
> **Fascia signs** – "means a sign attached, etched or painted on a building. A wall mural shall not be considered a fascia sign." – *C.3(t)*

Digital display sign types are designed to meet the unique needs of sign owners and therefore their size is regulated differently in the Land Use Bylaw. Figure 2 illustrates the maximum display area regulation relative to each digital display sign type and the corresponding height dimensions for a 16:9 widescreen aspect ratio.

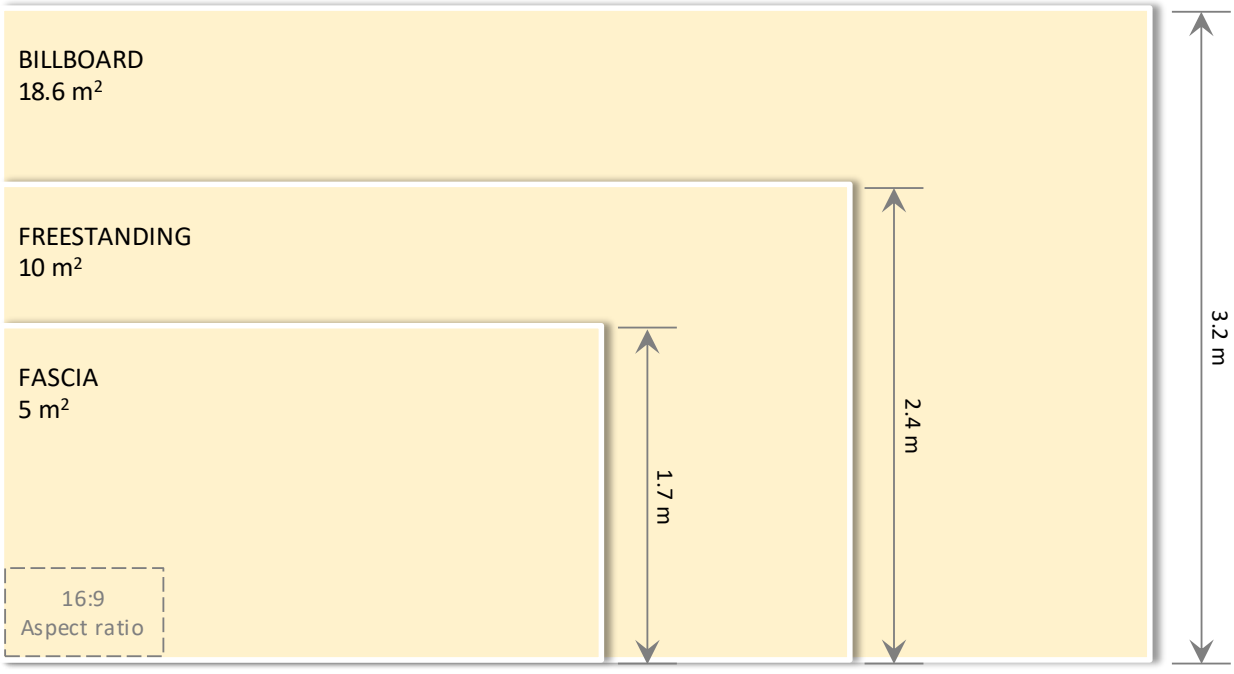


Figure 2: Relative size of digital display sign types.

Roadside advertising signs and digital displays are identified as either on-site or off-site based on the sign ownership and content. Freestanding digital displays can be classified as either an on-site sign or an off-site sign. Examples of on- and off-site digital displays are shown in Figure 3 and defined as follows:

> On-Site Sign - A freestanding or fascia sign whose message and design relates to a business, profession, product, service, event or other commercial activity sold, offered, or conducted on the same property where the sign is located.
>
> Off-Site Sign - A billboard or freestanding sign that displays third-party advertising that is not sold, produced, manufactured, furnished, or conducted at the property upon which the sign is located. Billboards can only display third-party content, where as freestanding signs can display both first-party and third-party content.



(a) (b)

Figure 3: (a) On-site digital display and (b) off-site digital display located in Edmonton, AB

The main difference between on- and off- site signs is ownership, location, and content.

On-Site Signs

- Typically owned and operated by businesses located at the physical location of the sign.
- The primary revenue source of these businesses is not directly related to having the sign; resulting in less priority of short frame duration.
- Potential of large volume of On-Site Sign applications.
- Associated Transportation concern of quantity of On-Site Signs may be addressed via maximum display density with lengthier frame durations.

Off-Site Signs

- Typically owned by companies not operating immediately on-site.
- Primary source of revenue for theses businesses (intent of sign) is advertising third-party content. They may display content from national and international businesses that are not located near the sign, resulting in a higher priority for short frame duration.
- Associated Transportation concern of quantity and frame duration of Off-Site Signs may be addressed via minimum spacing between signs and minimum requirements for frame duration.

2.3 Digital Display Operational Characteristics

Digital displays have unique operational characteristics that are different from traditional static advertising signs. Many of these characteristics relate to the ability of digital displays to dynamically display content on a video screen and include brightness, animation, message sequencing and text scrolling, and transition time and effects. This section introduces operational characteristics of digital displays and their potential impact on collision risk.

Brightness

Digital display brightness is based on the appearance of the sign to the driver which can be influenced by many factors including driver age and eye sight, ambient lighting, angle of view, distance from sign, and atmospheric conditions. The brightness of digital displays should be measured by illuminance (foot-candles, fc) which is the amount of light shining on a surface. Illuminance accounts for ambient lighting and therefore best represents a driver's perception of digital display brightness.

In general, brighter signs have been found to increase collision risk due to drawing more glances from passing drivers, increasing glance duration due to longer visual adaption time (i.e., transient adaption), and the potential to cause glare in a driver's field of view.

Animation

Animation refers to any digital display content that incorporates motion like video or movies. Digital displays with animation have been found to significantly increase glance frequency and glance duration. Consequently, there is a large body of literature that recommends prohibiting all animation from digital displays.

Message sequencing and text scrolling

Message sequencing refers to the use of multiple frames to convey a single message and text scrolling is the continuous movement of text across the digital display. Human factors research demonstrates that it is psychologically difficult for drivers to abandon an incomplete message; therefore, message sequencing and text scrolling can result in many glances for long durations towards digital displays with these features. Message sequencing and text scrolling is generally prohibited for this reason.

Transition time and effects

Transition time refers to the time between successive frame changes. During these transition time periods, digital displays are capable of using visual effects (e.g., flashing, spinning, dissolving) to transition from one sign to the next. Common frame transition times range from instantaneous to 2 seconds. Similar to animation, increased transition time and the use of effects makes a digital display more attractive to drivers and may distract them from their driving task. For this reason, literature recommends that transition time be minimized to instantaneous and transition effects be prohibited.

2.4 Guiding Principles

This section describes guiding principles that form the basis for these guidelines. Guiding principles are defined by the TAC DPAD Guideline and are followed verbatim for these guidelines as shown in Table 1.

