The Influence of Canadian Practices in Developing New Brunswick's Work Area Traffic Control Manual

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Abstract

In 2008, Opus International Consultants (Canada) Ltd. was retained by the New Brunswick Department of Transportation to develop a new Work Area Traffic Control Manual (WATCM). The WATCM provides a uniform set of traffic control guidelines for all construction, maintenance, and utility work carried out within the right-of-way of any provincial road. One of the Department's main priorities in developing the new manual was to ensure that it incorporated best practices consistent with those applied in other Canadian jurisdictions.

This paper presents some of the significant changes made to the new WATCM as a result of an extensive review of existing practices from across Canada, which include changes to:

- procedures for setting up and removing traffic control devices;
- crashworthiness requirements for traffic control devices;
- work zone components;
- maximum work zone length;
- work zone speed management philosophy;
- adoption of new technology;
- sign and device imagery; and
- typical application layouts.

The supporting rationale behind each change is provided, as well as a comparison with current practices contained in other provincial manuals. In some instances, considerable variations amongst particular practices were found to exist. The paper identifies these as potential opportunities for developing national guidelines to help rationalize practices that vary from province to province.

Introduction

In 2008, Opus International Consultants (Canada) Ltd. was retained by the New Brunswick Department of Transportation to develop a new Work Area Traffic Control Manual (WATCM) (1). The WATCM provides a uniform set of traffic control guidelines for all construction, maintenance, and utility work carried out within the right-of-way of any provincial road. This new manual replaced the previous version, which was originally drafted in 1994.

One of the Department's main priorities in developing the new WATCM was to ensure that it incorporated best practices consistent with those applied in other Canadian jurisdictions. Consequently, Opus obtained and reviewed equivalent work area traffic control manuals from the other nine Canadian provinces and Part D of the Transportation Association of Canada's *Manual of Uniform Traffic Control Devices (MUTCD-C)* (2), which deals with traffic control for "Temporary Conditions". Part 6 of the of US Federal Highway Administration's *Manual on Uniform Traffic Control Devices* (3) was also reviewed.

This paper presents some of the significant changes made to the new WATCM as a result of the best practice review, which include changes to:

- procedures for setting up and removing traffic control devices;
- crashworthiness requirements for traffic control devices;
- work zone components;
- maximum work zone length;
- work zone speed management philosophy;
- adoption of new technology;
- sign and device imagery; and
- typical application layouts.

The supporting rationale behind each change is provided, as well as a comparison with current practices contained in other provincial manuals. In some instances, considerable variations amongst particular practices were found to exist. The paper identifies these as potential opportunities for developing national guidelines to help rationalize practices that vary from province to province.

Inclusion of Setup and Removal Procedures

The biggest perceived "gap" in the previous WATCM was the lack of guidance for the setup and removal of traffic control signs and devices. This is somewhat surprising considering these activities are often more hazardous than completing the actual work, as approaching drivers have no advance working that workers are present ahead. However, in the past it was left to the workers' discretion to determine the most safe and efficient procedure for setting up and removing devices. As a result, a wide range of practices evolved over time that included:

- Unloading signs on the right shoulder of a multilane highway and carrying them across the travelled lanes for installation on the left shoulder;
- Backing up the sign truck against the flow of traffic during sign removal;
- Ensuring that the Construction Ahead sign was the last sign to be removed from the work zone; and
- Laying out delineation devices before all signs are in place.

A review of manuals from other Canadian provinces revealed a significant variation in the amount of guidance provided for the setup and removal of traffic control devices. Some manuals provide little or no guidance, while others contain up to 85 pages of instructions dedicated specifically to this topic. The MUTCD-C provides limited guidance pertaining to the setup and removal of traffic control devices.

