Work Zone and Flagger Safety

Temporary Traffic Control (TTC) Zones

Oct 2022

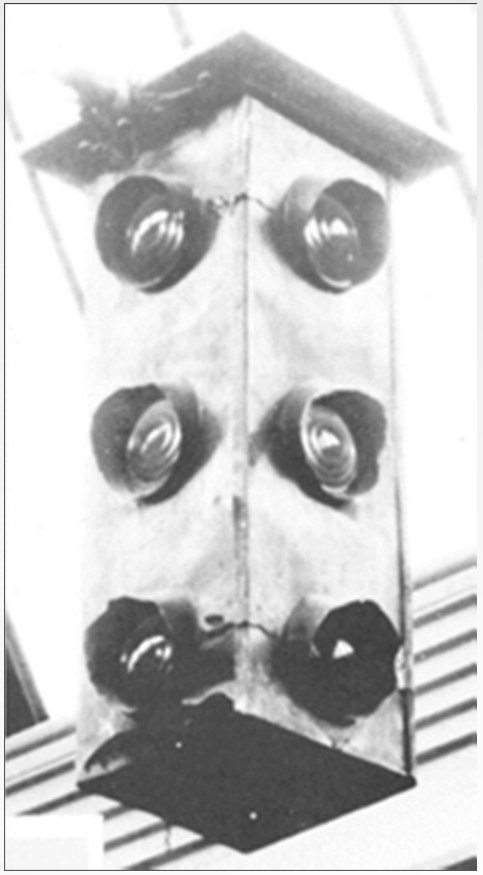
Traffic Control History

- Early markers were used in the Roman Empire
- Also used on pioneer trails in America
- Automobile age created new demands