Table 1: Guiding principles

Principle	Description
1. Safety	Public safety should be the primary concern of a jurisdiction and road safety professional. Consequently, regulations and by-laws should control the distracting effects of digital displays to limit the increase in collision risk. This principle seeks to minimize increases in collisions within the context of freedom of speech rights, limited knowledge about the road safety impacts of digital displays, and the urgency to regulate digital displays from a road safety perspective.
2. Consistency	Guidelines should recommend regulating digital displays such that they emulate static advertising signs. The rationale for this principle is that the road safety impact of static advertisements is generally accepted by jurisdictions while the road safety impacts of digital displays are generally unknown. Therefore, by regulating digital displays such that they are perceived by drivers as static signs, the road safety impacts of digital displays can be approximated to the impacts of static signs. Assimilating digital displays to static signs can be achieved by regulating motion, frame duration, transition time and effects, message sequencing, and brightness. Following this principle still allows advertisers to take advantage of many digital display features; e.g., remotely changing content, multiple advertisements, and day-parting.
3. Specificity	Digital display guidelines should pertain only to issues unique to digital displays and not issues that are common to all advertising signs. This principle recognizes that shared aspects of digital and traditional displays are currently regulated by Schedule C of the Land Use Bylaw and can be applied to digital displays. Applying this principle simplifies the regulation of roadside advertising signs and helps ensure that all advertising signs are regulated consistently.
4. Evidence-based	Guidelines should be evidence-based, scientifically supported, and sensitive to local conditions as much as possible. This principle helps jurisdictions defend their policies, encourages jurisdictions to follow best practices, and recognizes that a rigid, one-size-fits-all approach to regulating digital displays is unlikely to be effective.
5. Pragmatism	Regulations should be pragmatic and enforceable. The scientific research concerning digital displays can be complex and detailed. Some of this research includes complicated equations for determining appropriate digital display characteristics for different situations. Detailed regulations could be developed which scrutinize every aspect of a digital display and its location according to the scientific research; however, jurisdictions may not have the resources to conduct detailed analyses for each application or to enforce the regulations. Developing and applying commonly accepted heuristics or lookup tables as approximations for regulating certain digital display features may be an effective way to control digital displays within available resources without compromising road safety.

Adapted from: TAC DPAD Guidelines, 2014.

3 ASSESSMENT GUIDELINES FOR DIGITAL DISPLAY PERMIT APPLICATIONS

In St. Albert, digital displays are regulated by *Section C.5 Regulations for Signs with a Digital Display* from *Schedule C – Sign Regulations* of the Land Use Bylaw (09/2015). However, digital displays that meet regulations in the Land Use Bylaw may not adequately consider the potential impact on road safety. This chapter provides the criteria and the methodology for assessing the sign placement and display operational characteristics of digital display permit applications, as they relate to road safety impacts. Criteria and methods for road safety approval are provided for:

Sign Placement

- Spacing and Density
- Lateral Placement
- Proximity to Traffic Control Devices
- Proximity to Decision-Making Areas

Display Operation

- Motion Effects
- Frame Duration
- Brightness

These guidelines help assess unique characteristics of digital displays. Some characteristics of digital displays and static advertising signs are shared, such as sign size and content restrictions. St. Albert's existing Land Use Bylaw (09/2015) regulates shared sign characteristics and they should be applied to digital displays. Additionally, these criteria are associated with transportation evaluations (targeting road safety perspectives); other areas of review or criteria of the digital display application, such as economic development and Land Use Bylaw conformance may also influence the outcome of the evaluation and approval/rejection of the DPAD application.

Appendix A provides a *Digital Display Road Safety Assessment Form* that can be used to assess digital display permit applications from a road safety perspective and may be delivered to the applicant as the rejection report if the application is rejected. In this way, the applicant will clearly understand why their application was rejected and learn what is required of them should they choose to re-submit.

3.1 Sign Placement Guidelines

From a road safety perspective, digital display sign placement is governed by the maximum number of digital display frame changes that a driver could observe within their field of view. As defined in the *TAC DPAD Guidelines, a* driver's field of view is limited laterally by their cone of vision and longitudinally by their site distance.

According to the MUTCDC (TAC 2014), a 10° horizontal cone represents good lateral vision; thus, a driver's lateral cone of vision is measured as 5° away from each of the outside lane edges of a single direction of travel. Figure 4 illustrates a driver's cone of vision on a two-lane, one-way roadway.

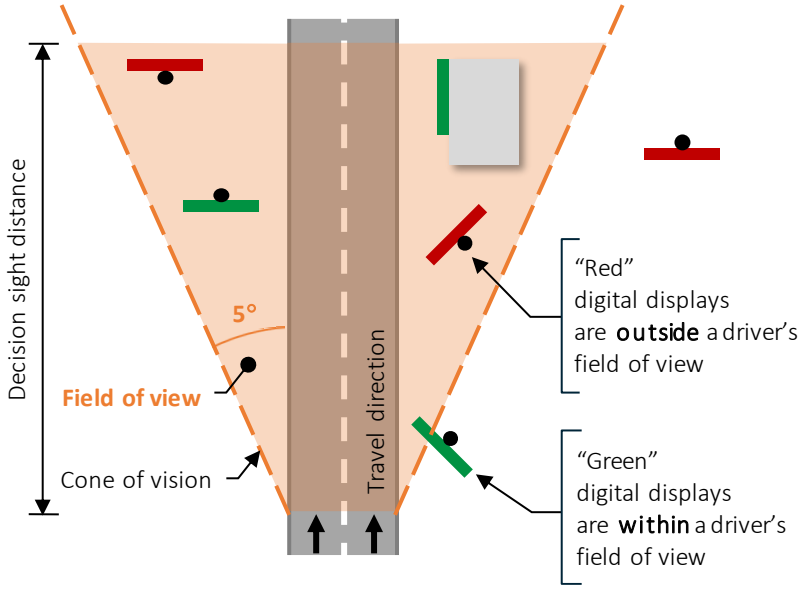


Figure 4: Example of digital displays within a driver's field of view

Sight distance measurements refer to the distance from a driver to the furthest object they can comprehend adequately for the intended purpose. Sight distance is used to determine the placement of digital display (e.g., spacing, density, and lateral placement) and calculate their frame duration. As recommended by the *TAC DPAD Guidelines*, decision sight distance (DSD) is used to represent a driver's sight distance when assessing the placement of digital displays. Decision sight time (DST) is the elapsed time for a driver to travel the decision sight distance at the posted speed limit. For these guidelines, this represents the maximum amount of time a digital display will be in a driver's field of view. The DSD and DST vary by roadway environment (i.e., urban, suburban, and rural) as shown in Table 2. This table, including the definitions of urban, suburban, and rural roadway environments, is derived from the latest version of the TAC Geometric Design Guide published in 2017 and may be superseded by newer versions in the future. Currently, digital displays are only permitted on urban roadway environments in St. Albert.

Table 2: Decision sight distance (DSD) and decision sight time (DST) for urban, suburban and rural roadway environments.

Posted Speed (km/h)	Urban		Suburban		Rural	
	DSD (m)	**DST (s)**	DSD (m)	DST (s)	DSD (m)	DST (s)
50	**200**	14	160	12	145	10
60	**235**	14	205	12	175	11
70	**275**	14	240	12	200	10
80	**315**	14	275	12	230	10
90	**360**	14	320	13	275	11
100	**405**	15	365	13	315	11
110	**435**	14	390	13	335	11

Adapted from: TAC (2017) Geometric Design Guide for Canadian Roads

Note: Consult the latest version of the TAC Geometric Design Guide for current DSD values.

The number of digital displays within a driver's field of view is the number of digital displays facing the driver within the lateral limit of their cone of vision and within their decision sight distance. As illustrated in Figure 4, there are seven digital displays; however, only the three "green" signs are counted as part of the number of digital displays within the field of view. The "red" signs are excluded since they are completely outside the cone of vision or they are not facing the driver. It is possible for every digital display frame within a driver's field of view to change at least once during their decision sight time, regardless of frame duration. Therefore, the minimum number of frame changes a driver may observe at any one time is equal to the number of digital displays within their field of view.

The following criteria is used to assess digital display placement:

> The number of digital displays, including on-site and off-site signs, within a driver's field of view should not exceed three.