The new WATCM contains separate procedures for the setup and removal of 1) traffic control signs on two-way and multilane roads, and 2) lane closures on two-way and multilane roads. Some best practices identified and incorporated in the manual include:

- A dedicated traffic observer is required at all times;
- All signs are to be setup and removed with the flow of traffic;
- Delineation devices are to be setup with the flow of traffic, and removed against the flow of traffic;
- Ensuring that all signs are erected before laying out delineation devices; and
- A truck mounted attenuator is required for setting up lane closures on multilane roads.

Changes to Device Crashworthiness Requirements

The Transportation Research Board's NCHRP Report 350 (4) contains procedures for evaluating the crashworthiness of traffic control devices. The previous WATCM did not require that devices meet minimum crashworthy standards. A review of other provinces' manuals revealed this to be the case is most jurisdictions. Although the MUTCD-C makes reference that specific devices "should easily break away", it does not explicitly state that all devices should meet NCHRP 350 requirements.

It was ultimately decided that the new manual would not require all devices to meet minimum crashworthiness requirements. However, signs shall no longer be mounted in orange steel drums like the one depicted in Figure I, which was an accepted and commonly used practice under the old manual. These devices, which have also been banned in many other jurisdictions, can pose a major hazard if struck by a vehicle.

Figure I: Sign Mounted in Orange Steel Drum

Changes to Work Zone Components

The previous WATCM defined a work zone as consisting of three components: the advance signing area, the approach signing area, and the work site area. This definition was inconsistent with the one contained in the MUTCD-C, which defines a work zone as consisting of an advance warning area, approach area, transition area, buffer area, work area, and termination area.

It was discovered during the jurisdictional review that the MUTCD-C definition of a work area has now been generally adopted by every Canadian province in their respective manuals, with very few subtle variances. As a result, the new WATCM now contains a revised work area definition very similar to that contained in the MUTCD-C (see Figure II). The biggest change from the previous version is the introduction of the buffer area to provide additional recovery space for errant vehicles. Although not previously defined, the transition and termination areas have always been incorporated into New Brunswick work zones.

