



P36 NOTES FOR
NZ Transport Agency
VARIABLE MESSAGE SIGNS

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<p>This document is the NZ Transport Agency Notes for Variable Message Signs (VMS).</p> <p>A separate document titled NZ Transport Agency Specification for Variable Message Signs is available to provide a set of specifications for the design and procurement of electronic VMS signage for motorway and regional applications.</p> <p>NZ Transport Agency's requirements for VMS messages are described in the National VMS Operating Policy, & National VMS Operating Procedures.</p> <p>Requirements for Mobile VMS are set out in SP/M/031 Specification for Mobile VMS, and the associated Notes.</p>		
Document Purpose The purpose of this document is to assist the site selection, design, environmental planning, construction of support structures, reticulation of power and communication services, and post construction acceptance and maintenance, of VMS for the State Highway network where NZ Transport Agency has a responsibility to provide driver information.		
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1. Introduction

1.1. Scope

These Notes provide guidance to the Specification for Variable Message Signs (VMS). They should be read in conjunction with the Specification.

Accordingly the scope of this document has been defined as follows

1. Site selection
2. Design of support structures
3. Road safety
4. Urban design and environmental planning
5. Construction of support structures
6. Power and communication services
7. Post construction acceptance and maintenance

These Notes cover:

Motorway VMS
Regional VMS which encompass: <ul style="list-style-type: none"> • High Volume Urban (HVU) VMS • Rural VMS

1.2. Definitions and Acronyms

Term/Acronym	Definition
ADSL	Asynchronous Digital Subscriber Line.
Angle of Internal Friction	Soil shear strength. Generated by-inter particular contact.
ATMS	Advanced Traffic Management System.
Barrier Protection	Generic term covering various roadside protective barrier systems including rails, fences, and crash cushions, which are designed to restrain vehicles which are out of control.
Bezel	The border surrounding the VMS enclosure, mounted flush with the polycarbonate front panel.
cd	Candela.
CDMA	Code Division Multiple Access. The term refers to a cellular telecommunication network.

CIS	(NZTA) Customer Information Services
Clear Zone	The area adjacent to the road that is clear of fixed or non-frangible objects and provides a recovery zone for vehicles that have left the carriageway.
CMS	Changeable Message Sign
Cohesion (C)	Soil shear strength. Generated by inter-particle forces.
COPTTM	NZTA Code Practice for Temporary Traffic Management.
Design Wind Speed	Ultimate wind speed at the site based on terrain and return period.
DHCP Delivered IP	Dynamic Host Configuration Protocol - it allows devices to configure their own network settings by querying a host server about the details of the network.
Enclosure	The enclosure housing the display and the electronics systems immediately associated with the display.
Ethernet Protocol	Industry standard network Broadcast technology.
FAT	Factory Acceptance Test (Also see SAT).
FDCU	Field Device Control Unit.
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	In the context of this document, a support structure with legs on each side of a carriageway, designed to support an overhead sign.
GDM	NZTA Geometric Design Manual.
GPRS	General Packet Radio Service.
GSM	Global System for Mobile communication
High Voltage Lines	Lines carrying electrical current greater than: 1000 volts AC or 1500 volts DC.
HVU	High Volume Urban. In the context of this document HVU refers to non-motorway, generally high volume roads, in urban environments.
ITS	Intelligent Transport Systems.
Lantern	In the context of this document, a lantern consists of multiple LEDs in a circular grouped array.
LCD	Liquid Crystal Display.
LED	Light Emitting Diode.
LODMAT	Lowest Observed Daily Mean Air Temperature. Used when considering design parameters for materials in low temperature environments.
Low Voltage Lines	Lines carrying electrical current less than: 1000 volts AC or 1500 volts DC.
M23	NZTA specification for Road Safety Barrier Systems.
MACA	Monitoring And Control Application. NZTA's software that monitors and controls VMS message changing.
MIB	Message Information Block
Motorway	Roads designated as motorways, generally characterised by high volume multilane carriageways.
MOTSAM / TCDM	The NZTA <i>Manual Of Traffic Signs And Markings</i> , and its progressive replacement, the Traffic Control Devices Manual.
NCHRP 350	National Highway Cooperative Research Programme report. <i>Recommended Procedures for the Safety Performance Evaluation of Highway Features</i> .

NTCIP	National Transportation Communications for ITS Protocol.
NZTA	NZ Transport Agency
P/24	NZTA Performance Based Specification for Traffic Signs, which covers performance of frangible structures.
Pixel	A single point in a graphic image. In the context of this document pixels must achieve the viewing angle, luminance, and other performance characteristics described in this Specification. The performance characteristics may be achieved with a pixel consisting of a single LED, or closely grouped LEDs, that present a single point of light at a normal viewing distance.
RCA	Road Controlling Authority
Regional VMS	In the context of this document Regional VMS refers to non-Motorway VMS. Regional VMS are not as large and are generally mounted on roadside structures as opposed to overhead gantries.
RHS	Rectangular Hollow Section. Used in this document in context of support structure materials.
Road Reserve	A corridor of land owned by the crown, which is designated for roading infrastructure.
RS-232/485	Is a standard for serial connections
Rural	In the context of this document Rural refers to low average volume uncongested roadways in non-urban environments.
Scala Penetrometer	Test equipment used to determine the penetration resistance of soil.
SAT	Site Acceptance Test (Also see FAT).
Slip Base	A shearing system for support structures involving upper and lower base plates clamped together by slip bolts in slots that are tightened to a prescribed torque.
SNMP	Simple Network Management Protocol
Soil Density	The mass of particles in the material divided by the volume.
Strength Reduction Factor (Φ)	A factor used to multiply the nominal capacity to obtain the design capacity.
Support Structures	Structures supporting VMS.
TCDM	Traffic Control Devices Manual.
Terrain Category	Multiplier applied to the wind speed to reflect the topography around the site.
TTM	Temporary Traffic Management.
UB	Universal Beam. Used in this document in context of support structure materials.
UMTS	Universal Mobile Telecommunications System
UPS	Uninterruptible Power Supply.
VMS	Variable Message Sign.
WEL	The white edge line painted on a road.

2. Process, Hold Points and Responsibilities

2.1. *Process*

The process starts by defining objectives and requirements for a proposed VMS installation. These include:

- Strategic network linkages and requirements
- Route(s) covered
- Potential scenarios which in turn produce a suite of messages
- Characteristics of the intended message recipient spectrum
- Criticality of such factors as response time and system reliability
- Operation and control of the VMS

2.2. Hold Points and Responsibilities

Table 1: Hold Points and Responsibilities

	Description	Phase	Responsibility
1	Define objectives for proposed VMS.	Concept	NZTA Regional Office
2	Complete site investigations and determine sign types, concurrent with Item 3 selection of communication and control systems.	Concept	NZTA Regional Office
3	Determine appropriate communication and control systems in conjunction with Item 2.	Concept	NZTA National Office
4	Assess concept. Ensure it meets NZTA criteria, is technically sound and will add value.	Concept	NZTA Regional Office
5	Capital funding application.	Concept	NZTA Regional Office
6	Funding approval based on national objectives, route priorities, and funding availability.	Concept	NZTA National Office
7	Confirm all requirements including land, access, communication, power, and environmental planning, are resolved or imminently resolvable.	Concept	NZTA Regional Office
8	Motorway VMS: Conclude tendering process for procurement of integrated package of support structure, civils, <i>and</i> display.	Tender Process	NZTA Regional Office, with NZTA National Office
	Regional VMS: Conclude tendering process for <i>national</i> procurement of display units.	Tender Process	NZTA National Office
	Conclude procurement process for <i>regional</i> support structures and civil works.		NZTA Regional Office
9	For Regional VMS, manage interface between VMS enclosures, and civil/supports.	Design	NZTA National Office
10	Approval of support structure/foundation design if non-standard.	Design	NZTA Regional Office
11	Confirm site layout, and construct support structure.	Construction	NZTA Regional Office
12	Site Acceptance Test (SAT) of civil works.	Construction	NZTA Regional Office
13	Factory Acceptance Test (FAT) of display enclosure.	Construction	NZTA National Office
14	Site Acceptance Test (SAT) of the VMS.	Commission	NZTA National Office
15	Ongoing asset management, including support, maintenance, and communication	Operational	NZTA Regional Office (NZTA National Office)

3. VMS Site Selection

3.1. VMS Site Selection Criteria

VMS site selection must take into account a large number of inter-related factors. There is a close relationship between site selection and selection of the sign size/display technology. Site considerations influence the selection of sign and technology, and sign constraints influence the choice of site.

The strategic location and anticipated simultaneous message suite determine the number of characters per line and lines for each sign. The character height is subsequently decided during site selection based on the speed environment and other factors at the proposed site.

3.1.1. Strategic Locations – an Introduction

VMS projects are generally justified on the benefits of establishing a sign or signs at strategic locations or nodes on the state highway network. At a macro level the site selection process must identify all potentially suitable sections of highway for siting VMS to ensure that viable options are not excluded from subsequent consideration.

