WAKA KOTAHI
NZ TRANSPORT AGENCY

Electronic signs

Intelligent transport systems (ITS) design standard

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More information

If you have further queries, contact the Intelligent Transport Systems Standards and Specifications (ITS S&S) team via email: itsspec@nzta.govt.nz

More information about ITS is available on the NZTA website at https://www.nzta.govt.nz/its

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1 Overview

This section defines the operational requirements for electronic signs with respect to the transport network.

1.1 Purpose

The purpose of this document is to specify the electronic signs design requirements for operation, physical layout, safety, maintainability, and security. These include fixed variable message signs (VMS) and lane and carriageway signs (LCS) on the roading network. This design standard ensures compliance with the Client's operational and asset management systems.

The consideration of how the design meets the concept of operations (CoO) is an important component of the design process.

1.2 Overview

This standard seeks to define best practice on the approach to design of electronic signs.

This is to be read in conjunction with the latest versions of:

i. ITS delivery specification: *Variable message signs – fixed*
ii. ITS delivery specification: *Lane and carriageway signs*.

1.2.1 NZTA ITS class

001 Signs. Equipment which provides visual messages or warnings to users of the transport network.
Class definitions

1.3 Scope

This document provides electronic signage design requirements.

Electronic signs covered in this design standard are:

i. motorway/expressway VMS, which encompass VMS for motorways and expressways with more than one lane in the direction of travel
ii. regional VMS, which encompass:
   – high-volume urban (HVU) VMS
   – rural VMS
iii. LCS
iv. MVMS – refer to the project TMP for MVMS requirements.

Accordingly, the scope of this document is as follows:

i. design for operation, including
   a. site selection
   b. design considerations
   c. design parameters
   d. requirements for support structures

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    e. requirements for power, communication and other infrastructure
    f. environmental and planning requirements

ii. design for road safety, including site assessment and post deployment audits
iii. design for maintainability
iv. design for security.

The scope of this document does not cover:

i. speed-activated signs and safety signs
ii. parking displays
iii. advance warning regulatory signs (AWRS)
iv. changeable message signs (CMS)
v. school zone signs (SZS)
vi. estimated journey time sign (EJT)
vii. wrong way driver beacons (WWDB)
viii. speed indication devices (SID)
ix. bend warning signs (BEND)
x. the interface between an electronic sign and an advanced traffic management system (ATMS)
xi. dynamic lane systems or reversible lanes system
xii. electronic sign integration and commissioning - for tunnels, additional controls and integration will also be required through the tunnel plant management and control system (PMCS) as well as the ATMS).

1.4 Operational requirements

This document sets out the design requirements the Consultant shall address:

i. provide road users with clear, intuitive information and/or advance warning at appropriate locations with lane status and/or speed management instructions,
ii. manage traffic flow more efficiently and safely using dynamic speed limits and managing lane availability,
iii. execute traffic management plans in response to planned or unplanned events.

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2 Design for operation

This section defines the functionality required to achieve successful operation of fixed VMS.

2.1 Design considerations

For electronic signs design concepts, refer to Appendix B: Design Concepts.

Among others, design considerations shall be given to the following conditions at each site:

i. visibility – carriageway curves and bends, recognition time and clear sight distances
ii. specific design and application needs at tunnels and approaches
iii. speed environment, which among other factors shall impact the choice of an appropriate VMS and LCS sizes. For appropriate VMS and LCS sizes refer to **Table 1** in Appendix B: Design Concepts and **Table 1** in the latest ITS delivery specification: *Lane and carriageway signs*, respectively.

2.1.1 Recognition time

The recognition time (the time necessary to read and understand a message) is given in a range of at least 4 to 6 seconds.

Signs must be placed so that drivers approaching at the maximum appropriate/legal approach speed can read the message(s) for at least 6 seconds for a single page of text.

Sign placement shall be checked for horizontal and vertical alignment to ensure drivers stay within the VMS' readability cone for the longest possible time.

Signs shall be visible to drivers at a distance greater than the maximum legibility distance to allow drivers to observe the sign is activated and anticipate a message.

2.1.2 Clear sight distances

The Consultant shall look for sites that allow drivers clear sight distance to the sign of at least 375m for 300–400mm character height when travelling at 100km/h. In lower-speed environments the distances shall be reduced proportionally to allow for a clear sight distance of at least 250m for Regional Type C VMS and 150m for Type D VMS.

2.1.3 Downstream road geometry

Avoid positioning a VMS and an LCS immediately before a sharp bend, blind crest or intersection, where the sign distracts attention at a critical moment.

The VMS and LCS must not be positioned where the display is seen from a neighbouring road.

2.1.4 Presence of other signage

VMS shall not compete with other existing static signs and/or strong light-emitting sources or interfere with traffic control devices. The Consultant must review all signs and traffic control devices both preceding and

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beyond the potential site. Based on this review, existing signs shall be moved to accommodate the VMS placement.

For information on the longitudinal spacing of signs, refer to Part 1 'General requirements for traffic signs' in the *Traffic control devices manual* (TCD manual).

VMS and static signage can be co-located on the same gantry structure. For more information on mounting VMS and static signs on the same gantry, refer to *Ability to absorb information through electronic and static signs* (Austroads AP-R485-15).

2.1.5 Co-location of other ITS assets

Due to the high costs of installing power and communications to the roadside environment, Consultants shall investigate all existing ITS assets in the location of the proposed assets to determine whether any co-location can occur or whether slight movement of the equipment would enable sharing of power and communications.

This does not include adding equipment to an existing cabinet but taking a power or communications feed from the existing cabinet to a new cabinet. In some regions where the assets are owned and maintained by the same organisation, cabinets shall be shared if there is sufficient internal space.

2.2 VMS and LCS Placement

2.2.1 Minimum distance of VMS location from key intersections

If the VMS is intended to advise route diversions, the sign shall be located sufficiently in advance of the alternative route intersection to allow the road user to assimilate the message and react accordingly, including changing lanes if necessary.

Motorway/expressway VMS shall be placed at minimum distance of 1500m prior to the exit/diversion point. This distance provides the motorist with roughly 50–60 seconds from the time they have read the message until they reach the access/diversion point. In practice, this is difficult to achieve in urban areas where interchanges are closely spaced. If the motorway/expressway has two or three lanes in the direction the VMS is indicating, this can be reduced to a minimum of 800m. Alternatively, if two exits are closely spaced, the VMS can be in advance of the first exit. No motorway/expressway VMS shall be installed within 300m of the end of an upstream merge taper.