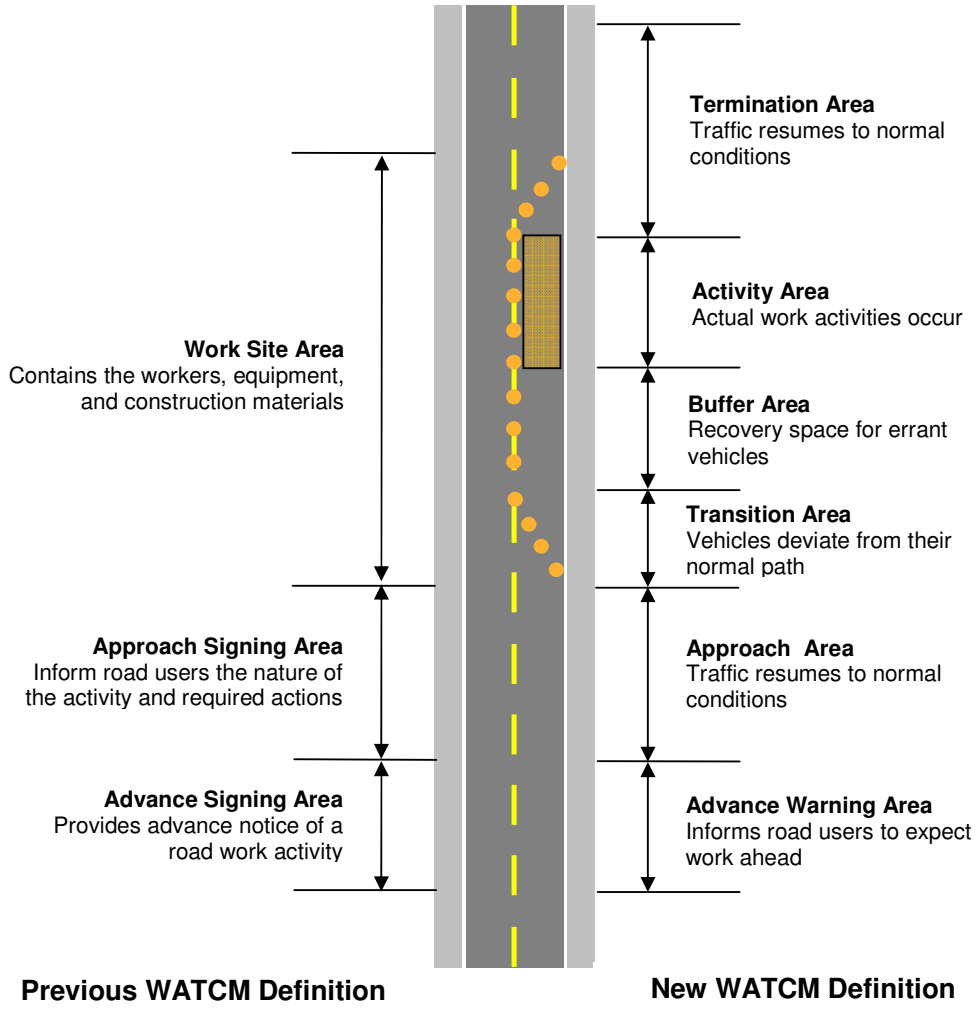


Figure II: Comparison of Work Area Components

Definition of Maximum Work Zone Lengths

One of the fundamental principles contained in the previous WATCM was that "traffic should be inhibited as little as possible" when designing a work zone. Many other manuals, including the MUTCD-C, also contain similar wording in this regard. However, very few manuals contain guidance as to the maximum road length over which traffic may be inhibited.

The new WATCM states that the maximum activity area lengths within a work zone shall not exceed two kilometres on a two lane road and four kilometres on a four lane road. These lengths were selected to prevent vehicle delays from becoming unreasonable. Longer work zones may be approved by the Department of Transportation based on a consideration of traffic volumes and anticipated delays.

Changes to Work Zone Speed Management Philosophy

Excessive vehicle speeds is perhaps the biggest perceived risk to workers in a work zone. However, it is a common misconception that this risk can be mitigated simply by reducing the regulatory speed limit. The Transportation Association of Canada's *Synthesis of Practices for Work Zone Speed Management* (5) states that imposing unwarranted regulatory speed limits is generally not an effective means of controlling vehicle speeds. In fact, posting unrealistically low speed limits tends to have an adverse effect on work zone safety since only a portion of drivers will comply with the reduced speed, while the majority will travel at whatever speed they perceive to be reasonable. The end result is an increased potential for rear-end collisions. Another potential risk of posting unwarranted speed reductions is that drivers who get stuck behind another vehicle complying with the speed limit may become frustrated, and subsequently become distracted from the driving task. In extreme cases, the driver may even attempt a passing manoeuvre within the work zone.

The aforementioned TAC synthesis of practices notes that experience has shown it is difficult to achieve an average speed reduction of more than 15 km/h where there is no clearly demonstrated need to do. For this reason, the document recommends that posted speed limits in work zones should not be more than 20 km/h unless restrictive features are present.

In the previous WATCM, any lane closure on a multilane road in New Brunswick, was to be posted at 70 km/h. For facilities posted at 110 km/h (including the Trans Canada Highway), this meant a speed reduction of 40 km/h. This reduction was perceived to be excessive, since the design standard of these facilities was sufficiently high that drivers felt they could safely travel through the work zone at much higher speeds. This is evidenced by a 2003 study which revealed that 85th percentile speeds within work zones on these facilities to be as high as 107 km/h (6).

In response to the above issues, the WATCM's work zone speed management philosophy was revised to be more consistent with TAC's Synthesis of Practices. The new manual recommends that reduced speed zones be limited to locations where restrictive features or unsafe conditions are present. Examples of such locations may include narrow travelled lanes, unpaved road surfaces, or complex road diversions. In such cases, the new WATCM requires that work zones be adequately designed such that vehicles can safely

travel through them without reducing their speed by more than 20 km/h. Any speed reduction greater than 20 km/h must now be approved by the Department.