3.1.1 Spacing and Density

The spacing between off-site digital display signs and density of on-site digital display signs within a driver's field of view are the first criteria assessed. Both spacing and density criteria must be met for a digital display permit application to be approved.

Road Safety Impacts and Issues to Consider

In conjunction with frame duration, both minimum spacing and maximum density criteria are used to control the number of frame changes a driver may observe within their field of view. Section 2.1 of this guide describes the road safety impacts of digital display spacing and density.

TAC DPAD Guideline Information Sources

Guidelines:
4.3 On-Premise DPAD Frame Density.
4.4 Off-Premise DPAD Frame Density.

Knowledge Base Report:
4.2.1 Longitudinal Placement.
4.5 Stakeholder Survey Synthesis.

Relevant St. Albert Land Use Bylaw Regulations

The Land Use Bylaw regulates the spacing of billboards and freestanding signs with digital displays. In addition, freestanding digital display density is regulated based on the land area or commercial building floor area. The spacing and density of fascia signs with digital displays are not regulated.

Digital display **spacing** regulations:

C.5(3) Billboards with a Digital Display

(b) A billboard with a digital display must:

(iii) be located a minimum of 150 m from another billboard without a digital display facing the same oncoming traffic;

(iv) be located a minimum of 300 m from another billboard with a digital display facing the same oncoming traffic;

(v) be located a minimum of 25 m from a freestanding sign without a digital display;

(vi) be located a minimum of 150 m from a freestanding sign with a digital display, facing the same oncoming traffic;

C.5(4) Freestanding Sign with a Digital Display

(b) A freestanding sign with a digital display must:

(ii) be located a minimum of 25 m from a freestanding sign without a digital display;

(iii) be located a minimum of 150 m from a freestanding sign with a digital display facing the same oncoming traffic;

(iv) be located a minimum of 25 m from a billboard without a digital display;

(v) be located a minimum of 150 m from a billboard with a digital display, facing the same oncoming traffic;

Digital display **density** regulations:

C.5(4) Freestanding Sign with a Digital Display

(e) No more than 1 freestanding sign with a digital display is allowed per site.

(f) Notwithstanding subsection (e), a maximum of 2 freestanding signs with a digital display may be permitted on a site measuring at least 1 ha or consisting (at least partially) of a commercial building that measures at least 10,000 sq. m in floor area, provided that at least 1 of the signs is a multiple tenant sign.

Desired Criteria for Road Safety Approval

Digital display spacing criteria	
Off-site signs	must be the greater of 300 m or the DSD from the nearest billboard or off-site freestanding digital display.
Digital display density criteria	
On-site signs	must not exceed 3 digital displays, including on- and off-site, per DSD.

Evaluation Method

This section outlines the method used by the City of St. Albert to evaluate digital display sign spacing and density.

Spacing

Digital display permit applications are required to show the distance between the proposed sign and all existing signs facing the same direction as the proposed sign. If the proposed sign has two faces, existing signs that face both directions of travel must be considered. Spacing is measured between successive off-site digital displays, from the nearest part of each sign and parallel to the roadway. The curvilinear distance should be used on roadways with curvature. Figure 5 provides an example of spacing on a straight roadway and curved roadway.

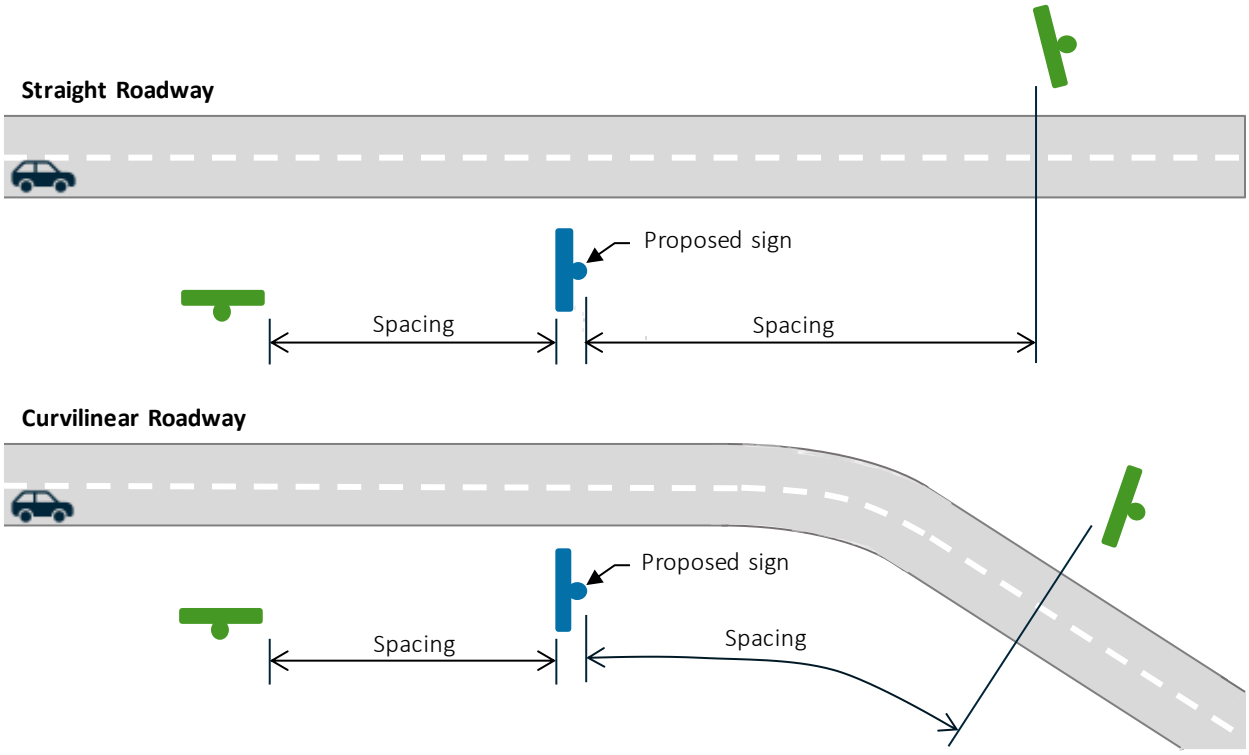


Figure 5: Example of digital display spacing measurement

Density

Maximum digital display density is measured using a sliding field of view (FOV) window approach. This approach is shown in Figure 6 and described below:

Step 1: create the FOV window by measuring DSD back from the proposed sign and overlay on the site plans. Slide the window to the existing display furthest from the proposed display but within the DSD.

Step 2: Count number of digital displays (on- and off-site) within FOV; if 3 or less (including the proposed sign) continue to next step.

Step 3: slide the end of the FOV window to the next digital display (on- or off-site). Repeat Step 3. If there are 3 displays or less in the FOV, continue to next step.

Repeat these steps until the start of the FOV window is at the proposed sign.

This methodology applies to all display types but is only measured for on-site digital displays (fascia and on-site freestanding) because the spacing of off-site digital displays ensures that only one off-site digital display is located within the DSD.