On HVU roads, the distance depends on considerations such as the speed limit, local factors and right-of-way constraints.

On a rural single-lane roadway, with no need to change lanes (but acknowledging the complexity of some decisions and the route choices), a distance equating to at least 1000m in a 100km/h zone, or a proportionally reduced distance in lower-speed zones, is suggested.

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2.2.2 Turn-around and pullover areas

Rural VMS with low traffic volumes (eg 2000 annual average daily traffic (AADT)) shall display a message advising motorists to turn back due to commonly occurring or expected road closure, such as at an alpine pass. In these circumstances, choose a site that:

i. has a pullover/turning area just after the sign for travellers to turn around
ii. is located near the exit to the adjacent town or village, covering all exit routes from the town possible
iii. is ideally visible from the low speed 50km/h section
iv. has a pullover area or turning area for heavy goods vehicles prior to the road closure location.

With higher traffic volumes in a high-speed environment, a level (~10,000 AADT) is reached where pulling over or turning around is unsafe. Under normal circumstances, the VMS will be placed in advance of the decision/alternative route point, so turning around will be unnecessary.

2.2.3 Road angle vertical and horizontal alignment

The Consultant must take into account the viewing angle of the light-emitting diodes (LEDs) when locating the VMS both horizontally and vertically.

2.2.3.1 Vertical alignment

The VMS must be positioned above or to the left of the approaching motorist.

Correct alignment is important to ensure approaching motorists will remain within the cone of illumination for as long as possible. Supplied VMS will have a −10 degree vertical cone (B6 LED).

The ability to optimally align the VMS in the vertical plane must be considered when the approach is up a steep hill, or if the VMS is unusually high above the road.

2.2.3.2 Horizontal alignment

In virtually all situations, it is considered unsafe to position a VMS on the right-hand side of approaching traffic.

Figure 1 Error! Reference source not found. and **Figure 2Error! Reference source not found.** illustrate the optimum alignment of the illumination cone for an VMS (with B6 LED class) on straight and curved sections of road. B6 LED class has a 30 degree (15 degree each side) horizontal cone and are aligned at 15 degree angle perpendicular to the road edge line. The right side of the LED cone (looking towards the approaching motorist) shall be aligned to run along the road reserve parallel with the road, while the left side of the LED cone will follow a tangent across the road. This alignment maximises the distance that an approaching motorist will spend within the LED cone.

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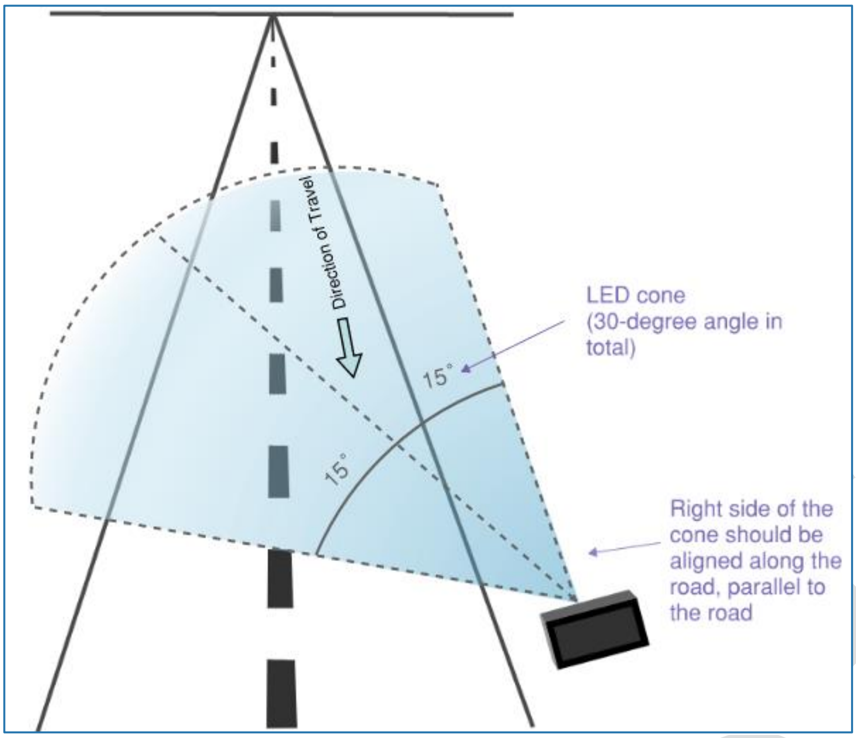

Figure 1. Example of alignment of VMS with B6 LED (straight road) from the view behind and above the sign

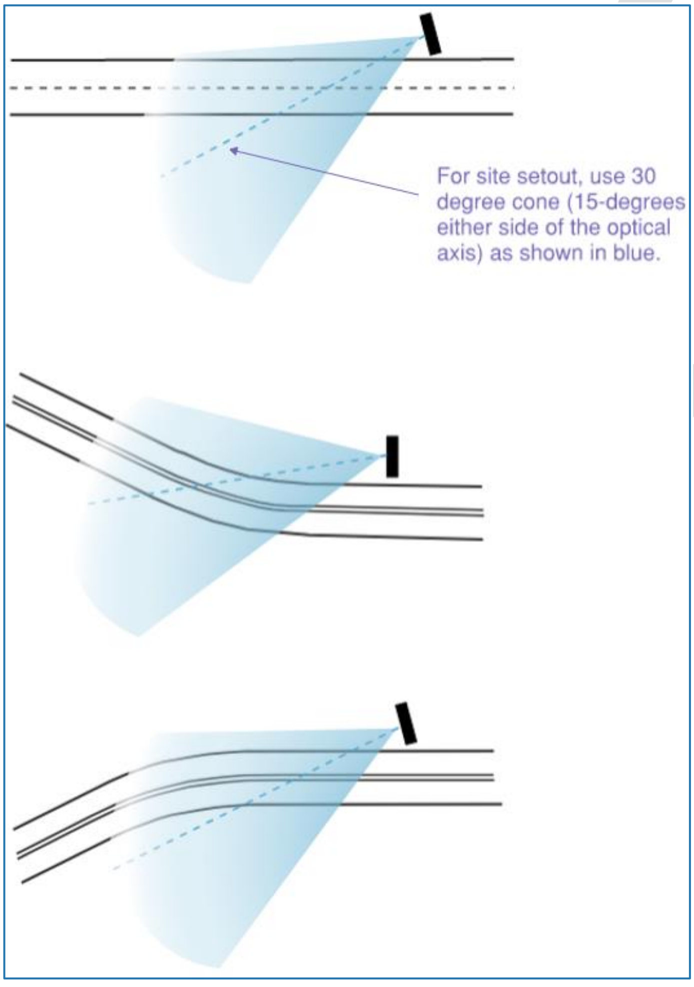

Figure 2. Optimum alignment of electronic signage for straight and curved road (plan view)

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For VMS mounted beyond a left- or right-hand curve, alignment shall maximise the time that drivers remain within the cone of visibility, as detailed in the latest version of ITS design standard: *Civil and structural requirements*.