Adoption of New Technology

Since the original WATCM was drafted in 1994, several new and innovative technologies have become available to further improve work zone safety. Despite widespread use of these technologies in other jurisdictions, many of them have not been used on New Brunswick roads because they were not recognized by the WATCM.

The new manual now specially recognizes several “new” technologies for traffic control including truck mounted attenuators, variable message signs, and radar speed displays signs.

Truck Mounted Attenuators

A truck mounted attenuator (TMA) is an energy absorbing device, either mounted directly on a truck or hauled on a trailer behind it, which is stationed in advance of workers to shield them from errant vehicles. They also provide protection for drivers who may strike slow moving or stopped work vehicles. Figure III depicts examples of both truck and trailer mounted units.

Trailer Mounted Unit

Truck Mounted Unit

Figure III: Examples of Truck Mounted Attenuators (TMAs)

TMAs are recognized by many other jurisdictions in their respective manuals. They are most commonly used on high speed or multilane roads. The MUTCD-C does not provide any guidance with respect to the use of TMAs in work zones.

The new WATCM not only recognizes the use of TMAs, but requires they be used in the following situations:

1. *Short duration work on a bridge* – Working on a bridge structure presents an elevated risk to workers as they do not have an escape route in the event an errant vehicle enters the activity area. For this reason, the WATCM requires that a concrete median barrier be installed for any bridge work that is expected to take longer than one day to complete. However, the associated time and exposure involved with installing a barrier makes it very impractical for work that is expected to take less than one day. In these situations, a TMA is now used as an acceptable alternative.

2. *Moving operations on a multilane road* – Any moving operation carried out on a multilane road that cannot maintain a speed within 30 km/h of the posted speed limit requires a buffer vehicle equipped with a TMA. This requirement recognizes that drivers approaching these types of operations receive little or no advance warning since static signs are not erected. Examples of moving operations include line painting and pavement testing.

3. *Setting up and removing traffic control devices on a multilane road* – As previously mentioned, the setup and removal of traffic control devices involves significant risk because drivers may have little or no warning that workers are present ahead. The risk is even greater on multilane highways, where the sign truck often must encroach into the travelled lane while setting up or removing signs on the left shoulder. Consequently, the new WATCM requires that a buffer vehicle equipped with a TMA follow the sign truck whenever narrow shoulders are expected to result in encroachment. If the work involves a lane closure setup, a TMA is also required during the setup and removal of the transition taper.

For each of the above cases, the TMA must satisfy the requirements of NCHRP 350 Test Level (TL)-3 (for speeds up to 100 km/h). Many jurisdictions only require TMAs to meet NCHRP 350 Test Level (TL)-2 (for speeds up to 70 km/h) on lower speed roads. However, in New Brunswick it was decided that specifying a single standard would allow for better optimization of resources and reduce the likelihood of a (TL)-2 unit being mistakenly deployed on a higher speed road.

Variable Message Signs

Variable Message Signs (VMS) are electronic signs used to provide road users with additional information about upcoming road work (see Figure IV). Although their use has become widespread in many jurisdictions, they were not recognized in the previous WATCM.

Figure IV: Example of a Variable Message Sign (VMS)
(Source: www.roadside-technologies.co.uk)

The amount of guidance provided in the respective provincial manuals related to the deployment of VMS was found to vary significantly. Some jurisdictions' manuals simply provide a description of the device accompanied by vague wording surrounding its use. Meanwhile, other jurisdictions' manuals provide detailed specifications regarding minimum letter size, bulb intensity, and standard messages. The MUTCD-C contains only very general guidance with respect to the use of VMS.

The new WATCM recognizes the use of VMS as a supplement to, but not a substitute for, conventional traffic control signs. It includes the following information related to their deployment:

- Minimum letter height and visibility requirements;
- Factors to be considered when designing a message;
- A brief list of standard messages; and
- Common applications where VMS use may be considered.

The New Brunswick Department of Transportation shall be contacted prior to deploying a VMS. This stipulation was included in the manual to ensure that VMSs do not become misused, causing them to lose effectiveness.