The Network Video, which provides a “motorist’s eye view” of the state highway system, is an extremely useful tool to rapidly and safely identify potential sites before actual site visits are undertaken.

The VMS must be positioned above or to the left of the approaching motorist. In virtually all situations it is considered unsafe to position a VMS on the right hand side of approaching traffic because it may confuse motorists’ point of reference under night time conditions and lead to a head on collision.

3.1.2. Minimum Distance from Key Intersections

If the VMS is intended to advise route diversions, the sign should be located sufficiently in advance of the alternate route intersection to allow motorists to assimilate the message and respond accordingly, including changing lanes if necessary.

Motorway VMS should be placed a minimum distance of 1,500 metres prior to an access/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.

On high volume urban (HVV) roads, the distance is dependent 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 1,000 metres in a 100 km/h zone, or a proportionally reduced distance in lower speed zones, is suggested.

If a Rural VMS with low traffic volumes (e.g. 2,000 AADT) may display a message advising motorists to turn back, consideration should be given to choosing a site that has a suitable pull over / turning area just after the sign for travellers to turn around.

With higher traffic volumes in a high-speed environment, a level (~10,000 AADT) is reached where pulling over or turning around is unsafe. Professional judgement should be exercised as to whether pull over / turning areas are appropriate.

3.1.3. Influence of Message Suite on Sign Configuration

The number of locations or routes covered by the sign, and range of messages required to be displayed at any one time, influence the selection of sign. This is particularly true in the rural context where a choice is made between two or four line signs. The interaction between this aspect, speed environment, and character height must reach a mutually compatible solution. Character height in turn determines sign width. It is therefore necessary to establish the maximum likely range of messages to be displayed at any one time, and understand sign type options before undertaking detailed site selection. Refer to Section 6. *Choosing the Appropriate Character Height*.

3.1.4. Speed Environment and Character Height

Refer to Section 6: *Choosing the Appropriate Character Height*. The minimum character heights are based on Table 1 of the UK Design Manual TD 33/05.

The standard categories of character height for NZTA VMS are:

- 400mm for Motorway
- 300mm and 200mm for HVU and Rural, dependent on message size and speed environment

The character height determines the width of Regional signs, and hence influences site selection i.e.

Standard Regional VMS with 300mm character height is ~ 5 metres overall width.
Standard Regional VMS with 200mm character height is ~ 3.3 metres overall width.

3.1.5. Standard Sign Types for Regional VMS

The sign types are summarised in the table below.

Table 2: Standard Regional Sign Types (A, B, C, D & F)

	Character Height mm	Number of Lines
Type A	300	4
Type B	300	2
Type C	200	4
Type D	200	2
* Type F	160	2

* Type F is only recommended for slow speed sites with tight space constraints

3.1.6. Clear Sight Distance

In motorway and HVU settings there are typically many other signs and distractions that compete for motorists' attention. Visibility and impact, proportional to the environmental context, are particularly important considerations of site selection.

For rural VMS the designer should look for sites that allow motorists clear sight distance to the sign of at least 375 metres for 300mm character height, and at least 250 metres for 200mm character height, when travelling 100 km/h. In lower speed environments the distances can be reduced proportionally.

Ensure that road side 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.

3.1.7. Road Angle Vertical Plane

The designer must take into account the viewing angle of the LEDs when considering a site. The total width of the standard LED viewing angle or illumination cone for Motorway VMS is 14 degrees, while for HVU and Regional VMS it is 30 degrees. Note however that VMS with shade louvers may have a reduced viewing angle in the vertical plane.

Correct alignment is important to ensure approaching motorists will remain within the cone of illumination for as long as possible. 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.

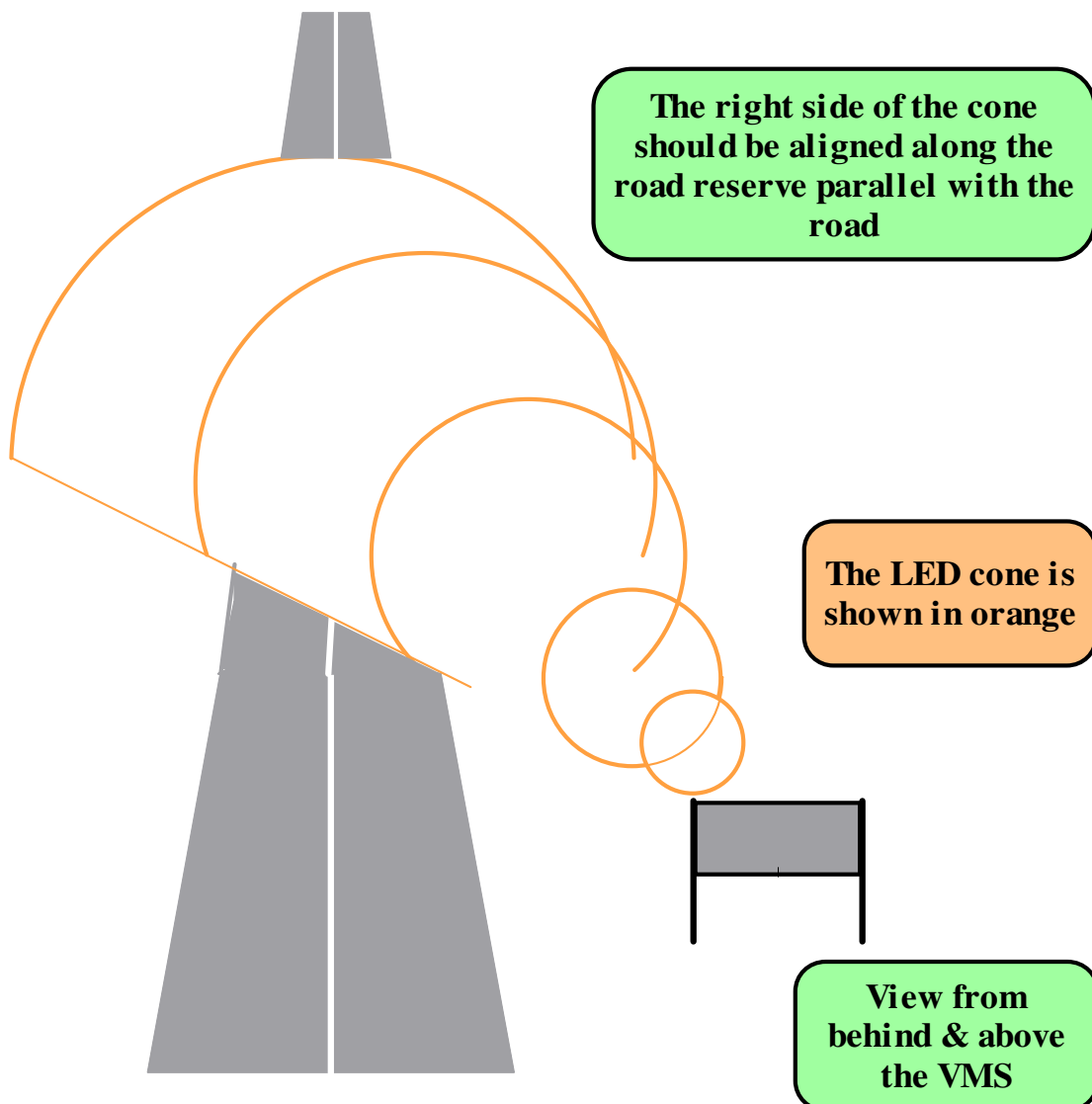
3.1.8. Road Angle Horizontal Plane

If possible avoid positioning the VMS directly in front of a rising or setting sun as this may significantly reduce its effective visibility. Similarly, reflections of the sun on the display face may reduce its legibility even with louvers or an anti-glare mask. Note the seasonal variation between the intersection of the arcs of the (higher) summer sun and the (lower) winter sun, and the horizon.

Where these display visibility factors cannot be mitigated by e.g. taking advantage of a natural backdrop of a hill or trees, or a downhill slope, then the use of a hood or louvers should be considered to shield the display.

In certain situations e.g. where traffic is angling across, rather than directly approaching the sign, it may be necessary to specify LEDs with a wider non-standard illumination cone.

Figure 1: Illustration of Illumination Cone for Roadside Regional VMS on Straight Road



3.1.9. Road Geometry

Avoid positioning a VMS immediately before a sharp bend, blind crest, or intersection, where the VMS may distract attention at a critical moment and could lead to loss of driver control.

Also the VMS must not be positioned where the display may be seen from a neighbouring road if this will result in motorists receiving confusing or conflicting information.

3.1.10. Presence of Other Signage

VMS should not compete with other existing signs and or strong light emitting sources or interfere with traffic control devices. The designer must make an inventory of all signs and traffic control devices both proceeding and beyond the potential site. Based on this inventory, existing signs may need to be moved to accommodate the VMS placement.