The horizontal alignments for straight and curved approaches are detailed in the latest version of ITS design standard: *Civil and structural requirements*.

For curved approaches, the VMS must be aligned to ensure:

i. at the maximum reading distance, the inside edge of the curve is within the cone of visibility
ii. approaching the VMS, the outside edge of the curve remains within the cone of visibility for as long as possible.

Ensure that roadside trees or other structures will not obscure the sign. Ensure that requirements for trimming or other activities to maintain clear line of sight in the foreseeable future can be legally enforced.

2.2.4 LCS Longitudinal placement

2.2.4.1 Integrated lane and speed management mode

LCS for this mode shall be installed on truss gantries.

General LCS gantry design layout principles are as follows.

i. The number of lanes needed to be closed (n) requires $n + 2$ gantries to safely manage the traffic. So when one lane is blocked, a total of three LCS gantries are required (refer to **Figure 3Error! Reference source not found.**) to divert traffic; two blocked lanes require a total of four LCS gantries to divert traffic.
ii. One LCS array shall be visible from the previous array.
iii. Interchanges can be very closely spaced, so the number of gantries between them shall be less than $n + 2$ for motorway closure at the downstream exit. In situations like this the speed reduction and/or lane closures for the downstream exit shall begin upstream of the first exit. LCS are a linear management tool and not an exit management tool.

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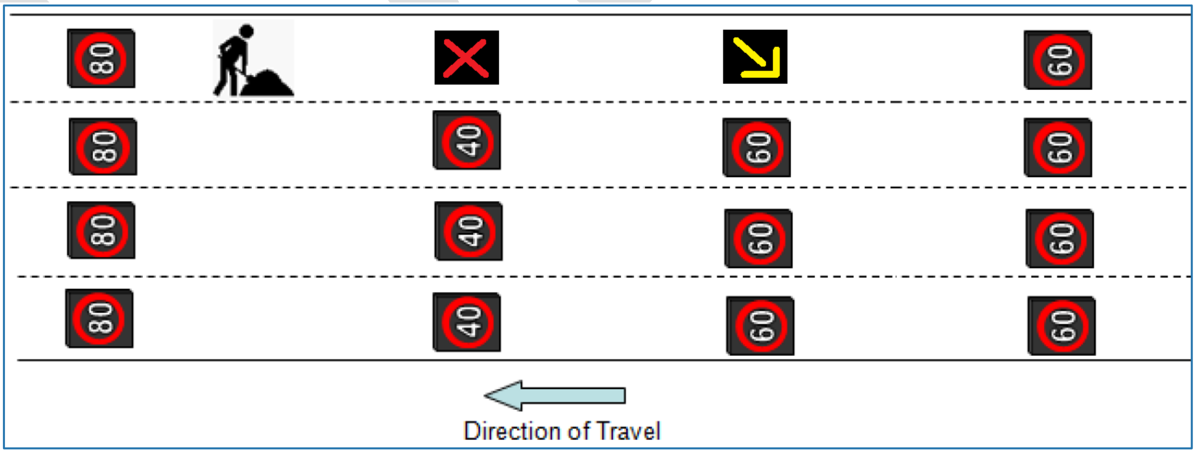

Figure 3. LCS usage to manage lanes and speed
Source: Guide to smart motorways (Austroads AGSM-16)

Gantry spacing along an expressway/motorway is affected by many factors. Due to the need for other infrastructure, combined with the need for user safety (eg the ability to see one gantry from the previous one),

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gantry spacing shall vary. The other important factors that influence the spacing of the gantries and shall be considered are operating speed and the complexity of the road environment (*Freeway design parameters for fully managed operations* (Austroads AP-R341-09)).

The desired schematic layout of LCS gantry spacing in relation to off- and on-ramps and other signage is shown in **Figure 4Error! Reference source not found.**.

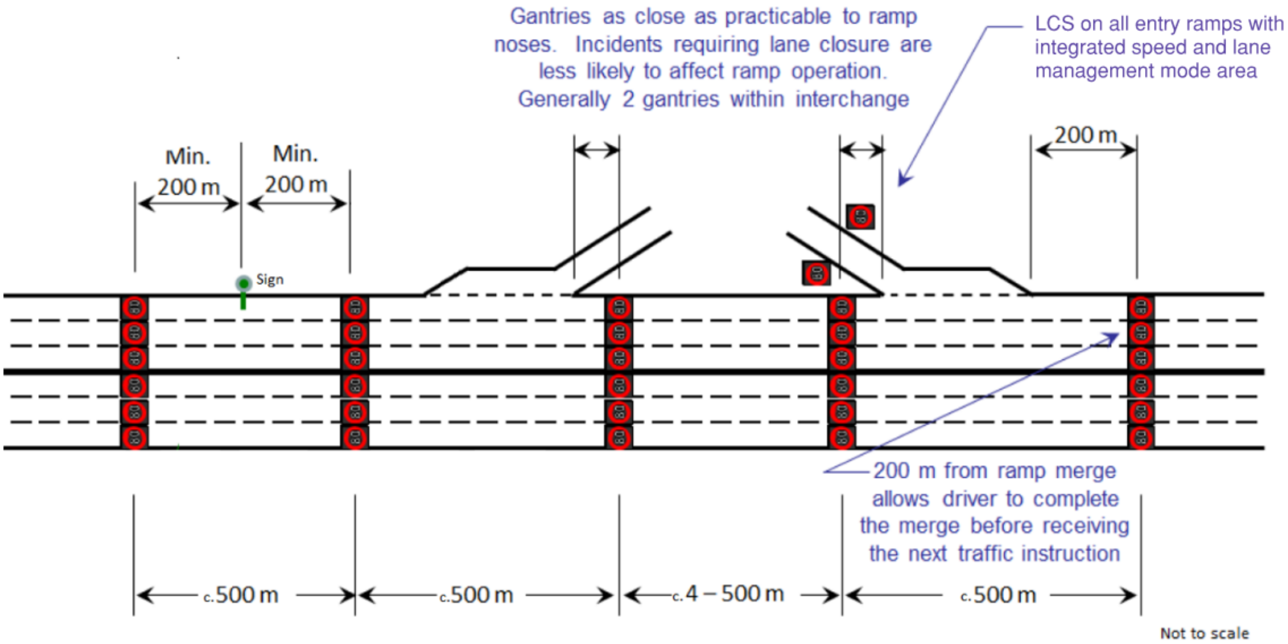

Figure 4. LCS gantry spacing
Source: VicRoads 2013

On-ramp LCS shall be located at the top of the ramp within 30m of the legal speed limit change. On a single-lane ramp only one LCS is required unless physical constraints dictate otherwise. Where there are two or more lanes on an on-ramp, LCS installation shall be gated.