Early Traffic Control Devices

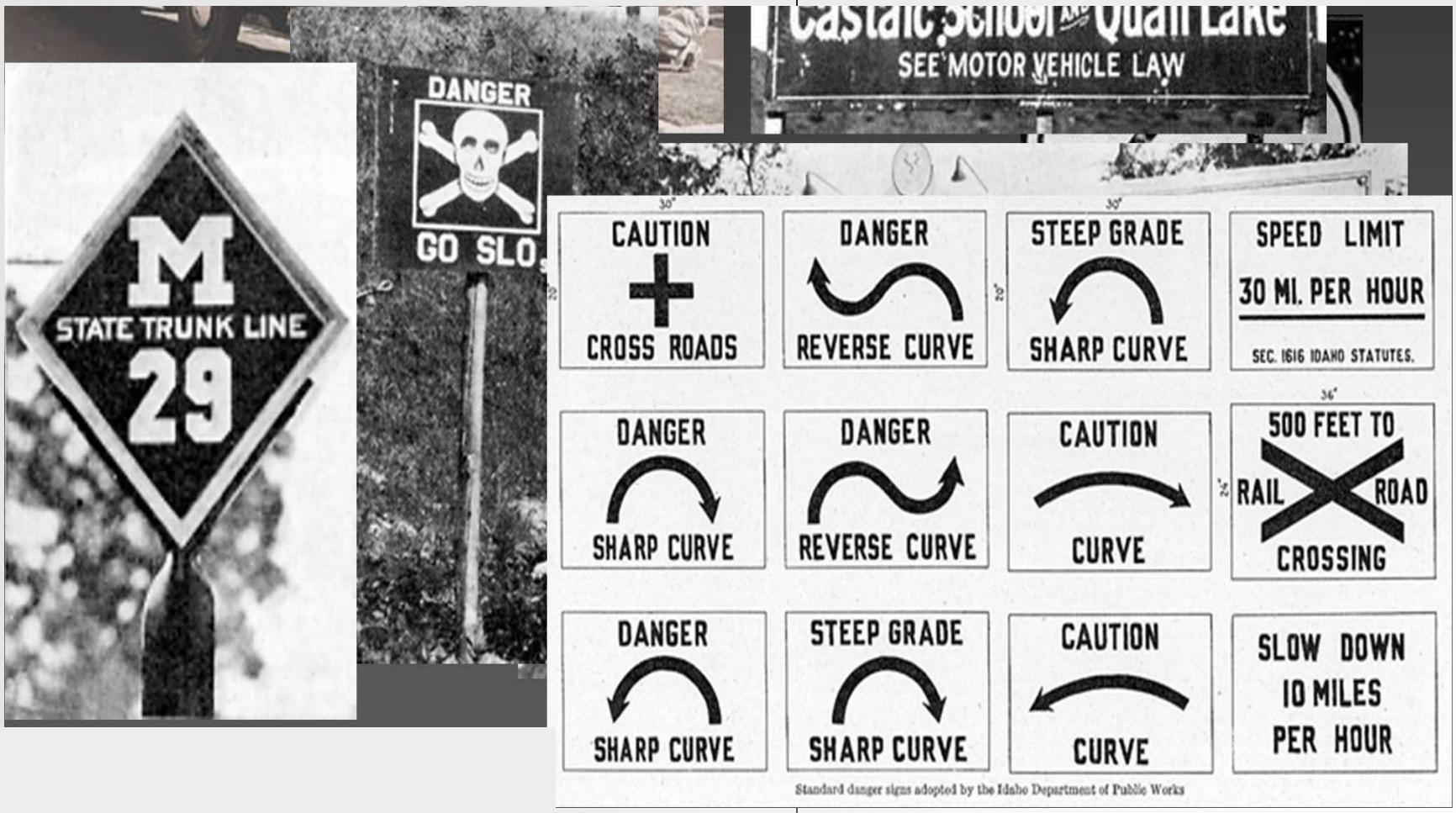
First Centerline Michigan 1911

1914 – 1st electric signal Cleveland

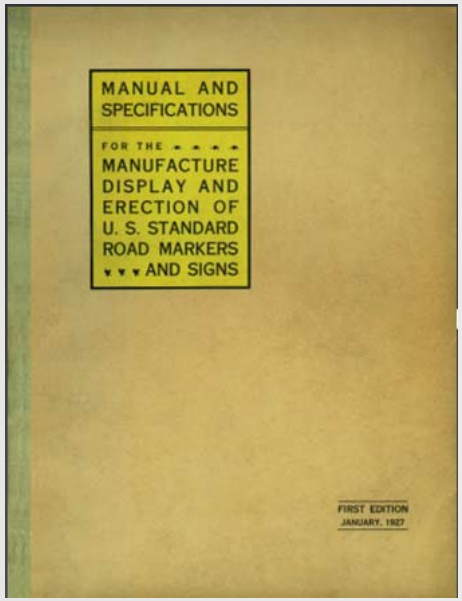