MOTSAM requires different signs to be located a minimum of $(0.6V_{85})$ apart, where V_{85} is the 85th percentile speed of traffic, in km/h, at the sign location.

3.1.11. Space to Ensure Safety Conformance

In the Motorway context, gantry support structures will normally require barrier protection.

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 dependent on speed environment (refer to the table in Section 4: Road Safety Requirements).

Regional VMS support structures should be sited outside the clear zone where practicable. Consideration should be given to natural protection afforded by positioning signs on top of cuttings or beyond culverts, providing the other site selection requirements can be met.

For speed environments at or above 70 km/h, structures in the clear zone must be frangible or protected.

Below 70 km/h there is no requirement to protect non-frangible signs, but the supports should be located as far from the road edge as practicable. Where a barrier is possible this should be considered especially when pedestrians and cyclists are using roadway or footpath.

Refer to Section 4: Road Safety Requirements. This section covers space requirements for barrier protection, and also the conditions where a frangible support may be used.

3.1.12. Width and Boundary of Road Reserve

Having established the space requirements for the VMS and any barrier protection, it is essential to identify the position of the legal boundary in relation to the boundary fence or other indication of the edge of the road reserve. The position of the boundary fence and the legal boundary of the road reserve may not coincide. It may be sufficient to overlay boundary plans on an aerial photo, or a survey may be required to establish the legal boundary.

3.1.13. Site Access

The site must allow reasonable vehicle access for erection, and for reactive and routine maintenance. The design should allow:

- Safe access to the sign for maintenance vehicles
- Minimise the exposure to hazards posed between maintenance vehicles and personnel, and traffic in the live lane(s)
- Facilitate effective traffic control for any maintenance work above the carriageway

3.1.14. Access to Mains Power

Assuming the VMS will be mains powered, it is necessary to estimate the cost of supplying power to the site. If there is not an existing power supply nearby, or if a line must be run over private property, the cost and delay factors can be significant.

If the power supply must come from the other side of the roadway, trenching across the State Highway is not acceptable, an aerial cable may also not be acceptable, and thrust boring may be the only option.

3.1.15. Communications Coverage

The communication options to the signs must be decided in conjunction with NZTA National Office Network Operations – Customer Information Services Manager. Refer to Section 7: *Communications*.

Depending on the communication options being considered, it may be necessary to establish the location of the nearest suitable hardwiring, or the strength of the cellular coverage at the proposed sites.

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

3.1.16. Extreme Weather or Other Environmental Conditions

Avoid sites 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 VMS. Consideration must be given to extreme or unusual conditions at each site that will require upgrading of part of the design. Extreme winds that are more likely >500m altitude, on a ridge or cutting, or in a lee effect multiplier zone, affecting foundations and structural support design; and corrosive environments requiring enhanced coating systems are obvious examples. Other less obvious examples are the need to protect exposed equipment in alpine locations from wildlife.

3.1.17. Foundation Conditions

The foundations for large Motorway, single pole, cantilevered, and other VMS structures outside the standard Rural type designs; require a detailed geotechnical assessment of the ground conditions, the specifics of which are not covered in these

Notes. However copies of VMS as-builts used as part of Auckland and Wellington projects are available from respective offices.

The Regional VMS two-post support structure standard designs, and the single post centre mounted support structure standard designs, include foundation designs for a specified envelope of wind and ground conditions. To reduce the risk to NZTA from the contractor encountering unforeseen ground conditions, the designer shall carry out appropriate investigations before a site is recommended. Refer to Section 8.4.4: *Foundation Design* and Section 8.3.1: *Foundation Conditions for Regional VMS*. The results of these investigations shall be used to determine whether the standard designs may be adopted. If ground conditions are poorer than the specified criteria at any site, then either an alternative foundation design must be provided in the tender, or sufficient information must be included to enable tenderers to submit foundation designs for approval.

3.1.18. Safety Issues - Above & Below Ground Services

The top of the sign shall not be located any closer than 2 metres to overhead low voltage power lines, and not closer than 4.5 metres for high voltage lines. However some power companies may require slightly greater separation distances.

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

Note - A check must also be made for the presence of underground services before digging, or testing with a scala penetrometer.

3.1.19. Environmental Impact and Public Consultation

Potential costs and delays arising from environmental planning and consent requirements must be considered when assessing a site, as a large VMS and its support structure may be visually intrusive on the surrounding area.

As a minimum requirement there is a need to consider the need to consult with nearby residents particularly those within the LED illumination cone, as the light emitted at night may create adverse effects.

Professional judgment 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 outcomes of these considerations, alternative sites may need to be considered.

Refer to Section 5.2: *Environmental Planning*.

4. Road Safety Requirements

4.1. Overview

4.1.1. Motorway

In the Motorway context, gantry support structures will normally require barrier protection.

4.1.2. HVU & Rural

In the HVU and Rural context, support structures should be sited outside the clear zone where practicable. Consideration should be given to natural protection afforded by positioning signs on top of cuttings or beyond culverts, providing the other site selection requirements can be met.

For speed environments at or above 70 km/h, structures in the clear zone must be either frangible, or protected to NCHRP 350 Test Level 3.

Where a barrier is being considered the needs of pedestrians and cyclists need to be taken into account.

For speeds below 70 km/h structures in the clear zone where practicable, shall meet NCHRP 350 Test Level 2 impact performance. The supports should be located as far from the road edge as practicable.

4.2. Barrier Protection

Where barriers must be installed to protect a sign, NZTA (Utility Structures in SH Corridors 22 December 2005) has proposed the following minimum distances:

Table 3: Typical Barrier Offset

Typical Barrier Offset From Edge line	
Design Speed (km/h)	Offset (m)
80	2.0
90	2.2
100	2.4

A further minimum distance of 1.0 metre should be allowed between the VMS support structure and the barrier.

Where safety barriers or guardrails are provided to protect the VMS support structure and any associated equipment, the design shall comply with the NZTA Geometric Design Manual (or its successor) and NZTA M23 (Specification for Road Safety Barrier Systems).

5. Urban Design, Environmental Planning, Site Services, & Land Issues

5.1. *Urban Design Requirements*

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

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

Whilst the design of the VMS 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 signs purpose or road users safety.

Key strategies and actions for VMS include:

- Design VMS as a vital element of the visual experience of the road and a possible means of reducing the number of signs.
- Ensure coordination and possible co-location of VMS with other roadscape elements.
- Ensure that the local character of an area is not adversely impacted by unnecessarily large and poorly located VMS.
- Design support structures and related signage hardware to be integrated with other elements such as lighting, bridge and guard rails, emergency phones, advertising etc.
- Where VMS 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”.
- Explore ways to improve the appearance of the rear of the VMS.

5.2. *Environmental Planning*

5.2.1. Outline Plan

Where VMS are to be located within the boundary of a road designation, the territorial authority (City or District Council) may 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.

Where a road designation is in place, resource consent will not be required to install a VMS. Works in accordance with the designation will override the District Plan rules. An exception to this would be if there were conditions on the roading designation relevant to the VMS such as sign height, sign area, letter size, or illumination. If a VMS exceeded the relevant conditions, resource consent would be required (refer to sections 5.2.2 and 5.2.3 below). However, conditions on roading designations relating to signage are uncommon and many District Plans provide for traffic management signs on roads as permitted activities. A check should be made as to whether the sign would be a permitted activity.

Section 176A of the Resource Management Act (RMA) requires an Outline Plan for works that are on designated land and are in accordance with the designation, to be submitted to the territorial authority. Section 176A (3) of the RMA states:

“An outline plan must show—

- (a) The height, shape, and bulk of the public work, project, or work; and
- (b) The location on the site of the public work, project, or work; and
- (c) The likely finished contour of the site; and
- (d) The vehicular access, circulation, and the provision for parking; and
- (e) The landscaping proposed; and
- (f) Any other matters to avoid, remedy or mitigate any adverse effects on the environment.”

An Outline Plan for VMS need only include the information listed above, which is relevant to the particular proposal.

Territorial authorities do not have the discretion to approve or decline an Outline Plan. Their sole discretion is to request changes to an Outline Plan prior to commencement of the work. The authority responsible for the road designation i.e. NZTA, may then accept or reject the recommendation of the territorial authority in full or in part.

In the early discussion with the territorial authority it would be appropriate to enquire whether they require an Outline Plan of works. Section 176A (2) of the RMA lists the following exceptions to the general rule:

“An outline plan need not be submitted to the territorial authority if—

- (a) The proposed public work, project, or work has been otherwise approved under this Act; or
- (b) The details of the public work, project, or work [referred to in Section 176A (3)] are incorporated into the designation; or
- (c) The territorial authority waives the requirement for an outline plan.”

In the past a number of territorial authorities have, upon enquiry from the roading authority or its agent, not required an Outline Plan of works given the minor nature of the VMS.