In tunnels, LCS in integrated lane and speed management mode shall be spaced between 100m and 200m (VicRoads 2013).

2.2.4.2 Speed management mode

On motorways and expressways, LCS in speed management mode shall be installed on both sides of the carriageway, at 500m spacing with maximum 800m spacing (VicRoads 2013).

Spacing must meet consistency of messaging requirements. For example, for managed motorways the gantries distance shall be considered closer to 500m.

In tunnels LCS in speed management mode shall be spaced at a maximum of 500m (VicRoads 2013).

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2.2.5 LCS Horizontal (lateral) placement

2.2.5.1 Integrated lane and speed management mode

LCS shall:

i. be positioned centrally over each lane
ii. be located above off-ramps, either over the painted nose, gore or physical nose with signals over the main carriageway lanes and the exit lane(s)
iii. have one signal per lane at the start of every on-ramp
iv. not be positioned over a merging or diverging lane
v. be aligned to maximise visibility.

Refer to **Figure 5Error! Reference source not found.** as an example of LCS positioning.

Gantries shall be always perpendicular to the carriageway.

The gantry shall span both carriageways of a motorway/expressway in locations where:

i. both carriageways require LCS, or
ii. a narrow median restricts gantry leg installation.

The gantry shall span each carriageway of a motorway/expressway where:

i. carriageways for different directions are at different elevations
ii. LCS for different directions are not required to be positioned at the same location.

Figure 5. LCS on a gantry spanning motorway

2.2.5.2 Speed management mode

For side-mounted LCS installations, other signage shall not be installed on the same pole as the LCS. The distance between the side-mounted LCS and other non-related signage shall not be less than 200m.

2.2.6 LCS Vertical placement

2.2.6.1 Integrated lane and speed management mode

The minimum vertical clearance to the gantry and LCS shall be minimum 6m, but no more than 8m.

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LCS site design shall consider if LCS can be co-located with destination signage (lane specific) and VMS when it is not possible to space destination signage and VMS gantries using required distances.

2.2.6.2 Speed management mode

The mounting height (measured from the underside of LCS) for an LCS installed on the top of a pole on the side of a road shall be minimum at:

i. 2.5m when installed on the left-hand side of a one-lane carriageway (TCD manual)
ii. 4.3m when LCS are gated or when an LCS is proposed to be located in the median on a two- or three-lane carriageway. This requires only the sign support to cater for barrier deflection and truck rollover requirements as the sign itself is above the maximum vehicle height. It can also reduce median widening costs and disruption.

Refer to the latest versions of the NZTA ITS standard drawings for standard details of mounting poles.

2.2.7 Routes for over- dimension vehicles

LCS site and VMS designs shall consider if a site is located on a route for over-dimension vehicles. These routes require a ‘design envelope’ clearance minimum 10m wide × 6m high as per the NZTA *Bridge manual* (SP/M/022). If the wider clearance envelope of 11.5m wide × 6.5m high can be accommodated, this is preferred by the New Zealand Heavy Haulage Association.

Consultants shall give specific design considerations for electronic signage at tunnels and their approaches, and provide details to the Client for approval.

2.3 Civil requirements and support structures

The design shall comply with the requirements detailed in the latest version of the ITS design standard: *Civil and structural requirements*.

2.3.1 Interface between VMS and LCS and the support structures

Where the electronic signs and the civil works are procured through separate contracts, the interface or integration between the VMS and LCS enclosures and the support structure must be closely managed by the Client or its appointed representatives.

The appointed Project Manager is responsible for ensuring the design requirements for the contract are met, including:

i. determining the sign dimensions, weight and method of attachment to the support structure with the contractor supplying the sign
   – A clear distinction must be made between the dimensions of the enclosure plus tolerance that are required for connection to the support structure, and the dimensions of the enclosure plus the surrounding border (which shall be bolted to the enclosure) that are relevant for wind-loading calculations
ii. coordinating design for attachment of the sign to the support structure

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iii. communicating this information to the appointed engineer(s) responsible for the sign and for the civil works.

2.3.2 Foundation conditions

To reduce the risk to the Client from the contractor encountering unforeseen ground conditions around foundations for mounting structures, the Consultant shall carry out suitable geotechnical assessment of the ground conditions investigations before a site is recommended.

2.3.3 Mounting to the support structure

The sign enclosure shall include structural attachment points, bolts and clamps to mount the VMS on the support structure.

When retrofitted to existing structures Consultants shall be aware that different manufacturers have mounting points at different locations on the VMS and LCS enclosures. Comparison of the manufacturer's shop drawings, review of structural as-built drawings, and site measurements shall be undertaken to determine if new brackets or mounting structures are required.

Size and weight of the new electronic signage shall be taken into consideration as this will result in the need for a complete check of the existing structure for capacity.

Consultants shall use as the basis for their design the latest versions of the NZTA ITS standard drawings for electronic signage mounting, gantry and pole details.

2.3.4 Road safety barriers

New installations will require an appropriate road safety barrier design as they create a hazard for road users.

2.3.5 Cabling and ducting

At a minimum, all signs will require a duct for data and power cabling from the ITS cabinet to the sign.
For regional VMS, all ducting shall be contained within the structure where possible to minimise vandalism and damage. All ducts shall be external rated UV-resistant conduit.

For gantry-mounted signs, the conduits shall be contained in secure galvanised ducts bolted to the vertical support legs. Where these ducts reach the horizontal walkway, the conduit shall be attached to the approved cable trays.

2.4 Power requirements

See the latest version of the ITS core requirements standard: *Requirements for intelligent transport systems* for VMS and LCS power supply requirements for each ONF road classification.

VMS and LCS power design shall consider the availability of power at the roadside. Consultants must engage with local power contractors as the cost shall be prohibitive.

If the power supply must come from the other side of the roadway, thrust boring shall be the only option.