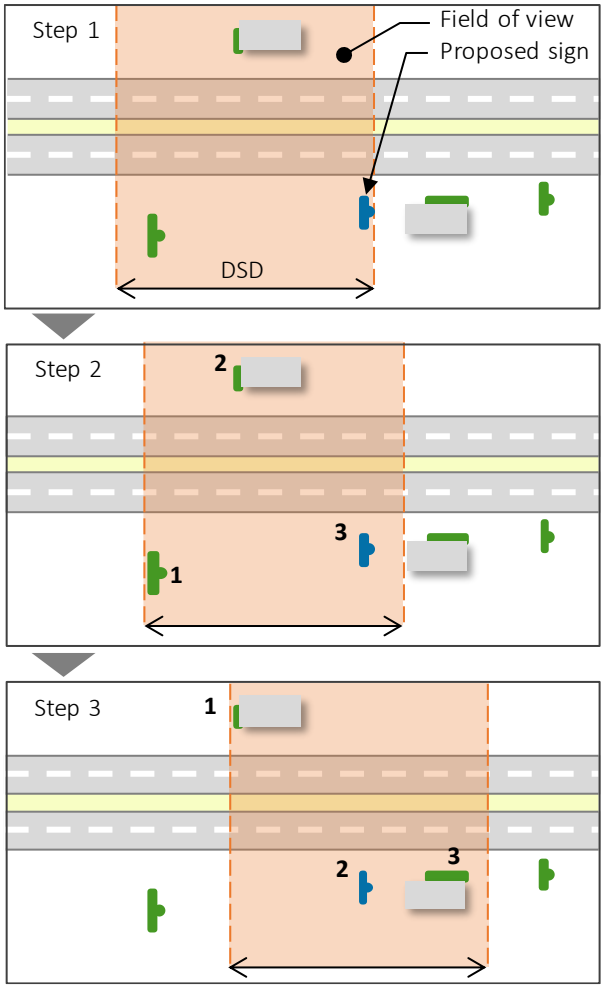


Figure 6: Example of digital display density measurement.

3.1.2 Lateral Placement

The lateral placement of digital displays refers to the distance digital displays should be located away from the roadway; measured as the perpendicular distance from the roadway.

Road Safety Impacts and Issues to Consider

Digital displays are permitted within a driver's cone of vision. Compared to digital displays located outside a driver's cone of vision, digital displays located within a driver's cone of vision, tend to increase glance frequency, decrease glance duration, and increase the probability of a driver detecting the digital display. Based on human factors principles, collision risk increases with longer glance duration despite less glance frequency.

TAC DPAD Guideline Information Sources

Guidelines:
3.1 Lateral Placement of DPADs.
Appendix A Cone of Vision Measurement and Lateral Offset Limits.

Knowledge Base Report:
3.6.2 Cone of Vision.
4.2.2 Lateral Placement.
4.2.3 Vertical Placement.

Relevant St. Albert Land Use Bylaw Regulations

Lateral placement applies to billboard and freestanding digital displays. The Land Use Bylaw does not impose a regulation on the maximum distance a digital display can be installed from the roadway. However, both billboard and freestanding signs must be at least 3 metres from all property lines adjoining the roadway (3 metres to the inside of property line).

Digital display **lateral placement** regulations:

C.5(2) Billboards with a Digital Display:

(b) (viii) subject to subsection (1)(a)(v), be located a minimum of 3 m from all property lines;

C.5(4) Freestanding Sign with a Digital Display:

(b) (viii) subject to subsection (1)(a)(v), be located a minimum of 3 m from all property lines;

Criteria for Road Safety Approval

The lateral placement of digital signs has both minimum and maximum lateral offset limits. The minimum lateral offset is regulated by the Land Use Bylaw (3 metres from all property lines adjoining the roadway). The maximum lateral offset is defined by the lateral distance of a driver's cone of vision at the decision sight distance (DSD).

Digital display **lateral placement** criteria

All types	Must be located a minimum of 3 m from all property lines (to the inside of the property).
	Shall be located within the lateral distance of driver's cone of vision at the DSD.

Evaluation Method

The lateral placement of digital displays is dependant on the cone of vision and DSD which may change based on the posted speed limit and the roadway environment (DSD provided in Table 3). Figure 7 illustrates the lateral placement area based on the lateral offset limits. Notice that the lateral placement area extends along the entire length of the roadway.

The lateral offset limits are measured from the curb lane edge. The minimum lateral offset is the distance from the curb lane edge to the property line, plus 3 metres. The maximum lateral offset can be determined using the following equation:

$$Maximum\ lateral\ offset\ limit = DSD \times \tan(5°)$$

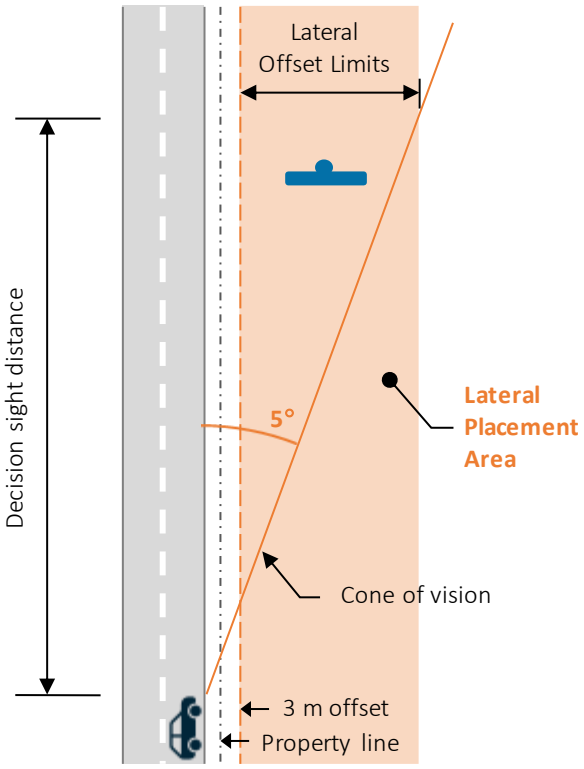


Figure 7: Illustration of lateral offset limits and lateral placement area.

The maximum lateral offset limits for common posted speed limits and roadway environments are provided in Table 3. Currently, digital displays are only permitted on urban roadway environments in St. Albert.

Table 3: Maximum lateral offsets by posted speed limit and roadway environment.

Posted Speed Limit *(km/h)*	Urban		Suburban		Rural	
	DSD *(m)*	**Max Lateral Offset *(m)***	DSD *(m)*	Max Lateral Offset *(m)*	DSD *(m)*	Max Lateral Offset *(m)*
50	200	**17**	160	14	145	13
60	235	**21**	205	18	175	15
70	275	**24**	240	21	200	17
80	315	**28**	275	24	230	20
90	360	**31**	320	28	275	24
100	405	**35**	365	32	315	28
110	435	**38**	390	34	335	29

Adapted from: TAC (2017) Geometric Design Guide for Canadian Roads

Note: Consult the latest version of the TAC Geometric Design Guide for current DSD values.

3.1.3 Proximity to Traffic Control Devices

Digital displays should not be located near traffic control devices. These guidelines provide guidance on areas of restriction around traffic control devices and will be subject to site specific evaluation.

Road Safety Impacts and Issues to Consider

Digital displays and modern traffic signals both use light-emitting diodes (LEDs) to illuminate their display or signal head. Digital displays located behind or close to traffic signals make it more difficult for drivers to detect the signal. This can delay a driver's reaction and increase collision risk at the intersection. Consequently, digital displays are prohibited in direct vicinity to illuminated traffic control devices (e.g., traffic signals, pedestrian crossing beacons, and railway crossing flashers) and may be restricted in vicinity of other intersection controls such as signage that provide regulatory, warning or guidance to road users.

TAC DPAD Guideline Information Sources

Guidelines:
4.8 Proximity to Traffic Control Devices

Knowledge Base Report:
4.2.1 Longitudinal Placement.
4.5 Stakeholder Survey Synthesis.
Appendix D: DPAD Restriction Area Around Traffic Control Devices.

Relevant St. Albert Land Use Bylaw Regulations

The Land Use Bylaw prohibits the placement of digital displays within the field of view of all traffic control devices that includes signs, signals, or devices used to control traffic. This definition encompasses many roadside signs and pavement markings and may prohibit digital displays on a majority of the roadside because each sign would have a restriction area extending at least 300 metres (or the DSD) before and after each sign. Further, field of view is unrelated to the physical location of the traffic control device; field of view depends on the cone of vision. Therefore, the field of view may not encompass approaching traffic control devices on roadways with curvature.