Radar Speed Display Signs

Radar Speed Display Signs (RSDS) are a special type of VMS equipped with a radar unit that displays an approaching vehicle's speed back to the driver (see Figure V). Other than specifying a minimum letter height of 45 cm (18 in.) and that the sign be placed in the approach area, the new manual provides limited guidance with respect to the use of RSDS. However, this level of detail is consistent with that contained in other manuals from other jurisdictions. The MUTCD-C does not provide any specific guidance for using RSDS in work zones.

Figure V: Example of a Radar Speed Display Sign
(Source: www.radartrailers.com)

The new WATCM recognizes the RSDS as a supplement to conventional traffic control signs in work zones where vehicle speeds are a particular concern. However, like VMS, the New Brunswick Department of Transportation shall be contacted prior their use.

Changes to Sign and Device Imagery

As previously mentioned, one of the Department's main priorities in developing the new WATCM was to ensure that it incorporated best practices consistent with those applied in other Canadian jurisdictions, particularly the MUTCD-C. During the jurisdictional review, it was revealed that some of the signs and devices historically used in work zones in New Brunswick were inconsistent with those depicted in the MUTCD-C. Although many of the differences may be considered to be subtle and not likely to have an adverse impact on safety, the Department opted in most cases to harmonize with the MUTCD-C in an effort to promote consistency. Using consistent signage and devices from work zone to work zone

is the best way to ensure that drivers can easily recognize a message and react to it in a safe and timely manner.

The following paragraphs describe some of the inconsistencies related to sign and device imagery between the previous WATCM and the MUTCD-C.

Traffic Signals Ahead Sign

The Traffic Signals Ahead sign alerts drivers that they are about to encounter a temporary traffic control signal in the work zone. In New Brunswick, these signs have historically appeared on the same orange background as all other temporary traffic control signs. However, the MUTCD-C specifically depicts this sign to have a yellow background (even for temporary conditions) since it is directly related to traffic regulations.

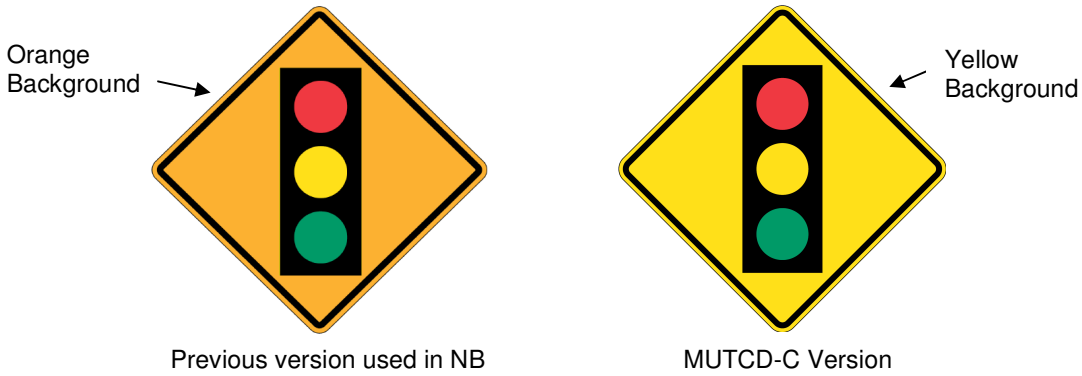


Figure VI: Comparison of Traffic Signal Ahead Signs

To be consistent with the MUTCD-C, the new WATCM now requires that Traffic Signals Ahead signs have a yellow background instead of orange. Similar changes were also made to Yield Ahead and Stop Ahead signs, both of which used to appear in orange, but are shown to be yellow in the MUTCD-C. It was noted during the jurisdictional review that other provinces have opted to use the orange background for these signs.