5.2.2. Resource Consents

Where VMS are to be located outside the boundary of a road designation, a land use consent may be required from the territorial authority. An assessment under the relevant rules of the District Plan will be necessary to determine whether the VMS needs a resource consent.

5.2.3. Assessments of Environmental Effects

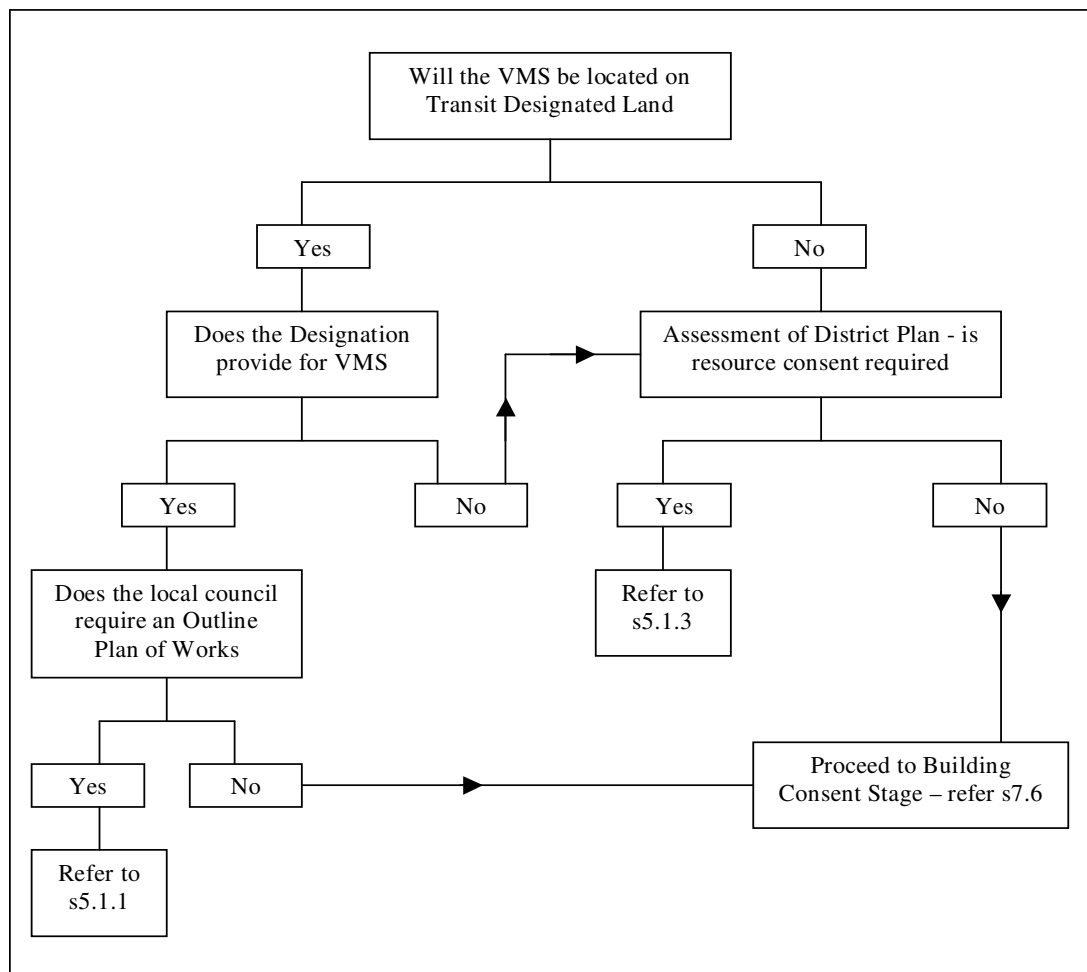
Where NZTA is required to apply for a resource consent to locate a VMS, an assessment of environmental effects must be undertaken. This would require a more extensive and detailed assessment than for an Outline Plan.

The actual or potential effects being assessed will need to be tailored to the circumstances of the particular VMS proposed. In most situations, the main effects

that will be considered are visual and traffic safety effects. The visual effects could include matters such as sign height, size, location or amenity. The traffic safety effects could include the benefits to traffic safety as a result of the sign or any potential driver distraction considerations. Site, location and sign design plans and information on how the sign will be operated and serviced should be included with the application. It would also be helpful to include visual imagery that demonstrates the appearance of the sign and the highly directional nature and narrow illumination cone of the LED.

Where a VMS requires a resource consent, written approval to the proposal from the affected party i.e. the land owner concerned, will be necessary. It is important to note that written approval to the VMS cannot be subject to conditions. The affected party either approves or does not approve the VMS. If the affected party has particular conditions they would like addressed, these should be incorporated into the proposal or through private contract with NZTA. If the resource consent application requires amendment due to the affected party's concerns then the application should note that the proposal has been amended to address the concerns of the affected party and that the affected party has provided written approval to the amended proposal.

Figure 2: Land Use Planning Diagram



5.3. Arranging Power Supply and Network Connection

5.3.1. Mains Power

For all permanent VMS, mains supply shall be single phase, 240v ($\pm 5\%$), 15 ampere, 50 Hz AC. The system shall be capable of being isolated from mains supply at ground level. The modules and associated driver network and the control and communications equipment shall operate at Extra Low Voltage (ELV).

All electrical work shall comply with the requirements of the New Zealand Electricity Regulations and AS/NZS 3000: Wiring Rules.

5.3.2. Network Connection and Supplier Agreement

The connection of the mains power supply needs to be made by the Network Company and a supply agreement and metering established with an appropriate electricity retailer. The process for establishing the connection and supply agreement is generically covered as follows:

When final site selection has been decided, consideration should be given to tasking a power contractor with arranging power supply to the sites. Initiating this work at the earliest possible stage avoids potential delays to the project. Refer to <http://www.electricity.org.nz> for a list of network companies and their area of operation.

The cabling contractor should normally be instructed to leave a minimum 10 metres of cable lightly buried in the ground at the boundary side leg position, unless the pad and conduits are already installed, in which case 2 metres of cable lightly buried beside the pad under the conduit opening will suffice.

Establish through the local NZTA regional office or the network consultant as necessary, what electricity retailers operate in the area and what electricity supply agreements NZTA already has in place for street lighting, traffic count stations or existing signage installed). Determine the existing account details and the account manager, as these can be used to simplify the process with discussions being held to determine requirements before any formal paper work is submitted.

- Complete application for the supply of electricity / network connection and submit to the chosen retailer (or delegate to the installation contractor). Include details of existing connections and account details as appropriate so that accounts are addressed correctly.
- Provide details of the estimated load for sign so that the electricity usage is calculated correctly for the monthly invoicing.
- The electricity retailer should then authorize / instruct the network company to establish an ICP number. Once the installation has been inspected a revenue meter will be installed by the electricity retailer (or their agent) and the connection certified for livening.
- Confirm the retailer's requirements for metering. Given the low power usage, preference is given to an annual meter reading. Note the meter is usually located within a roadside cabinet and can be read through a polycarbonate window in the door of the cabinet.

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

5.4. *Communication Services*

The VMS communication connection may be effected through a number of options. Refer to Section 7. *Communications*.

5.5. *Land Issues*

There are normally distinct advantages in having:

- The VMS site, and
- the line of clear sight to the VMS sign 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 land owner negotiations, compensation, legal issues, and potential delays.

This section is intended to flag the importance of ensuring any agreements with land owners 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 land owners, which may be required if encroachment occurs. For specialist advice NZTA's Property Consultant should be approached.

6. Choosing the Appropriate Character Height

6.1. Considerations for Regional VMS

For Regional VMS, once the number of lines has been determined the appropriate character height must be considered. The minimum character height is determined by visibility and the ability of the motorist to read and comprehend the message. This is a function of;

- Total message size
- Local speed environment
- Lateral position of the VMS

Drivers approaching the sign at the maximum appropriate / legal approach speed should be able to read the message(s) for at least 7 seconds for two line signs, and at least 11 seconds for four line signs.

Variations on VMS readability, distance and character height are acceptable to NZTA as long as they do not compromise safety. Variations shall not be in conflict with NZTA signage requirements or standards. Queries should be directed to the NZTA National Office Network Operations CIS Manager.

6.2. Character Height for Regional VMS

The table below summarises the recommended minimum character height for HVU and Rural environments for a range of speed environments, and single or dual lane roadways.

Table 4: VMS Minimum Character Heights

Speed Environment HVU & Rural	Minimum Character Height (mm)			
	Single Lane in Direction of Travel		Double Lane in Direction of Travel	
	2 Line VMS	4 Line VMS	2 Line VMS	4 Line VMS
Up to 50 km/hr	150	200	200	200
51-70 km/hr	200	200*	200	300
71-100 km/hr	200*	300	300	300

* In HVU environments with a single lane in direction of travel, where the AADT exceeds 20,000 vehicles per day; or 15,000 vehicles per day with pronounced peak flows; the designer should use 300mm character height for 4 line signs in 51–70 kph zones, and for 2 line signs in 71–100kph zones. Upgrading to a bigger font is strongly advised to improve prominence and readability in high volume traffic.