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2.4.1 VMS and LCS uninterruptible power supply (UPS)

All VMS shall be equipped with a UPS facility, housed in a cabinet adjacent to the VMS, not within the VMS enclosure itself. A UPS shall be provided inside an LCS site cabinet to supply power to an LCS site field controller.

Power to the VMS and LCS controllers and communications equipment shall be routed via the UPS to ensure a clean and stable power supply.

Batteries shall be automatically charged from the mains power supply and be a suitable product for the environment and the requirements of the installation.

For regional/remote sites, the backup power facility shall be capable of providing a minimum of seven hours of full VMS operation, including pixel lighting in normal daytime mode, communications, and controller operation under normal operational conditions.

For motorway and expressway sites, or urban locations where the power network is considered extremely reliable, UPSs are not generally required.

The UPS must be able to supply sufficient power to run all LCS at a site at full intensity and any other components that are necessary to maintain communication with the Client for a period of four hours.

2.5 Communications to site

A communications link is required to connect the VMS and LCS site to the Client's national control system. The Client has national communications agreements in place with a commercial provider. The Consultant must engage the commercial provider to investigate the most appropriate communications options for each site. These shall be:

i. any existing Client backbone fibre communications network
ii. leased lines from a commercial provider's dark fibre or asymmetric digital subscriber line (ADSL)
iii. cellular communications.

The commercial provider will provide the router/modem for each site, including aerials if required.

Depending on the communication system selected, there shall be a need to arrange cabling/trenching to the site. As with the power requirements, consider tasking a telecommunications contractor with arranging cabling to the site.

Note that consent from the Client is required before cabling installation is undertaken in the road reserve.

Where a VMS or an LCS is to be connected via fibre, Consultants shall reference the latest versions of:

i. ITS design standard: *Optical fibre*
ii. ITS design standard: *Ducts*
iii. ITS design standard: *Jointing chambers and pull pits.*

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The installation (capital) cost, operating cost and fitness for purpose of the communications options must be established.

2.6 Roadside cabinets

When a roadside cabinet forms the part of electronic signage design, refer to latest version of the ITS delivery specification: *Roadside Cabinets.*

2.7 Environmental and planning requirements

2.7.1 Environmental impact and public consultation

Potential costs and delays arising from environmental planning and consent requirements must be considered when assessing a site, because support structures with electronic signage can be visually intrusive on the surrounding area.

As a minimum, the Consultant shall consider the need to consult with nearby residents, particularly those within the LED illumination cone, as the light emitted at night can create adverse effects.

Professional judgement must be exercised as to the likely requirement for a consultation process, and the range of likely risk to the project in terms of community, sustainability, time and cost. Depending on the results of these considerations, alternative sites need to be considered.

2.7.2 Urban design, environmental planning, site services and land issues

2.7.2.1 Urban design requirements

As a signatory to the New Zealand Urban Design Protocol, the Client has a role to ensure that electronic signage respond to and enhance the environment in which they are placed.

Electronic signage can potentially add to the visual clutter on the roadside. It is important that electronic signage is located in relation to other elements in the visual field and that the design of support elements is not neglected and unrelated to other roadscape elements.

Although the design of the electronic signage is constrained due to safety reasons etc, their size, placement, support structures and related elements, including rear surfaces, can often be modified to improve the visual quality of roads and surrounding areas without compromising the sign's purpose or road users' safety.

Key strategies and actions for electronic signage are as follows.

i. Design electronic signage as a vital element of the visual experience of the road and a possible means of reducing the number of signs.
ii. Ensure coordination and possible collocation of electronic signage with other roadscape elements.
iii. Ensure that the local character of an area is not adversely impacted by unnecessarily large and poorly located electronic signage.
iv. Design support structures and related signage hardware to be integrated with other elements such as lighting, bridge and guard rails, emergency phones, and advertising.
v. Where electronic signage are to be located on overbridges, integrate them into the design of these structures if possible so that they do not appear as add-ons.
vi. Explore ways to improve the appearance of the rear of the electronic signage.

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2.7.3 Environmental planning

2.7.3.1 Outline plan

Where electronic signage is to be located within the boundary of a road designation, the territorial authority (city or district council) shall require an outline plan for the works. It is recommended that discussions be held with the appropriate territorial authority early in the project to determine their requirements.

2.7.3.2 Resource consents

Where electronic signage is to be located outside the boundary of a road designation, a land use consent shall be required from the territorial authority. An assessment under the relevant rules of the district plan will be necessary to determine whether the electronic signage needs a resource consent.

2.7.3.3 Assessments of environmental effects

Where the Client is required to apply for a resource consent to locate electronic signage, an assessment of environmental effects must be undertaken. This would require a more extensive and detailed assessment than for an outline plan.

Consultants shall consult the latest version of *Z/19 Taumata Taiao: Environmental and Sustainability Standard* to ensure a sufficient assessment has been undertaken where required.

2.7.4 Land issues

There are normally distinct advantages in having the electronic signage, the line of clear sight to the electronic signage over the entire legibility distance, and trenched or overhead services to the sign completely within the legal boundary of the road reserve or land owned by the Crown, to avoid landowner negotiations, compensation, legal issues and potential delays.

This section is intended to flag the importance of ensuring any agreements with landowners are placed on a formal legal basis if encroachment into neighbouring land is going to occur. It does not address details of such legal instruments as easements, land plans, land entry agreements, full and final agreements, and compensation for landowners, which shall be required if encroachment occurs. For specialist advice, consult the Client’s Property Consultant.

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3 Design for safety

This section defines the requirements to ensure the electronic signs can be operated and serviced safely.

3.1 Health and safety

All ITS equipment must be designed to ensure installation and maintenance in accordance with the Health and Safety at Work Act 2015.

3.1.1 Health and safety in design

Health and safety in design must be undertaken to identify any hazards and the appropriate interventions. See the latest version of the NZTA *Health and safety in design minimum standard* (ZH/MS/01).

3.2 Safety requirements

3.2.1 Space to ensure safety conformance – motorway and expressway

Health and safety in design principles must be undertaken to determine the appropriate space required to operate safely within the VMS or LCS site. The space must accommodate an LCS gantry or a pole, a cabinet with an apron and safety interventions (such as barrier protection if required), and safe maintenance vehicle parking, and it must allow additional distance to the edge of the live lane in a higher speed environment.