1920 – 1st 3-color signal Detroit

Early Traffic Signs

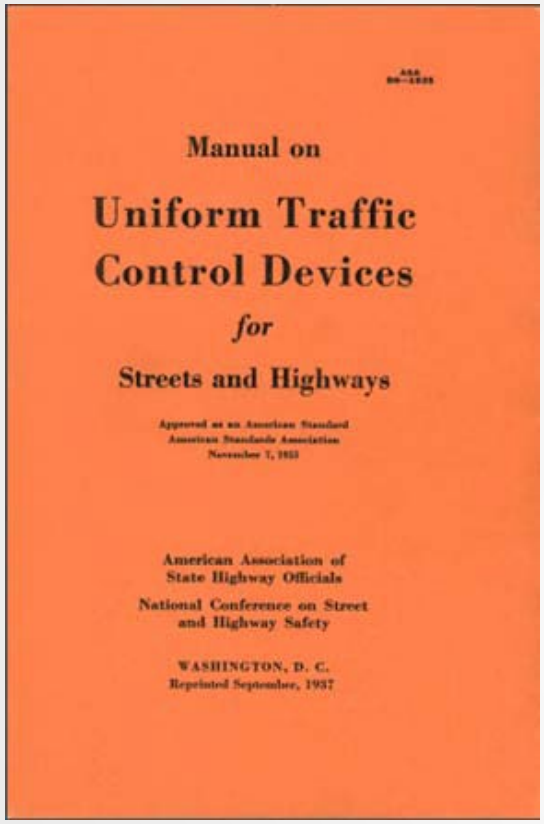


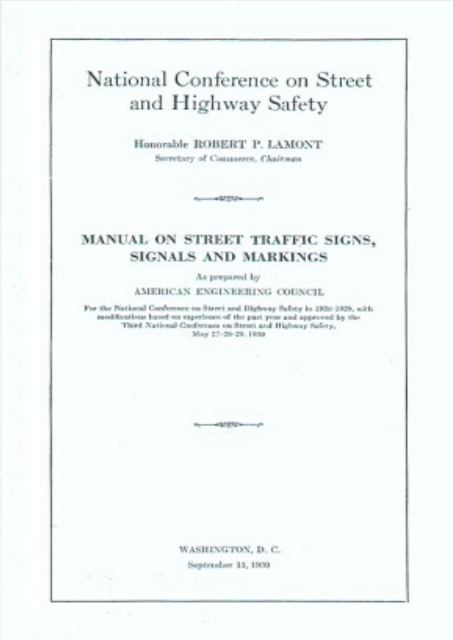
2 Different Manuals Led to Problems and Solutions