7. Communications

A communications link is required to connect the VMS to the NZTA national control system. Prior approval from the NZTA Customer Information Services Manager is required before any exception is made to this requirement.

In urban locations, there are a range of landline options that can be utilised including;

- Use of any existing NZTA communications network
- Leased lines from Telecom NZ or other providers (ADSL)

For Regional VMS sites options include;

- Telecom copper line connecting to ADSL (broadband) - preferred option
- Cellular. NZTA has national communication agreements in place with Telecom

Other technologies may be considered subject to specific approval from NZTA National Office Network Operations – Customer Information Services Manager.

- Wireless
- Satellite

Depending on the communication system selected, there may be a need to arrange cabling / trenching to the site. As with the power requirements, consideration should be given to tasking a Teleco contractor with arranging cabling to the site. With Regional VMS this is normally arranged by NZTA National Office.

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

Where the VMS is connected to mains power and a copper communication cable, there must be appropriate separation. Where power and communication cable is laid in the same trench for up to 200m, separation of >200mm is required.

8. Civil Design Requirements

8.1. Support Structure Options

This document provides guidance for the civil design of various types of VMS support structures:

- Gantry
- Single post mounted, including cantilever
- Dual post mounted

Figure 3: Typical Mounting Options for ATMS Motorway VMS

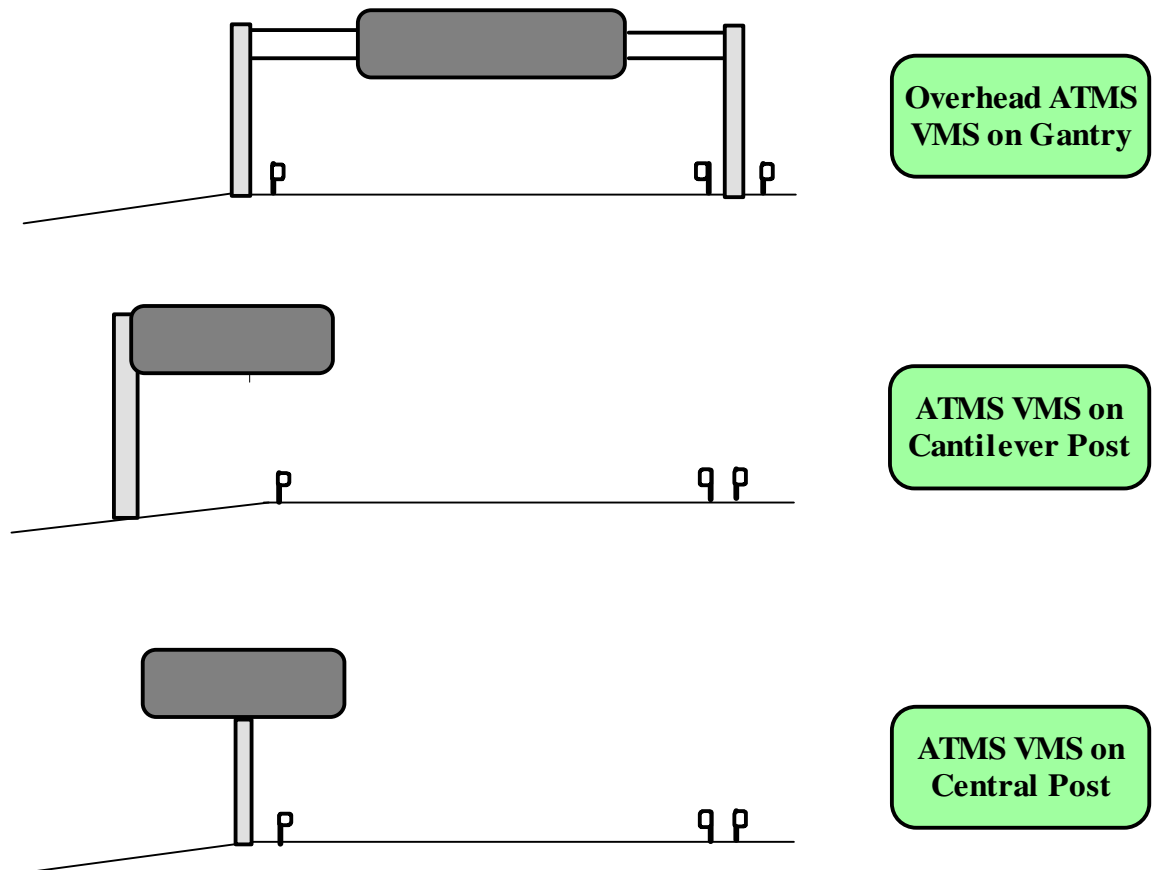
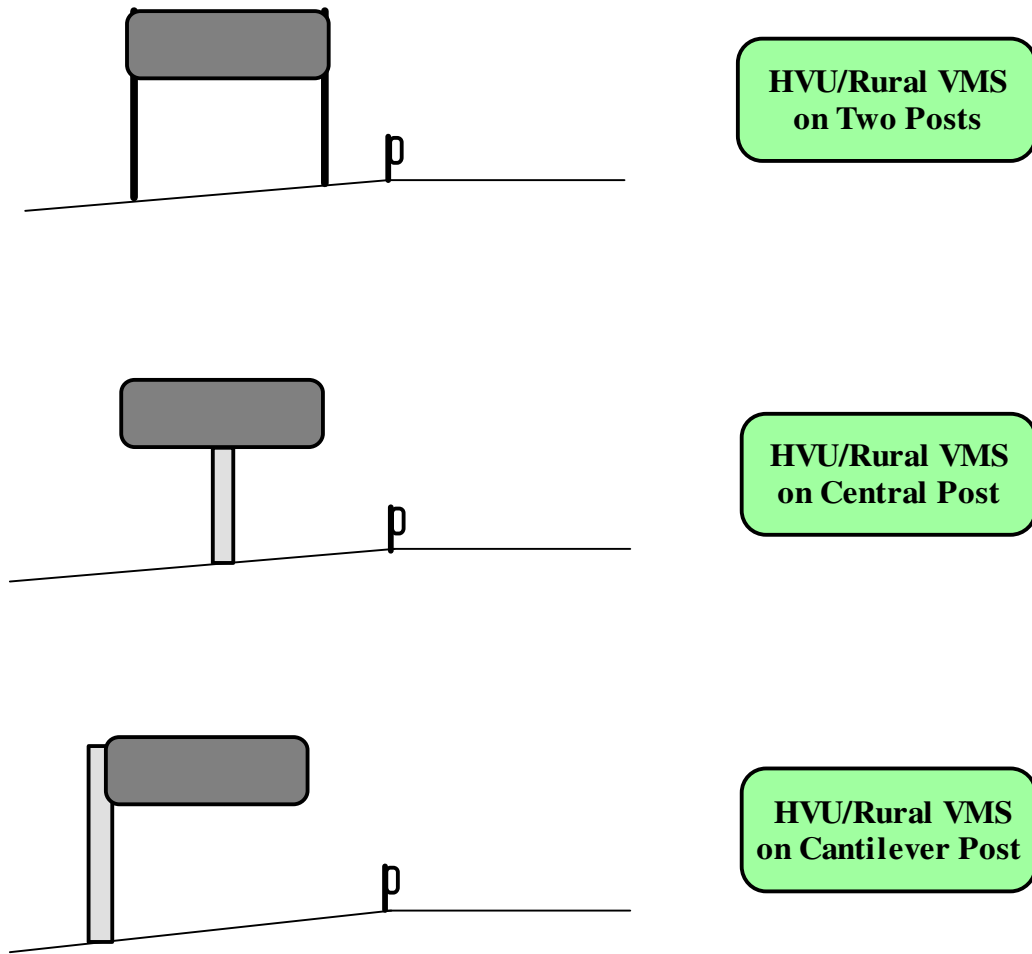


Figure 4: Typical Mounting Options for HVU and Rural VMS



8.2. Prescribed Design Routes

There are two prescribed design routes for VMS support structures.

A. Standard Solutions for Regional VMS

Standard solutions are generic standardised designs for Regional VMS, where neither the sign support system nor the foundation requires further specific engineering design. Standard solutions are provided for:

- Two post support structures for Sign Types A, B, C, D & F
- Single post, centre mounted support structures for Sign Types A, B, C, D & F. These standard solutions do allow for offsets of the supporting pole from the centre of the sign to suit the particular site circumstances, up to the dimension limits given on the drawings.
- Single post rotating flange support structures for Sign Types C, D & F. These standard solutions are for constrained sites. The VMS can be rotated on the support structure to provide access for planned and reactive servicing.

Standard support structure designs are available through the NZTA National Office Network Operations – Customer Information Services Manager. The drawings contain standard foundations designs for specified ranges of geotechnical conditions. These standard support structures and foundation designs should be used where the site and ground conditions meet the standard design criteria.