Survey Crew Sign

The Survey Crew sign indicates to drivers that a survey crew is working on or near the travelled portion of the road. The sign previously used in New Brunswick depicts the surveyor facing toward the right, while the sign contained in the MUTCD-C shows the worker facing toward the left (see Figure VI). Most Canadian jurisdictions have adopted a survey crew sign similar to the MUTCD-C version.

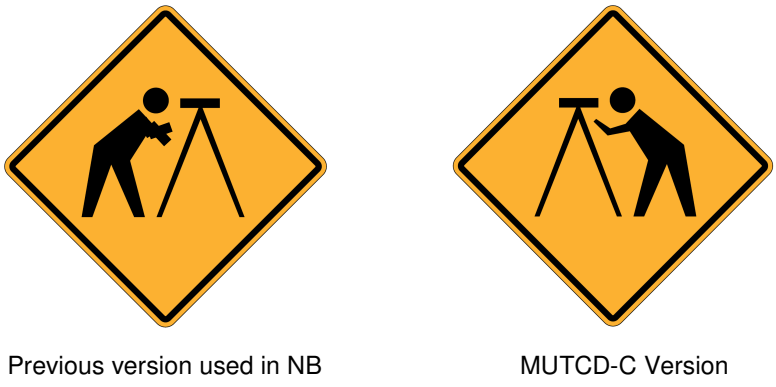
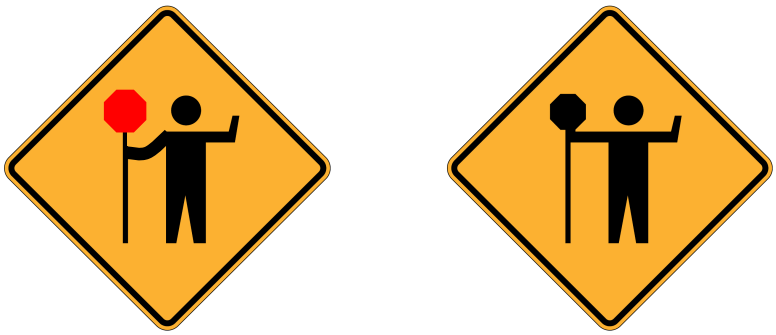


Figure VII: Comparison of Survey Crew Signs

The new WATCM has adopted the MUTCD-C version of the Survey Crew Sign. It is understood that this discrepancy would have little impact on a driver's ability to recognize the intended message. However, the change was made in an effort to further promote consistency.

Traffic Control Person Ahead Sign

The Traffic Control Person Ahead sign alerts drivers that a traffic control person (TCP) is directing traffic in the work zone using a stop/slow paddle. There have been several versions of this sign used in New Brunswick work zones in the past. The most common version depicted the TCP holding a stop/slow paddle with a red retro-reflective octagon silhouette. Meanwhile, the MUTCD-C version depicts the octagon silhouette of the stop/slow paddle to be coloured in black (see Figure VII). Most Canadian jurisdictions have adopted a traffic control person ahead sign similar to the MUTCD-C version.



Previous version used in NB MUTCD-C Version

Figure VIII: Comparison of the Traffic Control Person Ahead Signs

There was considerable debate about whether the previous version was more effective than the MUTCD-C version. Many argued that the previous version placed greater emphasis on a driver's potential requirement to stop, and therefore was safer. However, it was ultimately decided to adopt the MUTCD-C version of the Traffic Control Person Ahead sign in the new WATCM.

Heavy Barricades

Heavy barricades provide complete closure of a road, street, or lane for an extended period of time. They are constructed of barricade boards that either displays 1) a series of alternating chevrons - when a specific direction is to be indicated or 2) a series of alternating vertical stripes - when no specific direction is to be indicated.

The barricade boards historically used in New Brunswick consisted of alternating orange and silver patterns on both the directional and non-directional barricades (see Figure VIII). Both the orange and silver were constructed from high intensity sheeting materials. Meanwhile, the MUTCD-C specifies that the alternating patterns be orange and black. There are several variations of heavy barricades contained in provincial manuals across Canada.