1927 Rural

1935 MUTCD



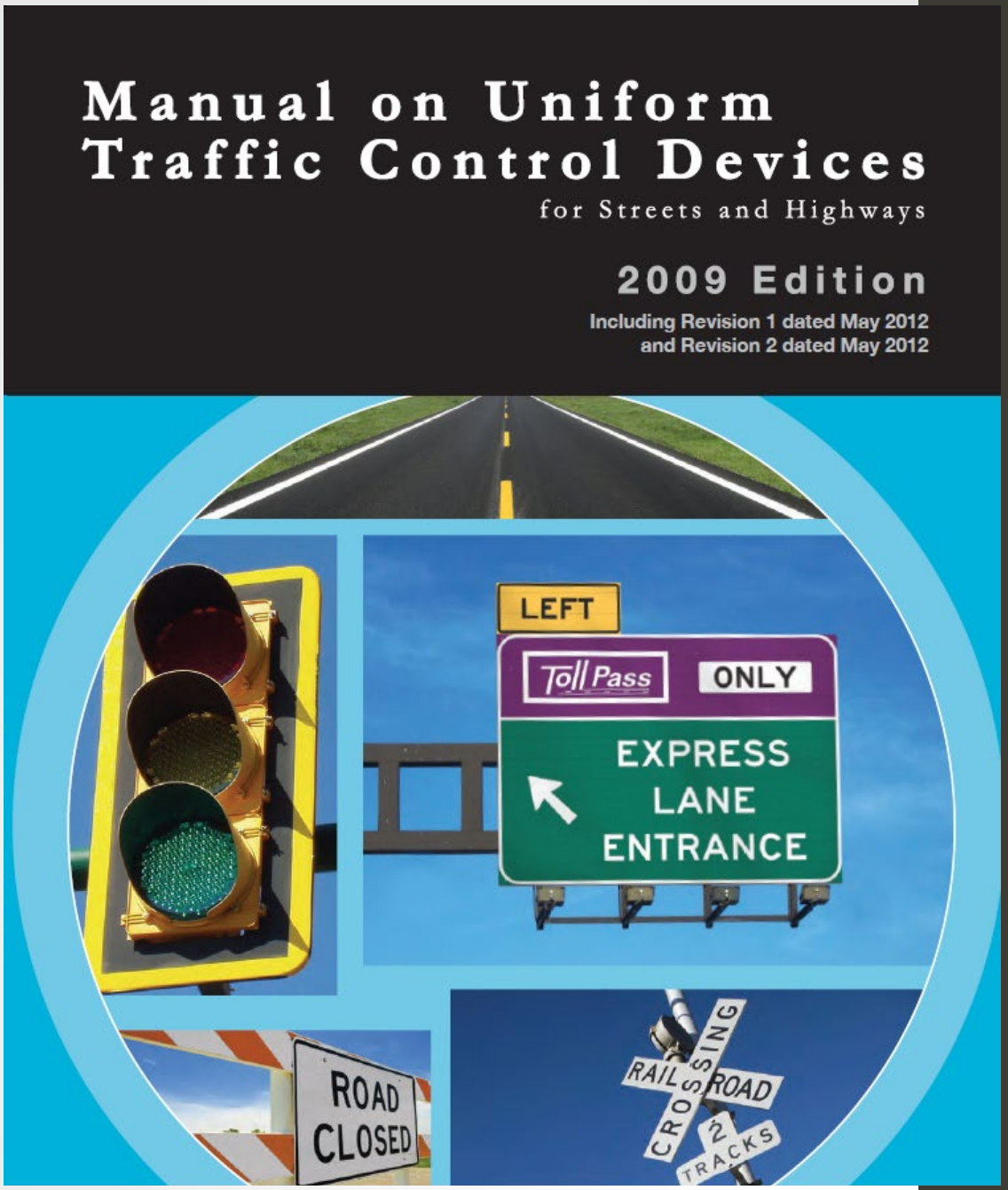


1930 Urban

MUTCD

- New Jersey adopted the 2009 edition.
- Section 6 Temporary Traffic Control (TTC).
- 8/22- Revision 3 of the 2009 MUTCD has been issued, this revision includes new provisions for maintaining minimum levels of retroreflectivity for pavement markings.

http//mutcd.fhwa.dot.gov



MUTCD Manual Section 6B.01

There are the seven fundamental principles of TTC, below is the 6th:

- *Each person whose actions affect TTC zone safety, from the upper-level management through the field workers, should receive training