Digital display **proximity to traffic control devices** regulations:

C.3 Definitions

(yy) "traffic control device" means any sign, signal, marking or device placed, marked or erected by the City for the purpose of regulating, warning or guiding traffic;

C.5(1) General Regulations

(xi) The Development Officer shall be satisfied that the sign:

(A) does not physically obstruct the sightlines or view of a traffic control device or traffic control signal for oncoming vehicular traffic;

(B) is not located in the field of view near or past a traffic control device or traffic control signal in the sightlines of oncoming vehicular traffic;

(D) does not include illumination that may compete with or dull the contrast of a traffic control device or traffic control signal for oncoming vehicular traffic.

Criteria for Road Safety Approval

Digital displays are prohibited from physically obstructing any traffic control device as defined by the Land Use Bylaw. Digital displays should also be prohibited from being located within a 3-metre lateral clearance of traffic control devices that are illuminated or may be illuminated in the future, as recommended in the *TAC DPAD Guideline*.

Digital display **proximity to traffic control devices** criteria

All types	does not physically obstruct the sightlines or view of a traffic control device or traffic control signal for oncoming vehicular traffic.
	is not located within the 3-metre lateral clearance of any traffic control device that is illuminated or has a variable display (e.g., traffic control signals and pedestrian crossings with flashing beacons) in the direction of oncoming vehicular traffic.

Evaluation Method

Evaluating the proximity of digital displays to illuminated traffic control devices involves the calculation of a restriction area based on the posted speed limit, driver sight distances, and the location of the illuminated surface of the traffic control device. The restriction area prohibits digital displays from being located within a 3-metre lateral clearance of traffic control devices facing oncoming traffic. Figure 8 illustrates what the restriction area and 3-metre lateral clearance zones would look like from a driver's perspective. The methodology described here can be applied to any type of traffic control device and on curvilinear roadways.



Figure 8: Illustration of digital display restriction area around traffic signals.

Figure 9 shows the variables used to calculate the restriction area around traffic control signals at a signalized intersection. The following steps can be followed to determine the restrictions area.

Step 1: determine the stopping sight distance (SSD, provided in Table 4) for the roadway and measure this distance back from the stop bar.

Step 2: determine the distance "x", measured from the stop bar to the nearest traffic control device.

Step 3: determine the distance "q_o" and "q_i", this is either measured as the perpendicular distance from the curb lane to the furthest edge of the traffic control device plus 3 metres (like "q_o" in Figure 9) or as 3 metres from the edge of the curb lane if the outermost traffic control signal is over the roadway (like "q_i" in Figure 9).

Step 4: determine "d_o" and "d_i" using trigonometry, calculated as:

$$d_i = q_i \times \left(\frac{DSD}{SSD + x}\right) \qquad d_o = q_o \times \left(\frac{DSD}{SSD + x}\right)$$

The decision sight distance represents a driver's sight distance to a digital display. Where as a driver should be able to clearly comprehend a traffic control device without being distracted by a digital display during the time when they must decide to stop before the intersection.

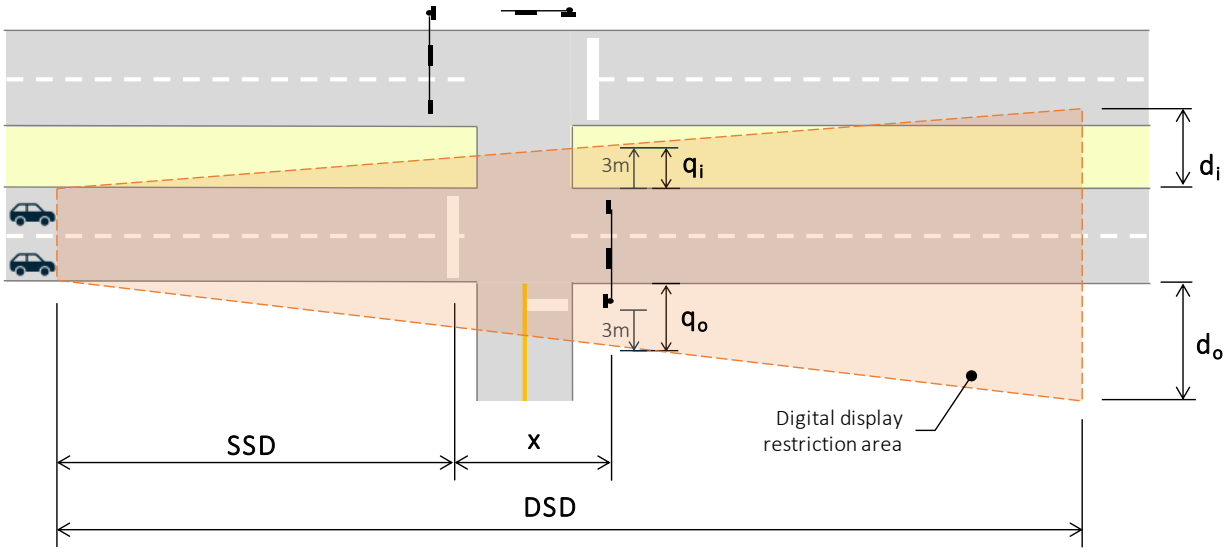


Figure 9: Illustration of digital display restriction area around traffic control signals.

Table 4 provides values for SSD and DSD that are required to calculate the digital display restriction area around traffic control devices.

Table 4: Values of stopping sight distance (SSD) and decision sight distance (DSD).

		DSD		
Speed	**SSD**	**Urban**	**Suburban**	**Rural**
km/h	*m*	*m*	*m*	*m*
50	**65**	**200**	160	145
60	**85**	**235**	205	175
70	**105**	**275**	240	200
80	**130**	**315**	275	230
90	**160**	**360**	320	275
100	**185**	**405**	365	315
110	**220**	**435**	390	335

Adapted from: TAC (2017) Geometric Design Guide for Canadian Roads
Note: Consult the latest version of the TAC Geometric Design Guide for current DSD and SSD values

The variables used to determine the digital display restriction area around traffic control devices are summarized and described in Table 5.

Table 5: Variables to determine digitial display restriction area around traffic control devices.

Variable	Description	Source
x	Distance between the stop bar and the nearest traffic control signal.	Measured
q_o	Lateral clearance from the curb of the outside approach lane, measured as 3 metres from the outside of the illuminated face of a traffic control device or the outside curb, which ever is furthest from the roadway.	Measured
q_i	Lateral clearance from the curb of the inside approach lane, measured as 3 metres from the inside of the illuminated face of a traffic control device or the inside curb, which ever is furthest from the roadway.	Measured
SSD	Stopping sight distance, measured back from the stop bar.	Given
DSD	Decision sight distance, measured from the SSD.	Given
d_o	Maximum lateral outside dimension of the digital display restriction area.	Calculated
d_i	Maximum lateral inside dimension of the digital display restriction area.	Calculated

This method of determining the digital display restriction area around traffic control devices can be applied to all types of traffic control devices and curvilinear roadways. Figure 10 and Figure 11 illustrate what the digital display restriction area may look like for pedestrian crossings and railway crossings respectively.