The new WATCM specifies that barricade boards display alternating orange and black patterns, as depicted in the MUTCD-C. This change also prompted a considerable debate, as many people believed the orange and silver to be more effective since both colours were comprised of high intensity sheeting. The counter argument was that the orange and

black (which is not retro-reflective) provides a greater contrast, making the chevron and vertical stripe patterns more distinguishable. Since there has been no known research conducted to test these theories, the Department ultimately opted to harmonize with the MUTCD-C.

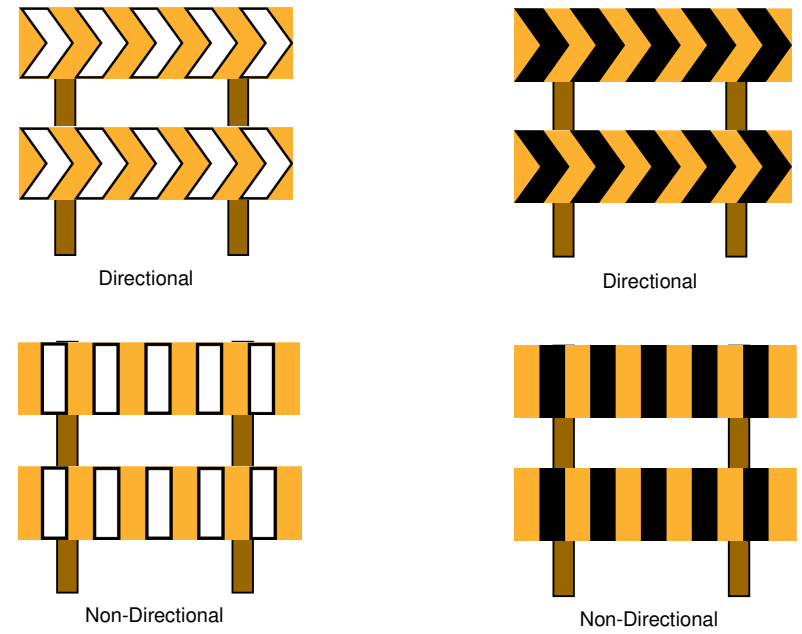
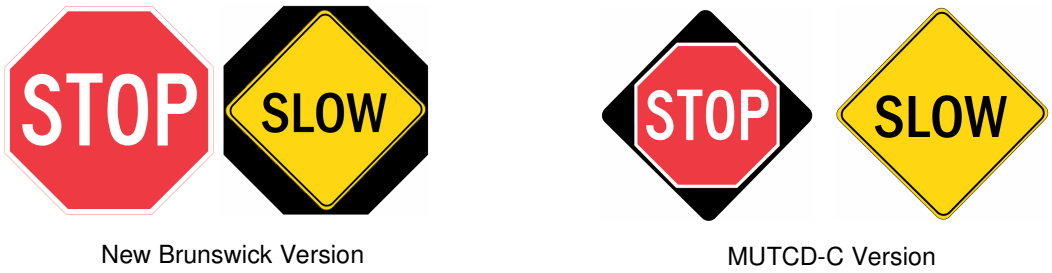


Figure IX: Comparison of Heavy Barricades

Stop / Slow Paddles

Stop / Slow paddles (or traffic control paddles) are used by traffic control persons to regulate the flow of traffic through a work zone. These devices generally consist of a conventional red stop sign and a yellow slow warning sign mounted back-to-back on a single pole. However, there are several variations of the stop / paddle currently in use across Canada.

The stop / slow paddle contained in the MUTCD-C has a 45 cm x 45 cm stop sign mounted against a 45 cm x 45 cm slow sign such that the combined silhouette depicts a diamond shape. However, New Brunswick's version of the stop/slow paddle has historically required the stop sign to be slightly larger, so the combined silhouette is an octagon shape instead. This is viewed to be a more "fail-safe" design, since the octagon is the universal symbol for stop. In the event that the sign text is not visible to drivers (perhaps due to glare), the octagon silhouette should indicate a requirement to stop. For this reason, it was decided to stick with the version previously used in New Brunswick, rather than adopt the version recommended in the MUTCD-C. Figure IX provides a comparison of these alternate versions.