appropriate to the job decisions each individual is required to make. Only those individuals who are trained in proper TTC practices and have a basic understanding of the principles (established by applicable standards and guidelines, including those of this Manual) should supervise the selection, placement, and maintenance of TTC devices used for TTC zones and for incident management.*

Control of all Road Users through a TTC Zone

MUTCD requires considerations for: Section 6A.01

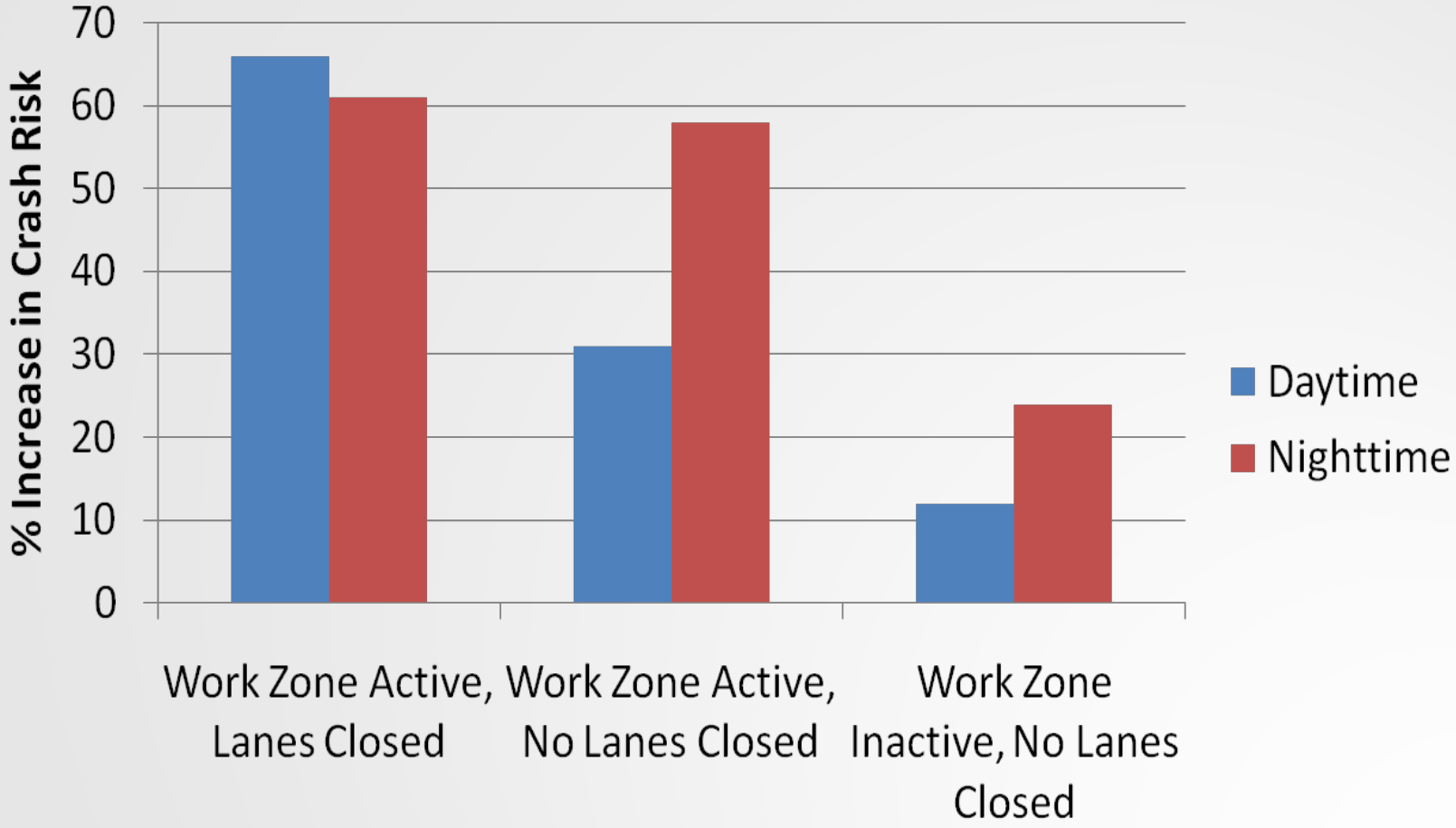
- Motorists
- Bicyclists
- Pedestrians
- People with disabilities