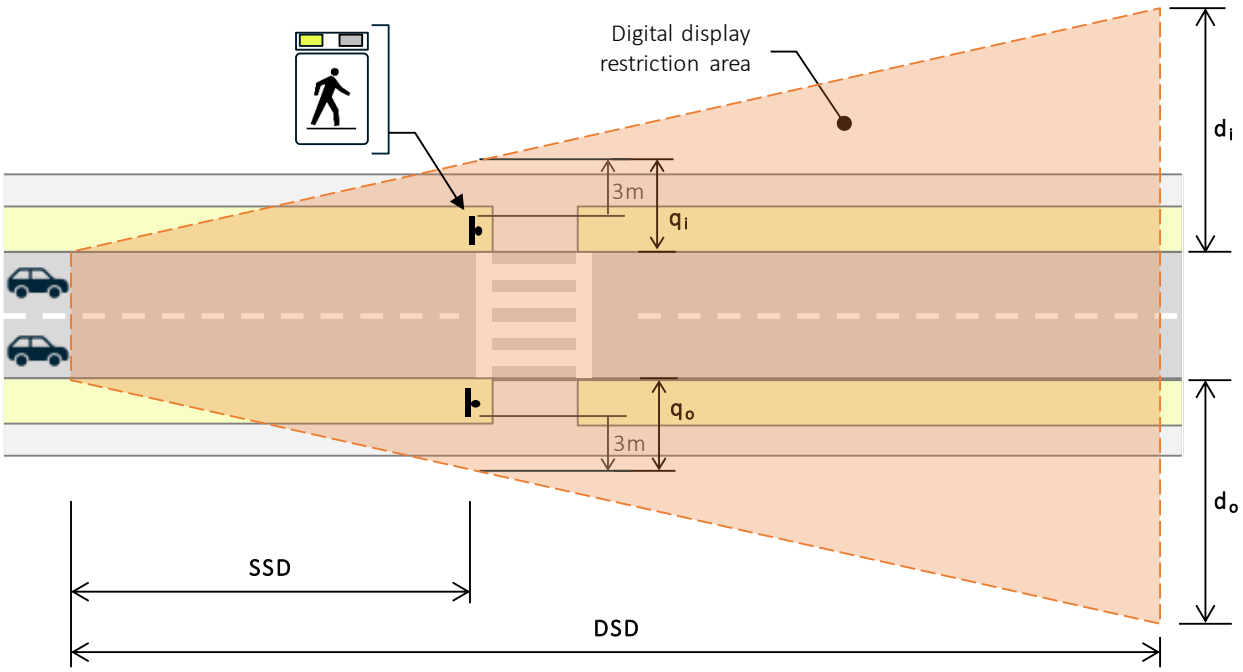


Figure 10: Illustration of digital display restriction area around pedestrian crossing signals.

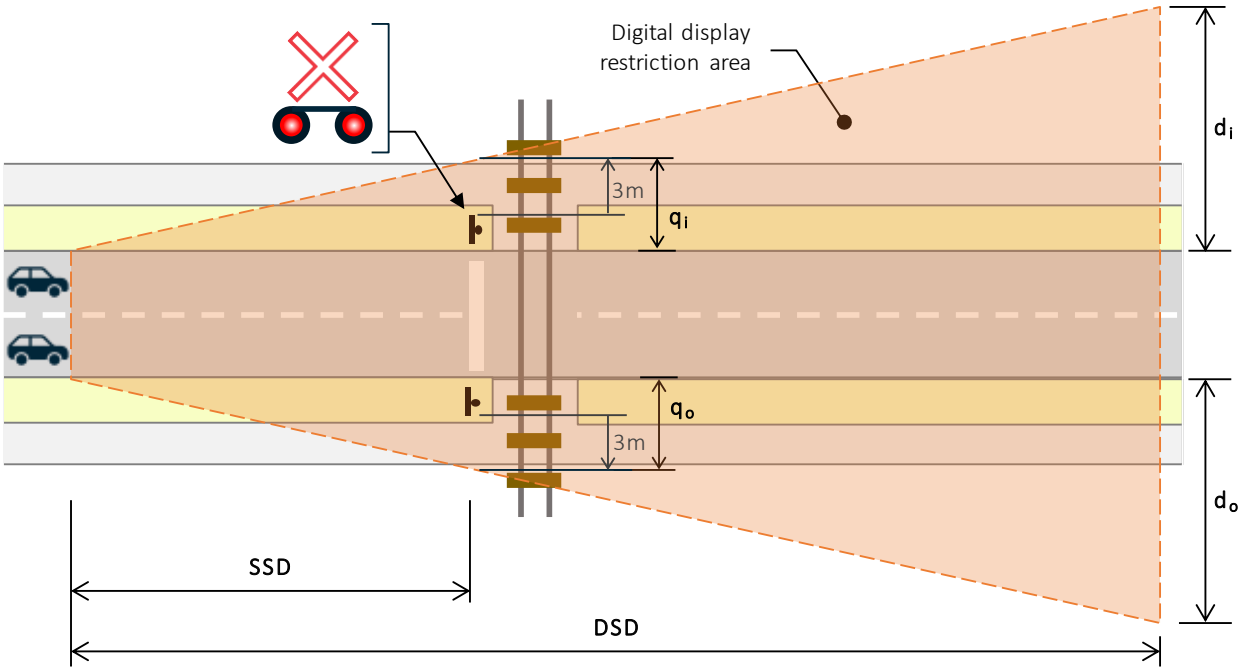


Figure 11: Illustration of digital display restriction area around railway crossing signals.

3.1.4 Proximity to Decision-Making Areas

Decision-making areas include intersections, interchanges, and roundabouts which comprise many conflict and decision-making points. Since the driver workload is high at these locations, drivers may not have much spare attentive capacity and therefore distraction should be minimized.

Road Safety Impacts and Issues to Consider

The distracting effect of digital displays may reduce a driver's ability to perform near key decision-making areas throughout the transportation network. Driver's may miss critical roadside information that prevent them from navigating through conflict points like interchanges and merge points. It is important that these decision-making areas are well defined and there is a standard approach for defining the digital display restriction area.

TAC DPAD Guideline Information Sources

Guidelines:
4.9 Proximity to Decision Making Points.

Knowledge Base Report:
4.2.1 Longitudinal Placement.
4.5 Stakeholder Survey Synthesis.
Appendix D: DPAD Restriction Area Around Decision Making Points.

Relevant St. Albert Land Use Bylaw Regulations

The Land Use Bylaw prohibits digital displays from being located within a fixed distance of 30.5 metres of all roadway intersections as is consistent with traditional sign regulations. In addition, digital displays are prohibited from being located within a driver's field of view around other traffic conflict points.

Digital display **proximity to decision-making points** regulations:

C.5(1) General Regulations

(v) Unless otherwise stated in this schedule, a digital display must be located a minimum of 30.5 m from a roadway intersection;

(xi) The Development Officer shall be satisfied that the sign:

(C) is not located in the field of view near or past other traffic conflict points such as intersections, merge points, exit ramps, or curved roadways.

Criteria for Road Safety Approval

Digital display restriction areas are determined for intersections, interchanges, and roundabouts. Digital displays are restricted 30.5 metres around intersections; digital displays are further restricted at intersections due to traffic control devices as described in Section 3.1.3 of this Guide.

When developing temporary traffic control plans for long-duration work zones existing digital displays should be identified. Depending on the project duration and nature of work, digital displays may be restricted from changing frames when workers are present or prohibit frame changes entirely during the tenure of work.

Digital display **proximity to decision-making points** criteria:

All types

Unless otherwise stated in this schedule, a digital display must be located a minimum of 30.5 m from a roadway intersection.

Shall not be located within the decision sight distance of decision-making areas that include interchanges and roundabouts.

May not be permitted to change frames within the decision sight distance of long-duration work zones and construction areas when workers are present or the nature of the site is dangerous for road users.

Evaluation Method

Evaluation methods are different for intersections than for interchanges and roundabouts.