B. Specific Engineering Design

Signs are subject to specific engineering design. Specific design is required in the following situations:

- Gantry signs
- Cantilever signs
- Single post centre mounted signs not meeting the requirements for use of a Standard Solution
- Dual post mounted signs not meeting the requirements for use of a Standard Solution

8.3. Standard Solutions for Regional VMS

Where the proposed sign and foundation soil conditions meet the standard design criteria, a “Standard Solution” sign support structure and foundation detail can be used for Regional VMS. Construction drawings for Rural/HVU VMS support structure Standard Solutions are available from the NZTA National Office Network Operations CIS Manager.

Where the following requirements are met a Standard Solution VMS support structure may be used and no specific engineering design is required.

8.3.1. Foundation Conditions for Regional VMS

Before adopting a standard solution, site investigations shall be completed to confirm that the foundation soil meets the following minimum soil property requirements:

- For non-cohesive soils (sands/gravels) angle of internal friction (Φ) ≥ 25 degrees, and soil unit weight of 16 kN/cubic metre, for the dual post mounted signs
- For non-cohesive soils (sands/gravels) angle of internal friction (Φ) ≥ 33 degrees, and soil unit weight of 18 kN/cubic metre, for the single post centre mounted signs
- For cohesive soils (clay) a Cohesion (c) value of at least 50kPa
- The ground water level must be at or below the base of the footing

8.3.2. Face Area of VMS Sign Panel

The standard solutions may only be used for signs that conform to the range of dimensions shown on the drawings. Note that the face panel dimensions **must include the bezel**, as the wind loading calculations are based on the total face area.

8.3.3. Sign Mounting Height

The mounting height of standard solution signs, measured from ground level to the bottom edge of the enclosure, on flat ground shall be 3.0 metres. This is to ensure:

- Safety requirements are met when servicing from a ladder
- Vandalism is minimised
- Design wind loading requirements can be met

8.3.4. Site Design Wind Speed

Site design wind speed for standard solution signs, determined in accordance with AS/NZS1170.2, shall not exceed 49 metres per second.

8.3.5. Structure Importance Level (AS/NZS 1170.0)

The standard solution sign “structure importance level” (refer to AS/NZS 1170) shall be:

- Category 3 for signs greater than 12 square metres (Regional VMS are usually smaller than this, but become Category 3 if they are located over the carriageway)
- Category 2 for signs between 4.7 and 12 square metres
- Category 1 for signs less than 4.7 square metres

For design loadings and other details relating to structure importance, refer to Table 5 of these Notes.

8.3.6. “Frangible” Structures

Frangible structures must have an impact performance that meets NCHRP 350, or is deemed by NZTA’s Traffic and Safety Manager to meet the standard.

The following requirements shall also apply:

- The maximum weight of the above ground support structure and sign is 270kg.
- The post mass must be no more than 27kg per metre.
- Each leg of the structure must incorporate an approved slip base <100mm above ground level.
- Where an impact is likely to come from multiple directions, a multi directional slip base is required.
- The underside of the sign enclosure must be 3.0 metres above ground on a flat site. (The standard design for sloped ground specifies 3.0 metres for the downhill end, and allows the uphill end to be >2.5 metres)
- The roadside post shall incorporate an approved hinge located immediately below the sign enclosure. (Refer to the comment below concerning NZTA P24).
- The power cable shall allow the slip base to function as intended in an impact.
- When a roadside cabinet is mounted behind a post, its position must allow a clear space of at least 3 times the width of any slipbase for the slipbase to activate in an impact. The width of the slipbase is measured in the plane parallel to the road.

Refer to the standard frangible design for a two line, 200mm high character sign, (Type D) supported on two posts that may be used for situations within the design criteria.

The following risk based principles have been applied to the two post Standard Design solution for Sign Type D:

- The roadside leg is significantly more vulnerable to collision than the boundary leg.
- If the boundary leg is located at the edge of the road reserve it has a significantly lower risk from collision.
- Because the two legs are approximately 3 metres apart, it is unlikely both will be hit simultaneously.
- Both legs require slipbases
- The roadside leg also requires a hinge.
- Due to the limitations of hinge performance, in a collision the enclosure must be supported on the remaining boundary leg post.

In some specific situations, NZTA may deem the risk of injury to pedestrians and cyclists from breakaway signposts exceeds the risk to the vehicle occupants. In that case certain requirements of this section may be waived.

8.4. Specific Engineering Design

8.4.1. General

Specific engineering design is required for the following situations:

- Gantry signs
- Cantilever signs
- Single post centre mounted signs not meeting the requirements for use of a Standard Solution

- Dual post mounted signs not meeting the requirements for use of a Standard Solution

Where specific engineering design is required, the design engineer must seek approval of the final sign support design from the NZTA Regional Office. The following information must be submitted for this approval:

- Producer Statement Design, in accordance with the requirements of the New Zealand Building Code.
- Construction drawings
- Construction specification
- Design Calculations

8.4.2. Access Ladder and Platform for Motorway VMS

For Motorway VMS applications, the design of the support structure shall include an external access ladder and platform over the full width of the enclosure. The truss structure shall be 2m high to provide safe head room. An integral ladder hoop is to be provided to the top of the truss. The walkway floor shall consist of checkerboard and be free of trip hazards. The walkway shall include a kickboard and a minimum of two rails on each side. A suitable mesh shall be included on each side to prevent tools and small parts from dropping through to the ground below. The design shall ensure that the enclosure doors are not obstructed by any section of the platform or fittings and are capable of being fully opened. The access ladder shall be capable of being securely locked and the ladder cage shall include measures to prevent trespassers climbing up the external face.

Motorway VMS suppliers may offer enclosures with side entry doors which fully enclose the hardware and any maintenance staff. This has the advantage of allowing maintenance in all weather conditions and fully mitigating any risk of dropped items. For this design, the support structure will only require the access ladder and cage and possibly a small platform.

8.4.3. Applicable Design Standards

Design of VMS signs and support structures shall be in accordance with the following standards:

- AS 1111: ISO metric hexagon bolts and screws
- AS 1163: Structural steel hollow sections
- AS/NZS 1170: Structural design actions
- AS/NZS 1252: High strength steel bolts with associated nuts and washers for structural engineering
- AS/NZS 1554: Structural steel welding
- AS/NZS 1664: Aluminium structures
- AS/NZS 1866: Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes

- AS/NZS 2312: Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
- AS/NZS 3678: Structural steel- hot rolled plates, floor plates and slabs
- AS/NZS 4506: Metal finishing – Thermoset powder coatings
- AS/NZS 4671: Steel reinforcing materials
- NZS 3104: Specification for Concrete Production
- NZS 3124: Specification for concrete construction for minor works
- NZS 3404: Steel Structures Standard
- NZS 4680: Hot-dip galvanised coatings (zinc) on fabricated ferrous articles

8.4.4. Foundation Design

For the purpose of determining soil foundation capacity, a strength reduction factor (Φ) shall be applied to calculated ideal ultimate soil foundation capacities as follows:

- For signs greater than 12 m² face panel area, or designated as structure importance level 3, a specific engineering assessment of the soil strength reduction factor (Φ) is required
- For signs of up to 12 m² face panel area, that are designated as structure importance category 2: $\Phi = 0.45$
- For signs of up to 4.7m² face panel area, that are designated as structure importance category 1: $\Phi = 0.6$

8.4.5. Design Loadings

Derivation of design wind and earthquake loading is to be based on the following table:

Table 5: Design Loadings

Sign Description	Structure Importance Level (AS/NZS1170)	Design Wind Event Return Period (yrs)	Design Earthquake Return Period Event	Design Life (yrs)
High Value Sign – Sign face area ≥ 12 m ² or located over carriageway. (Includes gantry and cantilevered signs).	3	1000	1000	50
Normal Sign – Sign face area between 4.7m ² and 12 m ² and sign not over carriageway.	2	500	500	50
Minor Sign – Low traffic volume rural road, sign face area < 4.7 m ² , and sign not over carriageway.	1	250	100	25

Note: Earthquake capacity need only be checked where the total sign and support structure mass above ground level exceeds 500kg.

8.4.6. Design Wind Speed

The design wind speed shall be derived in accordance with AS/NZS 1170.2: 2002, with the following specific requirements:

- a. The design wind speed shall be taken as non-directional
- b. The Terrain Category of a particular site shall be taken as either 2 (Exposed Rural Terrain) or 1 (Exposed Open Terrain). The value of the Terrain Height Multiplier ($M_{z, \text{cat}}$) used must not be not less than that given in Table 4.1 of AS/NZS 1170 for Terrain category 2.

8.4.7. Structure Serviceability Requirements

Under serviceability limit state wind loadings, the top of the sign shall not deflect more than $0.05h$ where h is the height from ground level to the top of the face panel.