Work Zone Facts and Statistics

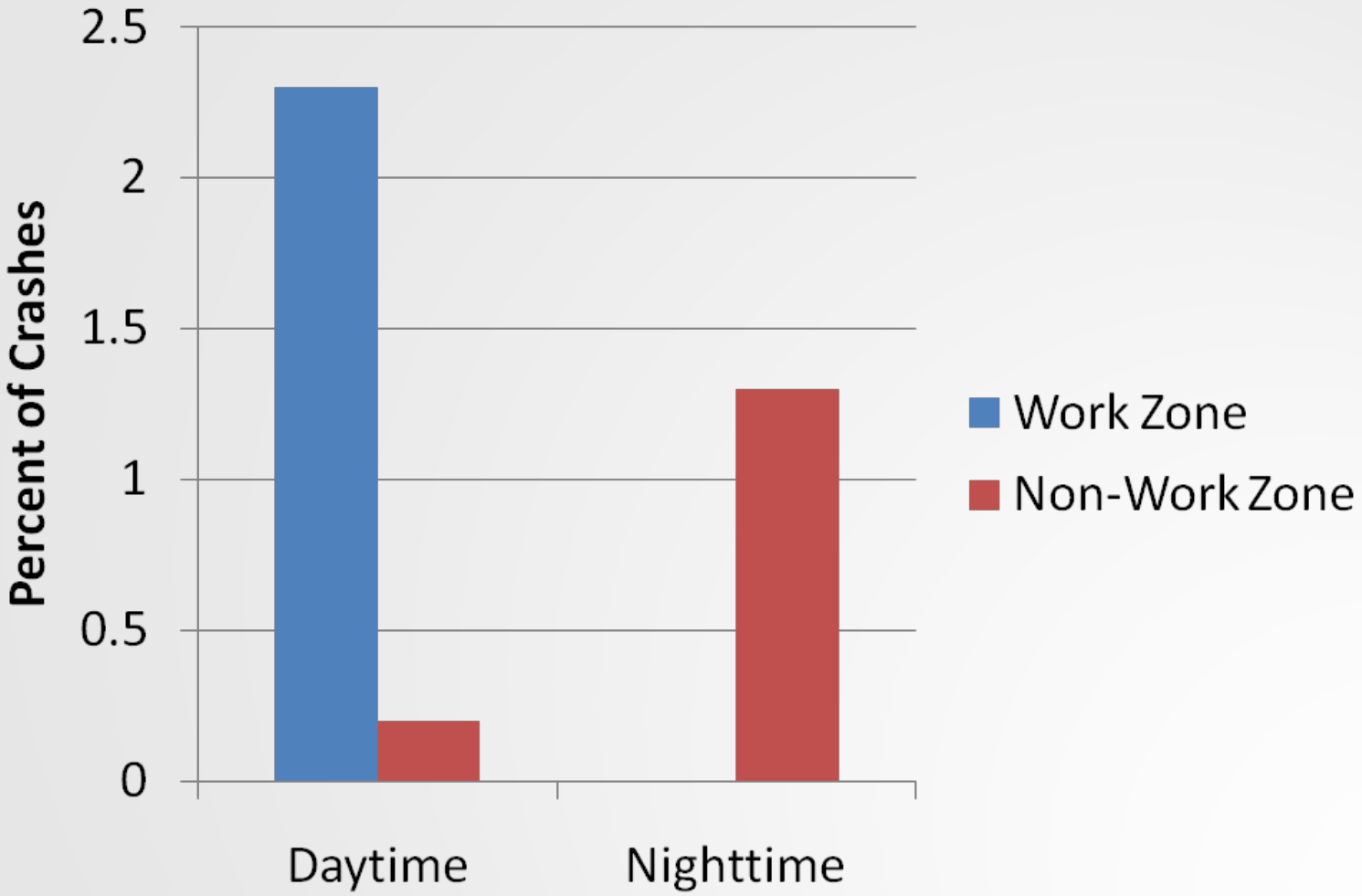
- **Work zone fatalities reached a 16-year high in 2020.** Between 2013 and 2020, work zone fatalities increased 45%.
- In 2020, over 102,000 work zone crashes were estimated to have occurred resulting in over 45,000 injuries and 857 fatalities. Economic costs of these crashes have been estimated at over $17.5 billion annually.
- In 2020, during the COVID-19 pandemic, work zone crashes & fatalities climbed despite lower traffic volumes. The Governor's Highway Safety Association (GHSA) projected that the U.S. pedestrian fatality rate jumped an unprecedented 21% from 2019.
- A prior study found that 38% of "Pedestrian" fatalities in work zones were workers (i.e., road construction/maintenance workers, utility workers, and planning/surveying workers). The serious hazards faced by people working on foot on or along our roadways, who are among the most "Vulnerable Road Users", highlights the need for positive protection measures.
- For the first half of 2021, USDOT estimates another 18.4% surge in traffic fatalities over 2020 and the largest number of traffic fatalities since 2006.