- Intersection restriction areas are determined using a fixed minimum offset distance.
- Interchange and roundabout restriction areas are determined using the decisions sight distance (DSD) which is a function of the posted speed limit and roadway environment.

Intersection digital display restriction areas

The digital display restriction area is defined by a 30.5-metre offset from the intersection area defined by the approach stop bars. Figure 12 illustrates the intersection area and corresponding digital display restriction zone for a 3-leg intersection.

At signalized intersections, this restriction area is applied in **addition** to the restriction area for illuminated traffic control devices described in Section 3.1.3 of this Guide.

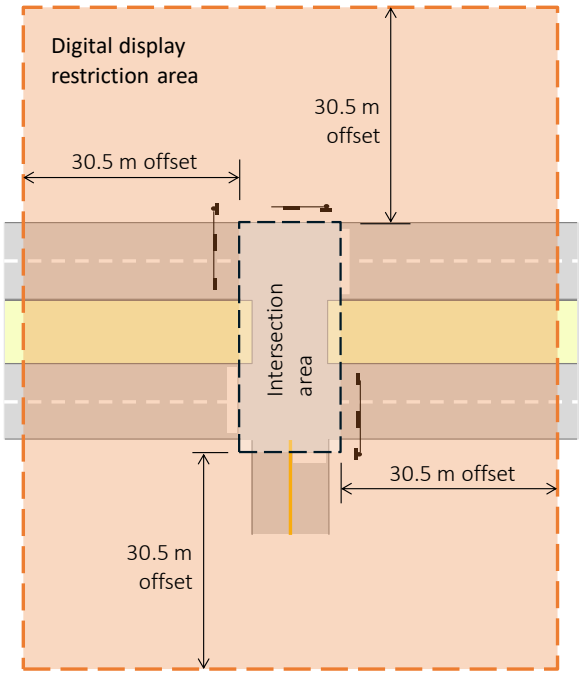


Figure 12: Illustration of digital display restriction area around an intersection.

Interchange and roundabout digital display restriction areas

Digital display restriction areas comprise a polygon that encompasses the entire decision-making area and extends the DSD back from the first decision-making point of each approach. Typically, the first decision-making point of an interchange approach is the start of the off-ramp lane taper. For roundabouts, the first decision making point may be the start of the lane taper, the gore of the splitter island, or the entrance line of the roundabout. Figure 13 reveals the digital display restriction area for both interchanges and roundabouts. The method is described in steps as follows:

Step 1: locate the first decision-making point for each approaching roadway to the interchange or roundabout.

Step 2: measure the DSD distance back from the decision-making points identified in step 1.

Step 3: connect all the points identified in step 2 to create a polygon which is the digital display restriction area.

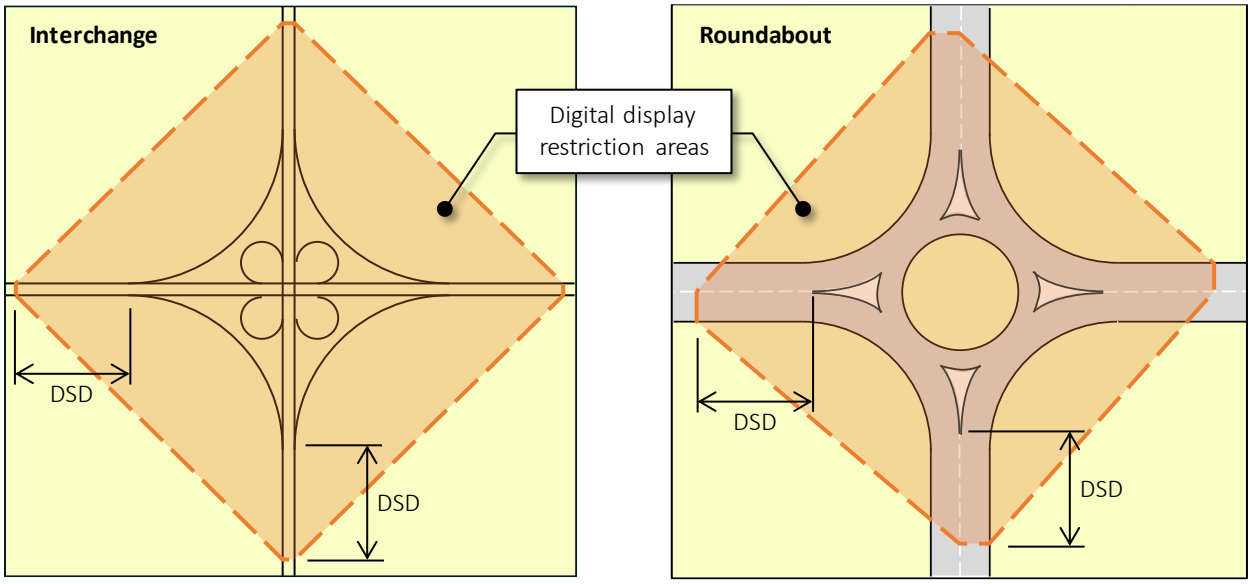


Figure 13: Illustration of digital display restriction area around an interchange and roundabout.

3.2 Display Operation Guidelines

Digital displays are different than traditional static signage because they can display dynamic content and use motion and illumination to increase their conspicuity. These operational differences can make digital displays more distracting and increase collision risk. This section provides criteria for motion, frame duration, and brightness of digital displays that meet the sign placement criteria in Section 3.1 or have otherwise been approved.

3.2.1 Motion Effects

Digital display motion effects include animation, transition time and effects, message sequencing, and text scrolling.

Road Safety Impacts and Issues to Consider

The purpose of motion effects is to increase the attractiveness of digital display content. Consequently, driver glance frequency, glance duration, and collision risk increases. Motion effects shall be prohibited.

Relevant St. Albert Land Use Bylaw Regulations

St. Albert's Land Use Bylaw prohibits the use of animation, prohibits transition effects, requires instantaneous transition times, and prohibits message sequencing.

TAC DPAD Guideline Information Sources

Guidelines:
4.5 Transition Time and Effects.
4.6 Message Sequencing and Text Scrolling.
4.10 Animation.

Knowledge Base Report:
4.1.1 Motion within an Advertisement.
4.1.3 Transition Time and Effects.
4.1.4 Message Sequencing.
4.5 Stakeholder Survey Synthesis.

Digital display **transition times, effects and motion** criteria:

C.5(1) General Regulations

(xiv) The transition time between each digital display copy shall be instantaneous;

(xv) Transitions between each digital display copy shall not involve any visible effects, including but not limited to: action, motion, fading in or out, dissolving, blinking, intermittent or flashing light, or the illusion of such effects;

(xvi) Copy shall not be shown on the digital display using full motion video, movies, Motion Picture Experts Group (MPEG), or any other non-static digital format;

(xvii) Copy shown in a manner requiring the intended message to be viewed over multiple copy transitions is not permitted;

Criteria for Road Safety Approval

Digital display **transition time, effects and motion** criteria:

All types	As per the LUB, transition time shall be instantaneous and shall not involve any visual effects, with no use of motion for the display.

3.2.2 Frame Duration

Digital display frame duration refers to the time between successive frame changes on a single sign.

Road Safety Impacts and Issues to Consider

Digital display frame duration is controlled in conjunction with minimum spacing and maximum density criteria (Section 3.1.1) to ensure that the number of frame changes within a driver's field of view does not exceed **three**.

In recognition of unique on- and off-site owner needs (Section 2.2), frame duration may be controlled differently for on-site and off-site digital displays. Minimum spacing and maximum density criteria shall be utilized to assist evaluation of applications for on- and off-site frame durations.