In the motorway and expressway context, gantry support structures will normally require barrier protection which will in turn provide protection for maintenance technicians. Where safety barriers or guardrails are provided to protect the VMS or LCS support structure and any associated equipment, refer to the section titled 'Safety Barriers' in the current version of ITS design standard: *Civil and structural requirements.*

Barrier designs are required to be undertaken by a suitably qualified installation consultant, using the Austroads *Guide to road design part 6: Roadside design safety and barriers* (Austroads AGRD06-22) and *Specification and guidelines for road safety hardware and devices* (NZTA M23:2022).

3.2.2 Space to ensure safety conformance – rural state highways

For regional VMS, the width of the left-hand road reserve is a crucial determinant in the decision process. The space must accommodate the width of the proposed sign, space for barrier protection if required, and allow a further distance to the edge of the live lane depending on the speed environment.

Consider using natural protection afforded by positioning signs on top of cuttings or beyond culverts, provided the other site selection requirements can be met.

For speed environments at or above 60km/h, structures must be frangible or protected.

Below 60km/h there is no requirement to protect non-frangible signs, but the supports shall be located as far from the road edge as practicable.

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Where a guardrail is being considered, the needs of pedestrians, cyclists and turning vehicles shall be considered.

3.2.3 Site access static locations

The site must allow reasonable vehicle access for erection, and for reactive and routine maintenance. The site shall be accessible, and the sign shall be maintainable, without the need for temporary traffic management. The design shall:

i. allow safe access to the sign for maintenance vehicles
ii. minimise the exposure to hazards posed between maintenance vehicles and personnel and traffic in the live lane(s)
iii. facilitate effective traffic control for any maintenance work above the carriageway.

3.2.4 Safe parking

The design shall allow a maintenance vehicle to decelerate to a crawl in the left lane of the road in order to pull out of that lane and then reverse into the paved maintenance bay. The maintenance bay shall be located behind a barrier or positioned within a safe distance from the road.

Parking areas shall allow for clear line of site for safe entry and exit and be sealed. Access from off the state highway from local roads shall be considered if achievable.

For reversing vehicles, rubber wheel stops or bollards must be installed where there is a risk of a vehicle hitting a gantry leg, a pole, a cabinet or other assets.

For regional sites – sight rails shall be used to reduce the chance of vehicles dropping into culverts, unrecoverable swales or other hazards.

3.2.5 Safety issues – above and below ground

The top of the sign shall not be located any closer than 2m to overhead low-voltage power lines, and not closer than 4.5m to high-voltage lines. However, some power companies shall require slightly greater separation distances. For safe distances from low- and high-voltage power lines, refer to the latest version of NZECP 34:2001 *New Zealand Electrical Code of Practice for Electrical Safe Distances*.

A note shall be made if the site is under power lines low enough to interfere with erection of the support structure, and this information shall appear in the tender documents.

A check must also be made for the presence of underground services before digging or testing with a Scala penetrometer or other geotechnical investigation equipment.

3.2.6 Electrical surge protection

All display equipment shall be internally protected against damage resulting from:

i. lightning strikes near the VMS/LCS/gantry/roadside cabinet
ii. electrical transients on power cabling
iii. electrical transients on internal and external signal wiring

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iv. electromagnetic interference
v. static electrical discharge.

A lightning protection system shall be installed in accordance with AS/NZS 1768:2021 Lightning protection. The system shall consist of:

i. an air termination to intercept lightning discharges directly
ii. down conductors to connect the air terminal to earth terminals
    – Note that it is possible that these down conductors can be formed from reinforcing steel that shall be used in concrete support structures, as applicable
iii. earth terminations to discharge the lightning currents into the general mass of earth
    – This shall in part, or in full, consist of the foundations for the support structure, depending on the calculated required maximum earthing resistance
iv. equipotential bonding between the lightning earthing system and any other earthing systems for personal and equipment protection.

Multi-stage surge diversion shall also be provided on the incoming power circuits and communication circuits. Surge diverters shall be field replaceable without the need to disconnect wiring, and they shall have integral indicators to show when they have blown (as applicable). A preferred option is to have an auto-reset function which negates the need for an actual site visit.

3.3 Site assessment

All site designs are required to be reviewed by the Client's regional safety team once the design is up to a suitable stage.

3.4 Site audit

Each electronic sign site shall be designed in accordance with the Client's Safe System principles, and the overall project shall be a subject to the Client's Safe System audit process (see NZTA's *Safe System audit guidelines for transport projects*).

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4 Design for maintainability

This section defines the requirements to ensure the electronic signs can be maintained.

4.1 Maintenance requirements

4.1.1 System-specific inspection and maintenance requirements

The design and layout must allow inspection to be done without the need for additional temporary traffic management.

The design and layout shall facilitate planned inspections and reactive maintenance (repair) with the minimum of equipment, in the shortest time and with minimum impact to traffic.

4.1.2 Maintenance access

For site and maintenance access to electronic signage structures, including typical maintenance bay drawings, refer to the latest version of ITS design standard: *Civil and structural requirements*.

4.1.3 Extreme weather or other environmental conditions

Consultants shall avoid locations that are prone to flooding where possible. If necessary, use a tall traffic-signal-type roadside cabinet ensuring its position does not offer vandals a platform to reach the electronic sign. Consideration must be given to extreme or unusual conditions at each site that will require upgrading of part of the design.

Obvious examples include:

i. extreme winds (which are more likely above 500m altitude, on a ridge or cutting, or in a lee effect multiplier zone) affecting foundations and structural support design
ii. corrosive environments requiring enhanced coating systems.

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5 Design for security

This section defines the requirements to ensure the electronic signs can be secured and maintain integrity.

5.1 Security requirements

The electronic sign design must deliver the following security-related requirements:

i. complies with appropriate NZTA specification security requirements and site networking equipment security requirements
ii. complies with the requirements in section 3.2 of this design standard
iii. meets all relevant Client security procedures and protocols
iv. passes all security audits/assessments of installed ITS equipment.

5.2 System-specific security requirements

5.2.1 LCS and fixed VMS gantry physical security

A gantry with a side access ladder and a gate shall be locked by either a key or a padlock with a key. Padlocks with an inbuilt combination lock are not permitted. Consider a padlock bolt hole to prevent bolt cutters from being used to remove padlocks.

For details of gantry access ladder, hoop, vandal barrier and gate, refer to the latest versions of NZTA ITS standard drawings.

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6 Appendix A: One Network Framework road classification and concept of operations requirements

The Consultant shall also refer to the latest version of the ITS core requirements guideline: *Requirements for intelligent transport systems* to assess the requirements for use of electronics signs for each One Network Framework (ONF) road classification.

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7 Appendix B: Design Concepts

7.1 Standard VMS types

The latest version of ITS delivery specification: *Variable message signs – fixed* has defined a selection of standard VMS types to be used in each roading environment and posted speed limit.