8.4.8. Low Temperature Performance

Except as noted below, structural steel components in signs located in areas where the LODMAT (Lowest Observed Daily Mean Air Temperature) temperature is below 0° Celsius, as detailed in Figure 2.6.3.1 of NZS 3404: 1997, shall satisfy the low temperature performance requirements detailed in Section 2.6 of NZS 3404: 1997.

Note: UB and RHS sections that have no welded or bolted connections at their junction with the foundation(s), meet low temperature requirements.

8.4.9. Durability Requirements

All components of the sign support structure and foundations are to be constructed such that a period of at least 25 years to first maintenance can be achieved in the specific site environment. For steel components this will normally require galvanising.

The designer must consider:

- Surface corrosion protection zone (Refer AS/NZS 2312 or AS/NZS4506)
- Whether the post needs to be painted and if so any finished colour requirements

8.5. Building Consent Requirements

As part of implementation of each VMS sign, whether or not a standard solution is adopted, application shall be made to the Territorial Local Authority for exemption from requiring Building Consent.

If the Territorial Local Authority advises that Building Consent is required, this shall be obtained prior to construction commencing.

9. Support Structure Construction

9.1. Site Set Out

Before construction commences the contractor will satisfy the NZTA representative that the foundation construction methodology will achieve optimal alignment of the LED viewing angle for approaching motorists.

Horizontal alignment of the VMS shall be achieved by correct alignment of the gantry span for gantry mounted Motorway VMS, or support posts for Regional VMS.

9.1.1. Motorway VMS

The optical axis of Motorway VMS shall be aligned 5 degrees below the line of sight from the VMS to the driver's eye height at the maximum reading distance (350-400m).

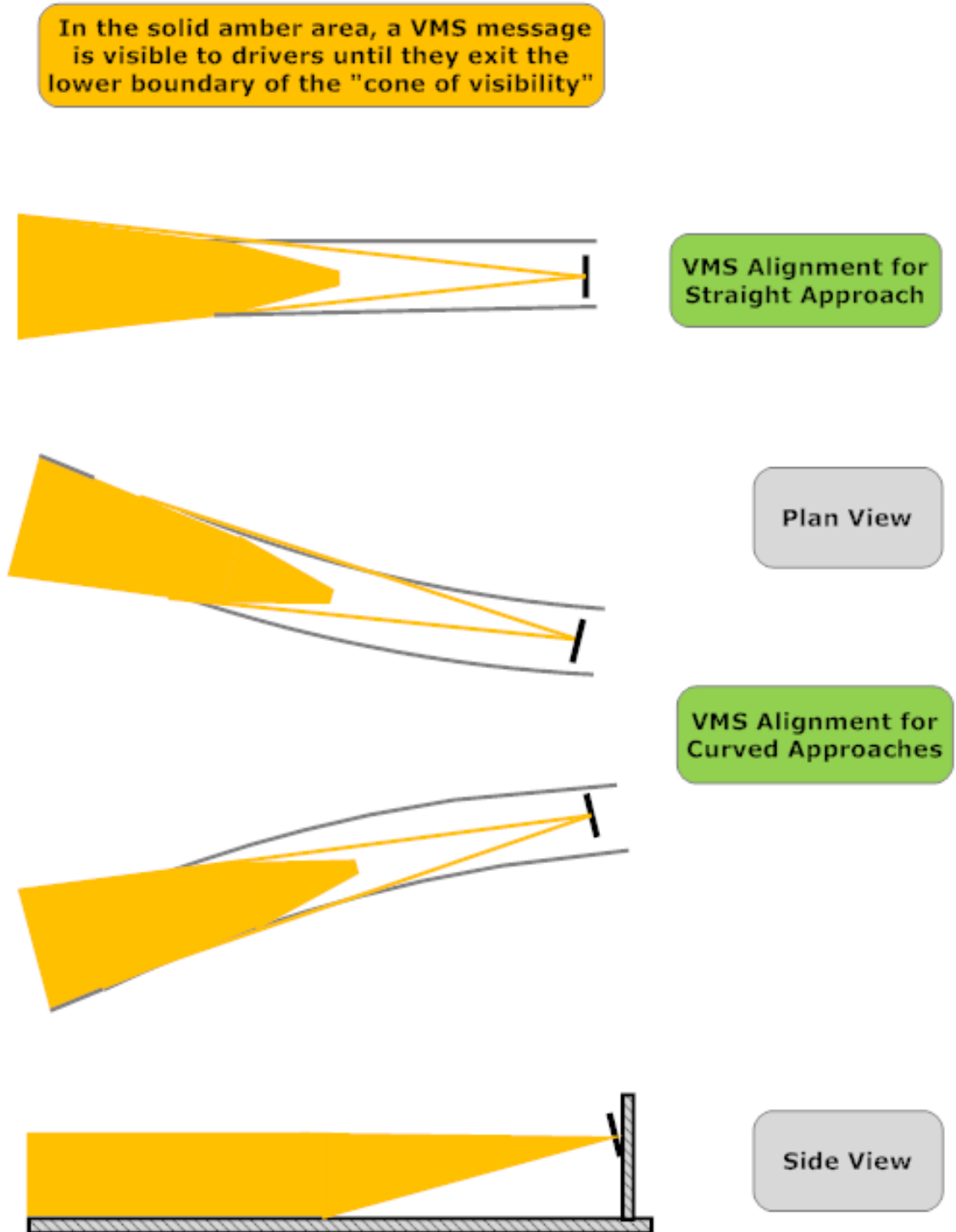
The vertical alignment can be achieved in most situations by using an enclosure having a front face angled down 5 degrees or having a mounting arrangement with the capability for at least 5 degrees adjustment downwards from horizontal. The vertical alignment for gantry mounted VMS can be achieved by setting the offsets to the top and bottom mountings to align the front face of the sign at the correct vertical angle for the road vertical alignment.

The horizontal alignments for straight and curved approaches are illustrated below.

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

- At the *maximum reading distance* the *inside edge* of the curve is within the cone of visibility, and
- Approaching the VMS, the *outside edge* of the curve remains within the cone of visibility for as long as possible

Figure 5: Optimum Alignment for a Motorway VMS on an Overhead Gantry

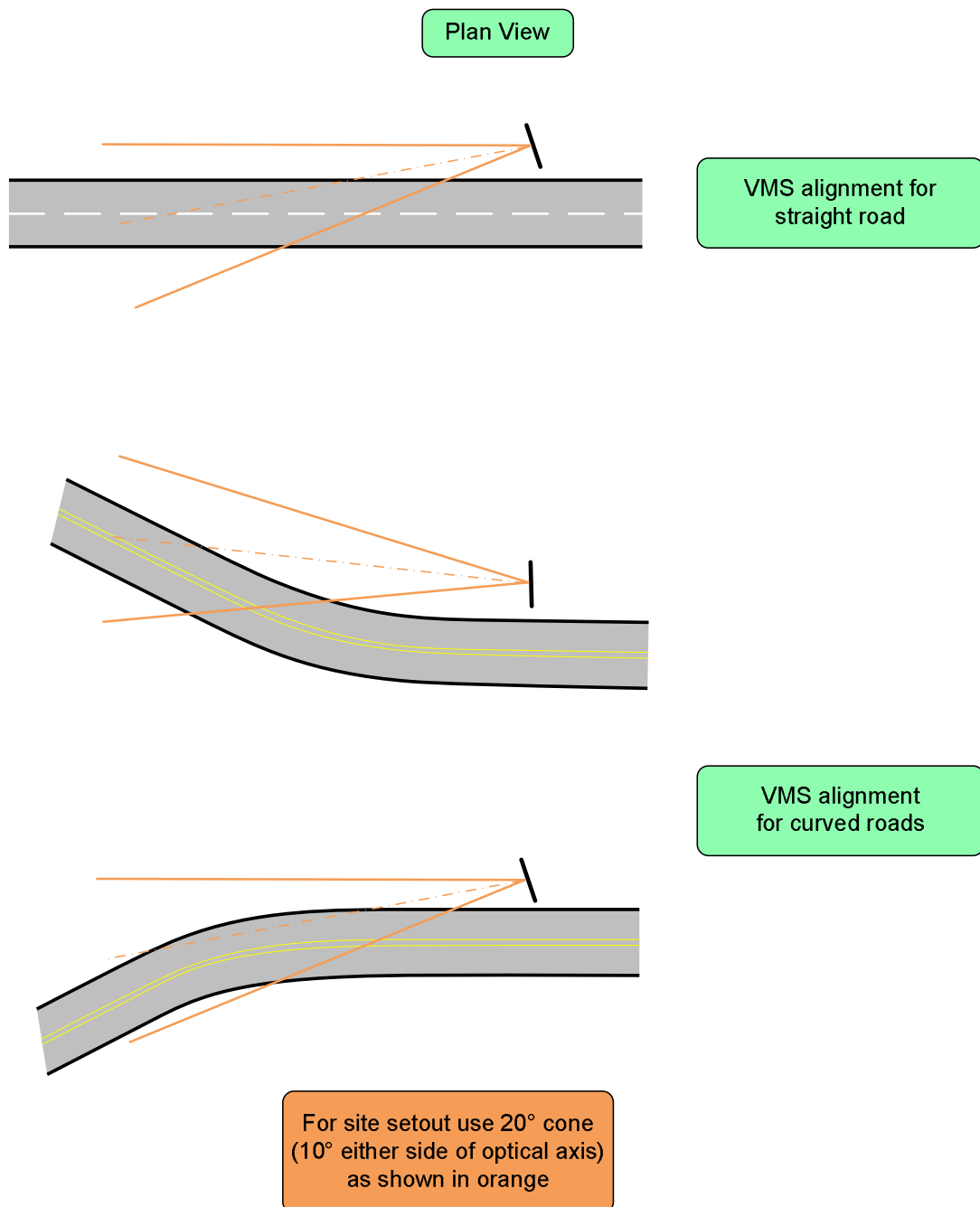


9.1.2. Regional VMS

Regional VMS are normally mounted on the side of the roadway on the left hand side of approaching traffic, For a straight approach, the offside edge of the cone of visibility should be aligned down the road reserve parallel with the road.