New Brunswick Version MUTCD-C Version

Figure X: Comparison of Stop / Slow Paddles

It was discovered during the jurisdictional review that many provinces use a stop/slow paddle similar to that used in New Brunswick. However, there are many subtle discrepancies across Canada with respect to actual sign size, minimum mounting height, and minimum sheeting materials. Such discrepancies may or may not inhibit the driver's ability to recognize and process the message.

Additions to Typical Application Layouts

Each province's work zone traffic control manual, as well as the MUTCD-C, contains a selection of typical application layouts which depict the minimum level of traffic control required for common work activities or locations. The number of typical layouts included in each manual varies across jurisdictions depending on which work activities or locations are considered to be most common. For example, Ontario's manual contains several typical layouts specific to five and six lane roads. However, these layouts are not included in any of the Atlantic Provinces' manuals since these types of facilities are not common in the region.

Obviously, it would not be practical for a manual to cover every possible situation that may occur. However, several typical layouts were added to the new WATCM to address common work activities and locations that were not covered in the previous version. Some of the more notable additions included layouts that address work at the following locations:

- Bridge structures;
- Climbing lanes;
- Acceleration & deceleration lanes; and
- Ramps.

These types of facilities are common to every province, yet they are not specifically address by many manuals. While many jurisdictions' manuals contain typical layouts for ramp closures and work in acceleration and deceleration lanes (including the MUTCD-C), fewer than half of them contain typical layouts specific to bridge structures, climbing lanes, or work on ramps where the ramp remains open.

Conclusion & Recommendations

The New Brunswick Department of Transportation's new Work Area Traffic Control Manual (WATCM) incorporates a range of best practices from other jurisdictions across the country. The new manual has a better level of conformance to the Transportation Association of Canada's (TAC) Manual of Uniform Traffic Control Devices (MUTCD-C) than the old manual and therefore traffic control devices used in New Brunswick work zones will be more consistent with those used elsewhere in the country.

Significant changes to the manual included procedures for setting and removing traffic control devices, guidelines for using new technologies, requirements for crashworthiness, work-zone components, new speed management philosophy, and typical application layouts for work activities and locations not covered in the old manual.

The jurisdictional review completed during the development of the new guidelines revealed many inconsistencies in the work area traffic control practices currently used from province to province. Many of these inconsistencies are arguably subtle and have a minimal impact on work zone safety. However, some inconsistencies have larger safety implications and would greatly benefit from a set of harmonize guidelines. In this regard, it is recommended that TAC review the following for potential inclusion in the MUTCD-C to provide a more uniform approach for controlling traffic in work zones across the country:

- Device setup and takedown procedures;
- The use of newer, higher technology devices such as truck-mounted attenuators, variable message signs, and radar speed display signs;
- Typical application layouts for bridge structures, climbing lanes and work on ramps were the ramp remains open, and,
- Standards for specifying the crashworthiness of traffic control devices.

References

(1) New Brunswick Department of Transportation. *Work Area Traffic Control Manual*, 2009 Version.

(2) Transportation Association of Canada. *Part D - Manual of Uniform Traffic Control Devices for Canada*, Fourth Edition.

(3) US Federal Highway Administration. *Part 6 - Manual on Uniform Traffic Control Devices*, 2003 Edition (including Revision 2 dated December 2007).

(4) Transportation Research Board. NCHRP Report 350: *Recommended Procedures for the Safety Performance Evaluation of Highway Features*, National Academy Press, Washington, DC, 1993.

(5) Transportation Association of Canada. Synthesis of Practices for Work Zone Speed Management, 2005.

(6) Roberts, C. Effectiveness of a Portable Radar Speed Display in the Reduction of Speeds in Temporary Rural Highway Work Zones. University of New Brunswick Master's Thesis, 2003.