Table 1 Error! Reference source not found. shows a variety of sign types with prescribed minimum character/font heights for use across the network. Minimum character height is fixed for each VMS type based on road type (including ONF category) and posted speed limits.

VMS type	Lines of text	Character height (mm)	Typical use location and mounting	ONF category example	Speed environment (km/h)
Motorway	3	400	• Urban motorway • Expressway – multiple lanes, high speed, high volume • Mounted on truss gantries to ensure all lanes of a multi-lane environment can view the message	• Transit corridor • Urban connector • Inter-regional connector	100+
Regional Type A	4	300	• Expressway – single lane • Rural state highway • Mounted on roadside supports located on the left side of the highway within the road reserve, or sometimes on private land	• Transit corridor • Urban connector • Inter-regional connector • Peri-urban road • Rural connector	71–100
Regional Type C	4	200	• Rural state highway • Urban road/local road • Mounted on roadside supports located on the left side of the highway within the road reserve, or sometimes on private land	• Inter-regional connector • Peri-urban road • Rural connector	51–70
Urban Type D (EJT)	3	200	• Local road • Local road approach to motorway interchange • HVU road • Mounted on frangible structures on the left or right side of local road or approach to motorway	• Urban connector • Main street • Activity street	Up to 50

Table 1. VMS minimum character heights related to typical locations, ONF category and speed environment

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7.2 LCS site

The LCS site is the defined location on the given carriageway where an orthogonal array of LCS is installed across the carriageway or in a tunnel.

7.3 LCS system

An LCS system includes several logically linked LCS sites used to manage a part of a road corridor or a tunnel.

7.4 LCS operation modes

LCS operate across a group of lanes along the length of a carriageway. LCS are operated in one of these modes:

i. integrated lane and speed management mode (regulatory)
ii. speed management mode (regulatory)
iii. information and warning mode (advisory).

In the integrated lane and speed management mode, LCS have a one-to-one direct correlation with a lane and are installed on an overhead gantry, as shown in **Figure 6**Error! Reference source not found.**Error! Reference source not found.**.

Figure 6. Integrated lane and speed management mode

Source: Managed freeways handbook for lane use management, variable speed limits and traveller information (VicRoads 2013)

In the integrated lane and speed management mode, LCS are used only on expressways/motorways with two or more lanes in each direction for the purpose of:

i. closing a lane or lanes and managing traffic flow around closed lane(s)
ii. closing a carriageway and managing diverted traffic off the carriageway, across multiple lanes onto alternative routes
iii. speed management for incidents, congestion and events.

In the speed management mode, displayed speed signs apply to a whole carriageway (gated), depending on the configuration, as shown in **Figure 7**Error! Reference source not found.**Error! Reference source not**

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found.. In this operating mode LCS on carriageways with up to three lanes shall be installed on vertical poles (VicRoads 2013). On three-lane carriageways with the percentage of trucks more than 5%, LCS gantry mounting shall be considered to alleviate visibility restrictions. For carriageways with four or more lanes, LCS shall be installed on gantries.

In the information and warning mode, pictograms or symbols with visual messages shall be used. For example, highlighting roadworks preceding a speed reduction, wind warnings (pictograms) or no use of high sided vehicle in lanes.

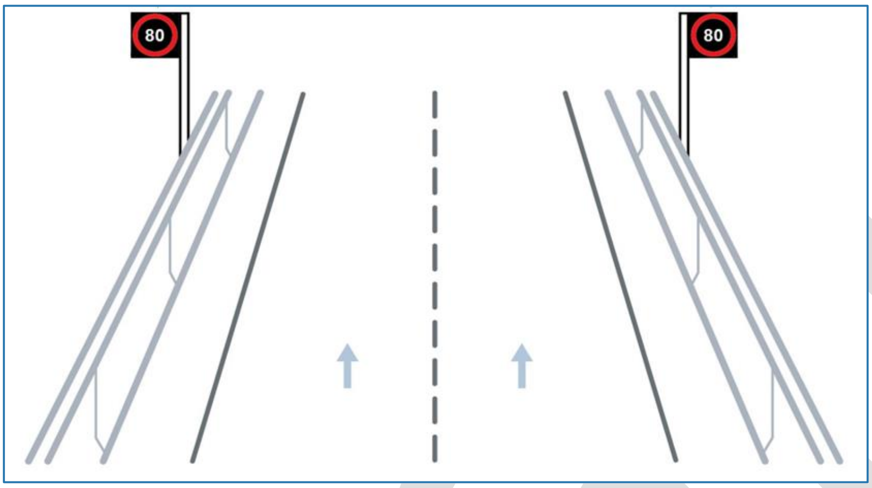

Figure 7. Speed management mode applied to a whole carriageway (gated)

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8 Appendix C: Integration, testing, commissioning and handover

8.1 Integration requirements

For integration requirements, refer to the latest version of ITS core requirements standard: *Variable message signs (VMS) and lane and carriageway signs (LCS) system interface*.

8.2 Commissioning, testing and handover

For commissioning, testing and handover requirements, refer to the latest version of ITS core requirements standard: *Commissioning and handover requirements.*

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9 References

This section lists all external and NZTA references included in this document.

9.1 Industry standards

Standard number/name
AS/NZS 1768:2021 Lightning protection
NZECP 34:2001 New Zealand Electrical Code of Practice for Electrical Safe Distances

9.2 NZTA standards, specifications and resources

9.2.1 Standards and specifications

See the NZTA website for the latest versions of the ITS S&S listed below.

Document name
ITS core requirements standard: Commissioning and handover requirements
ITS core requirements standard: Requirements for intelligent transport systems
ITS core requirements standard: Variable message signs (VMS) and lane and carriageway signs (LCS) system interface
ITS delivery specification: Lane and carriageway signs
ITS delivery specification: Mobile variable message signs
ITS delivery specification: Variable message signs – fixed
ITS design specification: Roadside Cabinets
ITS design standard: Civil and structural requirements
ITS design standard: Ducts
ITS design standard: Jointing chambers and pull pits
ITS design standard: Optical fibre

9.2.2 Resources

Document name/code
Health and safety in design minimum standard (ZH/MS/01)
Bridge manual (SP/M/022)
Traffic control devices manual (TCD manual)
Safe System audit guidelines for transport projects
Specification and guidelines for road safety hardware and devices (NZTA M23:2022)
Z/19 Taumata Taiao: Environmental and Sustainability Standard

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9.3 Legislation

Name
Electricity (Safety) Regulations 2010 (SR 2010/36)
Health and Safety at Work Act 2015

9.4 Drawings

See NZTA website for the latest versions of the ITS standard drawings.