For VMS mounted some distance beyond a left or right hand curve, alignment should maximise the time that travellers remain within the cone of visibility as illustrated below.

Figure 6: Optimum Alignment for a Regional VMS on a Roadside Support Structure



9.2. Unforeseen Foundation Conditions for Regional VMS

The Contractor is to be familiar with the foundation soil properties assumed in design of each sign, as detailed in the contract documents and these Notes.

If the foundation soil properties encountered during construction differ from those assumed in design, the Contractor is to immediately cease work at the site and bring this to the attention of the NZTA representative, who will assess the unforeseen conditions and advise how construction is to proceed.

In practice, for scala penetrometer testing (where this is appropriate for the soil type), the foundation soil is considered adequate if at least three blows are required to advance 100 mm depth, to a minimum depth of one metre below ground level.

In addition to the minimum bearing strength requirement, the foundation soil must fulfil the following requirements:

- Ground water table is below the proposed foundation depth (unless specifically allowed)
- Topsoil, very soft or very loose surface sediments shall not be included in the embedment depth given above. In no case should this be greater than a depth of 200mm
- No peat is present
- No soft clay is present
- There is no loose fill present

9.3. Construction Verification

At completion of the works, the contractor shall supply a Producer Statement – Construction covering the construction of all support structures.

The NZTA representative shall verify the adequacy and accuracy of the civil works by undertaking a Civil site Acceptance Test (Civil SAT) using the relevant current check sheet. An *example* for Regional VMS can be viewed in Appendix 2.

9.4. Traffic Management

Temporary Traffic Management (TTM) for the site activities shall conform to the NZTA Code of Practice for Temporary Traffic Management (COPTTM).

10. Post Commissioning Documentation

10.1. As Built Drawings

As built drawings shall be supplied by sign vendors and contractors and will include:

- Support structures
- Installation elevations/plans
- Cabinet drawings
- Power supply arrangements

10.2. Operating Servicing and Maintenance Manuals

The Contractor shall supply an Operating Servicing and Maintenance Manual for all equipment supplied. This shall be carefully laid out with detailed operating procedures for the equipment and systems, including all software supplied. It shall be written in a format that is easily understood by the intended VMS operators.

The manual shall document in detail the maintenance and service aspects of the equipment on an item-by-item basis. This shall include:

- List of Equipment including Part Numbers and availability;
- Routine Service/Maintenance Procedures;
- Troubleshooting Guide;
- Details of fault diagnostic features from the control centre;
- Other fault diagnostic procedures to be followed;
- Testing Procedures;
- Software Maintenance Procedures;
- Circuit Diagrams.

11. VMS Structures Inspection and Maintenance

11.1. Inspection

Inspection of VMS structures shall be undertaken in accordance with NZTA policies, specifications and guidelines. The VMS structures are classified as 'Other Structures'.

The scope of the inspection shall include:

- Damage (accident, or vandalism)
- Condition of the corrosion protection system
- The connection between support structure and cabinet
- Weather tightness and security of cabinet
- Security of power cable and conduit
- Adhesion of the mask to the polycarbonate panel
- Obstruction to the motorist's clear line of sight

11.2. Maintenance

Maintenance shall be undertaken following the identification of defects, in accordance with NZTA requirements. For VMS structures with frangible slipbases, regular maintenance of bolt tightness is required.

Appendix 1. Site Assessment Proforma for Regional VMS



Assessment of Potential VMS Sites For SH ...

Date:

General Location / Sign Type / Support Type

Dist Roadside Leg from WEL Other Key Site Dimensions			
Traffic Direction		AADT:	
NZTA Location			
GPS Coordinates			
If Near Major Intersection, Distance Up/Down Stream			
Geometry. Other signage. Pull over/turn around access			Low vol roads - Room for light vehicles / trucks to turn around?
Speed Limit			
Description if close to change in speed limit			
Clear Sight Distance			200mm: 250m at 100kph
Access to Power			
Will O/H Lines Need to be Moved During Sign Erection			
Cell Signal Strength: Telecom:		Vodafone:	Note signal strength on cell phone display
Width Boundary to Road Edge			
Access for Erection & Servicing			Can contractor get access to erect and service VMS
Existing Sign: Width			
Distance from Road Edge			
Angle of Approach:			
Compass Bearing			Glare: sun in front/behind
Vertical Plane			Flat, up/down hill
Effect of LED Light Cone On Neighbours. Need to Consult?			
If lightning prone do higher ground/trees protect?			See Thunder Day Map
(Check proness to flooding. (Specify traffic signal type cabinet on pad > 2m behind legs? Special foundation or wind conditions. Need for barrier protection etc			Check wind > 500m elevation, lee multiplier, & near ridges / cuttings
Site Suitable or Drawbacks of Site			<div style="display: flex; justify-content: space-around; font-size: small;"> Sketch Site Plan Sketch Over Page </div>

Appendix 2. Site Acceptance Test Proforma (Civil Works)

The Proforma below is an *example* of a SAT Civil Works check list for Regional VMS.



NZ TRANSPORT AGENCY
TE ATIHANGA

Type A Double Post Support Structure

Site Acceptance Tests for VMS Civils

State Highway: Location:

Date of Assessment: Name of Assessor:

Measuring equipment and tools required: Drawings, ladder, tape measure, spirit level, large set square, protractor/means of determining 10⁰ from optical centre, camera (GPS?).

Attribute	Required Standard/Guidance	Record Finding	OK?
1. Horizontal alignment	The post placement must align the right side of the LED cone down the road reserve. Assume the LED cone extends 10 ⁰ each side of the optical centre		
2. Roadside post location	The road-side post must be outside the clear zone or protected. Record the distance from the road-side post to the WEL or guard rail.		
3. Guard rail	If guard rail is required, are works complete?		
4. Post spacing	Distance between inside edges of posts is 4980mm		
5. Posts vertical	Posts must be vertical and straight		
6. Top caps of posts	Post tops must be capped, water tight, attachment eye OK.		
7. Height of post	Posts should be 5300mm above GL		
8. Height of bracket	Brackets should be 3000mm above GL		
9. Brackets level	Bracket to bracket must be level		
10. Post material spec	Visually establish that posts are constructed from steel RHS 200x100x6mm		
11. Surface coating & night time visibility	Check galvanising ok If post must be white for night visibility, is painting complete? (Applies to non-guarded in clear zone)		
12. Services exit hole	Power & comms services exit hole is located under support bracket of off-side post. Centred ~85mm below bracket.		
13. Diameter exit hole	Services exit hole should be 50mm diam.		
14. Weld quality	Record visual assessment of the weld quality		
15. Mowing pad dimensions	The mowing pad should extend approx 0.5m to front, 0.3m to side, & 1.5m behind, the post centres		
16. Mowing & service access pad	<ul style="list-style-type: none"> Acceptable for servicing & affixing roadside cabinet Have a rough broom finish Must not present a hazard to traffic 		
17. Conduits for Road-Side Cabinet	Should have two 40mm diam conduits incoming, and one 50mm diam conduit leading to off-side post. Draw strings present. Conduits free of debris/concrete.		
18 Conduit placement	Cluster should be 850mm behind centre off-side post and 350mm from off-side edge of mowing pad.		
19. Power	Is power reticulated to site?		
20. Telecom	Is Telecom pillar installed at site?		
21. Site made good	Is site restored to acceptable condition?		
22. Fences made good	Have any affected fences been made good?		
23. Site access	Is vehicle access for erection & servicing acceptable? Note any difficult access/soft ground.		
24. Safety issues	Record any site safety issues		
25. Other issues	Record any other issues/site preparation/relocation of other signage.		
26. Jig recovery	Confirm jig has been recovered (to avoid replacement cost).		
27. Photograph site	Take photographs of site to assist VMS installer.		