TAC DPAD Guideline Information Sources

Guidelines:
4.1 On-Premise DPAD Frame Duration.

Knowledge Base Report:
4.1.2 Frame Duration.
4.5 Stakeholder Survey Synthesis.

Relevant St. Albert Land Use Bylaw Regulations

The minimum frame duration of on- and off-site digital displays are the same, at 6 seconds between frame changes.

Digital display **proximity to traffic control devices** criteria:

C.5(1) General Regulations

(xiii) Copy shall be static and remain in place for a minimum of six (6) seconds before switching to the next copy;

Desired Criteria for Road Safety Approval

Digital display **frame duration** criteria (considerations of existing signage / impacts):

Off-site signs	Copy shall be static and remain in place for a minimum of eight (8) seconds before switching to the next copy.
On-site signs	Copy shall be static and remain in place for a minimum of twenty (20) seconds before switching to the next copy.

These criteria are based on a 15 second decision sight time (DST) and assume that there are three digital displays within a driver's field of view. The 15-second DST is the longest amount of time drivers can observe a digital display at posted speed limits in urban areas and three digital displays is the maximum number of signs that should be visible within a driver's field of view. This is a conservative approach that helps mitigate the potential for drivers to observe more than three frame changes within their field of view.

3.2.3 Brightness

Digital display brightness is the appearance of the sign to a driver and depends on many factors that include sign luminance, ambient lighting, distance from sign, atmospheric conditions, and driver eye sight. The brightness of digital displays should be measured by illuminance (foot-candles, fc) which is the amount of light shining on a surface or light meter. Illuminance accounts for ambient lighting and therefore best represents a driver's perception of digital display brightness.

Road Safety Impacts and Issues to Consider

Digital displays with brighter illuminance have been shown to attract more glances, increase glance duration due to longer visual adaption time, and cause visual glare – each of these have been shown to increase collision risk.

TAC DPAD Guideline Information Sources

Guidelines:
4.7 Brightness.

Knowledge Base Report:
4.1.9 Brightness.
4.5 Stakeholder Survey Synthesis.

Relevant St. Albert Land Use Bylaw Regulations

The Bylaw requires that all digital displays have ambient light sensors that automatically adjust display brightness. Digital display illuminance cannot exceed 0.3 foot-candles above ambient light.

Digital display **brightness** criteria:

C.5(1) General Regulations

(xii) All signs containing a digital display must be equipped with an ambient light sensor, in accordance with the following:

(A) The ambient light sensor shall automatically adjust the brightness level of the copy area based on ambient light conditions; and

(B) Brightness levels of the digital display shall not exceed 0.3 foot-candles above ambient light conditions when measured from the digital display face at its maximum brightness.

Criteria for Road Safety Approval

Digital display **brightness** criteria:

All types As per the LUB, all signs containing a digital display must be equipped with an ambient light sensor, in accordance with the following:

(A) The ambient light sensor shall automatically adjust the brightness level of the copy area based on ambient light conditions; and

(B) Brightness levels of the digital display shall not exceed 0.3 foot-candles above ambient light conditions when measured from the digital display face at its maximum brightness.

Evaluation Method

Illumination is measured using a lux meter designed to measure light output to two decimal places. When measuring illuminance in the field it may be necessary to take a base-line reading with the display turned off to account for other light sources near-by that may affect the measurement. The difference between the base-line reading and the in-service reading would be the display's illuminance. The lux meter should be positioned perpendicular to the display face and located a defined distance from the display based on the display area[1] as follows:

$$Measurement\ distance\ (m) = \sqrt{Sign\ Area\ (m^2) \times 100}$$

[1] International Sign Association. 2011. *Recommended night-time brightness levels for on-premise electronic message centers*. Alexandria, VA: International Sign Association.

3.3 Summary of Approval Criteria

Digital Display Placement Considerations for Road Safety	St. Albert Land Use Bylaw	Desired Criteria
Off-site digital display spacing		
What should be the minimum spacing of billboard digital displays?	300m	The greater of 300m or DSD
What should be the minimum spacing of off-site freestanding digital displays?	150m	
On-site digital display spacing		
What should be the minimum spacing of on-site freestanding digital displays?	150m	none
What should be the minimum spacing of fascia digital displays?	none	
Off-site digital display density		
What should be the maximum density of billboard digital displays?	none	none
What should be the maximum density of off-site freestanding digital displays?	if site is large 2/site, otherwise 1/site	
Digital display density		
What should be the maximum density of digital displays?	none	3 signs / DSD
Lateral placement of digital displays		
What should be the minimum lateral placement limit of digital displays?	3m inside of property lines	3m inside of property lines
What should be the maximum lateral placement limit of digital displays?	none	cone of vision at DSD
Proximity of digital displays to traffic control devices		
Should digital displays be prohibited near traffic control devices?	prohibited	prohibited
For what traffic control devices should restrictions be applied?	all traffic control devices	illuminated devices and critical intersection signage
Proximity of digital displays to decision making areas		
Should digital displays be prohibited near decision-making areas?	prohibited	prohibited
What decision making areas should restrictions apply to?	intersections, traffic conflict points	intersections, interchanges, and roundabouts

Digital Display Operational Considerations for Road Safety	St. Albert Land Use Bylaw	Desired Criteria
Motion effects		
What should be the transition time between frames?	instantaneous	instantaneous
Should animation, transition effects, message sequencing, or test scrolling be permitted?	No	No
Off-site digital display frame duration		
What should be the minimum frame duration for billboard digital displays?	6s	8s
What should be the minimum frame duration for off-site freestanding digital displays?	6s	
On-site digital display frame duration		
What should be the minimum frame duration for on-site freestanding digital displays?	6s	20s
What should be the minimum frame duration for fascia digital displays?	6s	
Brightness		
What should be the maximum illumination level?	0.3 fc	0.3 fc

APPENDIX A – DIGITAL DISPLAY ASSESSMENT FORM

Roadway Characteristics	
Roadway Environment	
Posted Speed Limit	*Km/h*

Distance Variables	
Decision Sight Distance (DSD)	*m*
Stopping Sight Distance (SSD)	*m*
Maximum Lateral Offset *Tan(5°) x DSD*	*m*

	Road Safety Assessment Criteria for Digital Displays	Criteria Threshold	Yes/ Pass	No/ Fail
Off-site signs only	**Off-site digital display frame duration**			
	Is the frame duration greater than or equal to 8 seconds?	≥ 8s	☐	☐
	Off-site display spacing			
	Is the distance between other off-site digital displays greater than 300m or the DSD, which ever is greater?	≥ _____	☐	☐
Off-site signs only	**On-site digital display frame duration**			
	Is the frame duration greater than or equal to 20 seconds?	≥ 20s	☐	☐
	On-site digital display density			
	Are there no more than 3 digital displays, including on- and off-site, per DSD?	≥ 3 signs / DSD	☐	☐
	Lateral placement of digital displays			
	Is the digital display at least 3m from all property lines?	> 3m	☐	☐
	Is the digital display within the maximum lateral offset based on the driver's cone of vision at the DSD?	≤ _____	☐	☐
	Proximity of digital displays to traffic control devices			
	Is the display located outside of sightlines or view of a traffic control device or traffic control signal for oncoming vehicular traffic?	N/A	☐	☐
	Is the display located outside the restriction area defined by a 3-metre lateral clearance from traffic control devices that are illuminated or have a variable display in the direction of oncoming vehicular traffic?	N/A	☐	☐
	Proximity of digital displays to decision-making areas			
	Is the sign located at least 30.5m from roadway intersections?	≥ 30.5m	☐	☐
	Is the sign located outside the DSD of decision-making areas that include intersections, interchanges, and roundabouts?	N/A	☐	☐