Drawing number

9.5 Other resources

Name
Ability to absorb information through electronic and static signs (Austroads AP-R485-15)
Freeway design parameters for fully managed operations (Austroads AP-R341-09)
Guide to road design part 6: Roadside design, safety and barriers (Austroads AGRD06-22)
Guide to smart motorways (Austroads AGSM-16)
Managed freeways handbook for lane use management, variable speed limits and traveller information (VicRoads 2013)

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10 Terminology used in this document

Term	Definition
DRAFT	The document is being written and cannot be used outside of NZTA.
FINAL DRAFT (pending ratification)	The document has been finalised and is pending approval and ratification by NZTA. It can be used for procurement at this status.
RATIFIED	The document is an official NZTA document. NZTA projects and other road controlling authorities connected to NZTA back-end systems must include this document in the contracts. The obligation to follow the requirements in this document would come from the inclusion of the S&S document in the contract.
RETIRED	The document is obsolete, and/or superseded.
AADT	Annual average daily traffic
ADSL	Asymmetric digital subscriber line
AS/NZS	Australian/New Zealand standard
ATMS	Advanced traffic management system
AWRS	Active warning and regulatory sign(s)
Barrier protection	Generic term covering various roadside protective barrier systems, including rails, fences and crash cushions, which are designed to restrain vehicles that are out of control
Border	Border surrounding an active display matrix on an electronic sign or signal
Character height	Height of an upper-case character expressed in millimetres
COC	Electrical Certificate of Compliance & Electrical Safety Certificate
CoO	Concept of operations
EJT	Estimated journey time
Enclosure	Housing for electronics systems to protect against environmental conditions
Expressway	High-speed roads, which shall include well-spaced at-grade intersections – which means they often have accesses and driveways onto them and sometimes traffic signals or roundabouts
Frangible	Performance capability of structures, which are designed to shear or collapse when struck by a vehicle, minimising the impact hazard to the vehicle's occupants
Gantry	Support structure spanning a carriageway for the purpose of supporting electronic signs and signals
High-voltage lines	Lines carrying electrical current greater than 1000V AC or 1500V DC
HVU	High-volume urban – refers to non-motorway, generally high-volume roads, in urban environments
ITS	Intelligent transport system(s)
LCS	Lane and carriageway sign(s)

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Term	Definition
LED	Light-emitting diode
Low-voltage lines	Lines carrying electrical current less than 1000V AC or 1500V DC
Motorway	Access-controlled, high-speed roads that normally have grade-separated intersections – which means they have overbridges (or underpasses) so road users don't have to stop at traffic lights
MVMS	Mobile variable message sign(s)
NZTA	NZ Transport Agency Waka Kotahi
ONF	One Network Framework
Pixel	Smallest controllable element of a display matrix for an electronic sign or signal
PMCS	Plant management and control system
RAMM	Road assessment and maintenance management
Road reserve	Corridor of land owned by the Crown, which is designated for roading infrastructure
ROI	Record of Inspection of High-Risk Prescribed Electrical Work
Rural	In the context of ITS, rural refers to low-volume uncongested roadways in non-urban environments
S&S	Standards and specifications
Scala penetrometer	Test equipment used to determine the penetration resistance of soil
TCD manual	Traffic control devices manual
UPS	Uninterruptible power supply
VMS	Variable message sign(s)

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11 Content to be redirected

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document	Class
2.3.5	Cabling and Ducting (second paragraph shall be redirected)	ITS design standard: *Civil and structural requirements*	010 Civil infrastructure
2.5.1	VMS uninterruptible power supply (UPS)	ITS core requirements specification: *General electrical requirements*	000 Core requirements

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12 Document control

12.1 Document information

Document number	ITS-STND-ES-202409
Previous document number/s (if applicable)	
Document status DRAFT | FINAL DRAFT | RATIFIED | RETIRED	DRAFT
[IF RETIRED] New document details	
Online ISBN	
Document availability	The controlled version of this document can be accessed from https://www.nzta.govt.nz/roads-and-rail/intelligent-transport-systems/standards-and-specifications/its-current-interim-and-legacy-standards-and-specifications/

12.2 Document owner

Role	ITS S&S Steering Committee
Organisation	NZTA

12.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation
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12.4 Full version history

This table shows the full history of changes made to this document, both minor and major, in chronological order, since the document was first authored.

Minor versions are numbered 0.1, 0.2 etc until such point as the document is approved and published, then it becomes 1.0 (major version). Subsequent edited versions become 1.1, 1.2 etc, or if it's a major update 2.0, and so on.

Version	Date	Author	Role and organisation	Reason
0.1	April 2024	Richard Quiney (VMS) Kirill Yushenko (LCS) James Ellison (MVMS)	Senior Specialist Principal Consultant Principal	Initial Drafts for expert panel
0.2	07/05/2024	Richard Quiney (VMS) Kirill Yushenko (LCS) James Ellison (MVMS) Allan Arora (MVMS) Catherine Rochford (MVMS)	Senior Specialist Principal Consultant Principal Transport Engineer Senior Associate – Project Manager	Documents merged into Electronic Signs Standard document. Draft for expert panel
0.3	27/05/2024	Richard Quiney (VMS) Kirill Yushenko (LCS) James Ellison (MVMS) Allan Arora (MVMS) Catherine Rochford (MVMS)	Senior Specialist Principal Consultant Principal Transport Engineer Senior Associate – Project Manager	Incorporated expert panel comments
0.4	25/06/2024	Richard Quiney (VMS) Kirill Yushenko (LCS) James Ellison (MVMS) Allan Arora (MVMS)	Senior Specialist Principal Consultant Principal Transport Engineer	Incorporated industry review comments

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Version	Date	Author	Role and organisation	Reason
		Alyssa Greaney (MVMS) Catherine Rochford (MVMS)	Transport Planner Senior Associate – Project Manager	
0.5	30/06/2024	Matthew Bauer	Editor, Clear Edit NZ	Copyedit
0.6	19/09/2024	Richard Quiney (VMS) Kirill Yushenko (LCS) Alex Lumsdon (MVMS) Alyssa Greaney (MVMS)	Senior Specialist Principal Consultant Associate – Transportation Engineering Transport Planner	Responding to Copyedit and NZTA comments
0.7	12/09/2024	Anandita Pujara	Document Manager	Updated section 4 and Appendix A as per TSC feedback

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