	2015	2016	2017	2018	(R) 2019	2020
Total work zone fatalities by person type	**717**	**781**	**809**	**756**	**842**	**856**
Drivers and passengers	601	652	667	620	692	683
Pedestrians and bicyclists	112	124	138	131	141	170
Others	4	5	4	5	12	3
Worker fatalities in highway work zones	**130**	**143**	**132**	**124**	**135**	**U**
Total work zone fatal crashes by type of roadway	**657**	**687**	**720**	**672**	**765**	**774**
Interstate	263	260	288	286	295	300
Arterial	325	355	357	324	390	372
Collector	43	51	58	38	49	62
Local	24	20	17	23	30	22
Other	2	1	0	1	1	18
Types of fatal work zone crashes						
Involving a rear-end collision	165	141	176	141	184	156
Involving a commercial motor vehicle (large truck)	176	194	221	207	249	204
Where speeding was a factor	187	193	211	171	242	287
Percent of fatal work zone crashes involved rear-end collisions	25.1	20.5	24.4	21.0	24.1	20.2

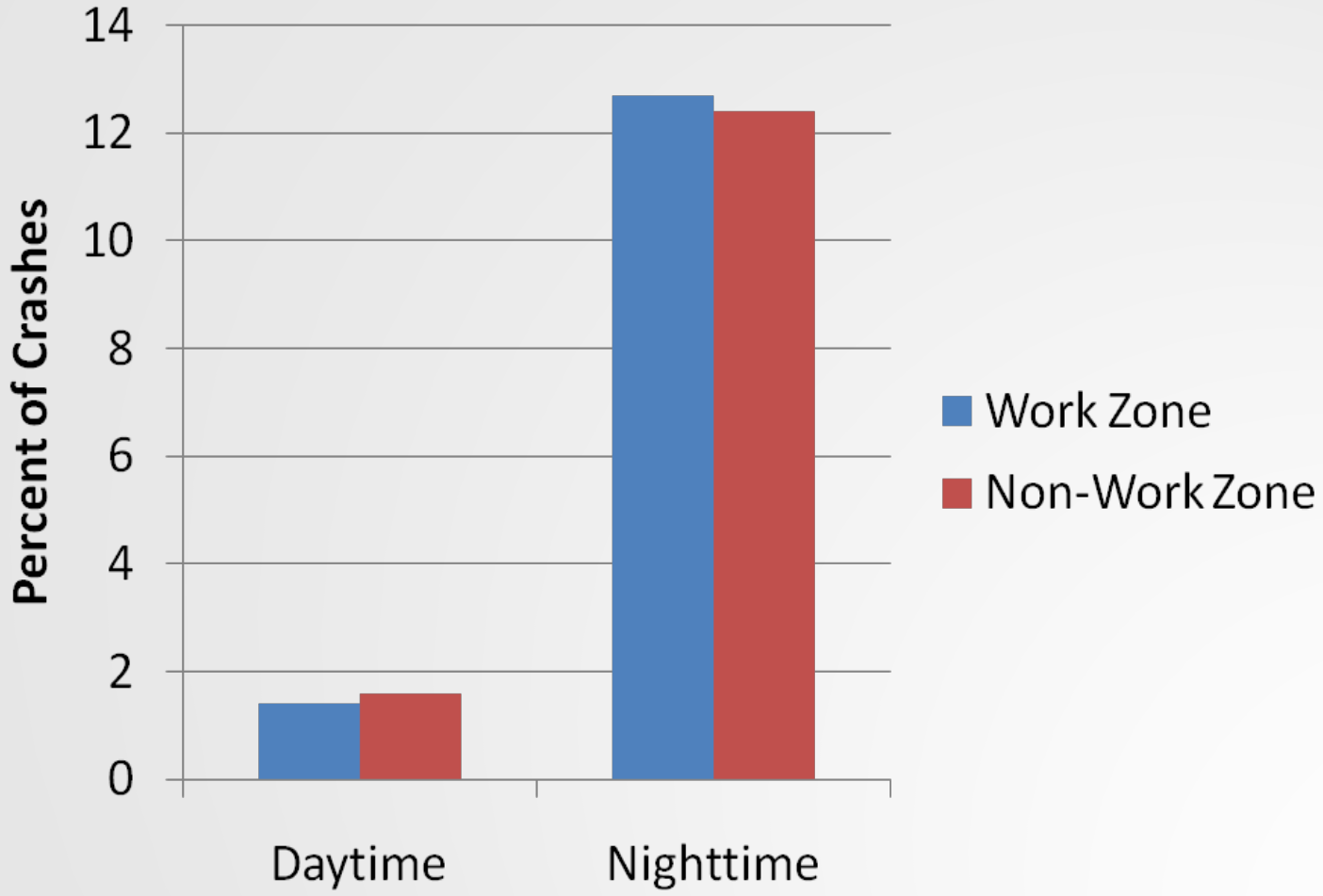
How is Motorist Crash Risk Affected?



Drowsy Driving in Work Zones



Drunk Driving in Work Zones



Fundamental Principles of TTC Section 6B

- Before any new detour or temporary route is opened to traffic, all necessary signs shall be in place.
- All TTC devices shall be removed as soon as practical when they are no longer needed.
- When work is suspended for short periods of time, TTC devices that are no longer appropriate shall be removed or covered.

TTC Channelizing Devices Section 6F.63

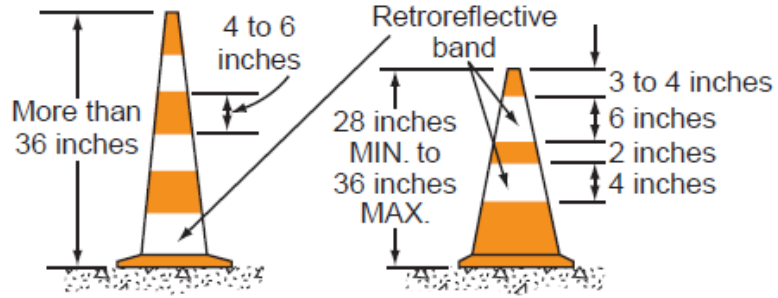
Used to regulate, warn, or guide road users through TTC Zone.

- Channeling Devices
  - Cones
  - Drums
  - Barricades
- Lighting Devices
- Signs

Cones Section 6F.64

- What size(s) cones does your department have and use?

04 Traffic cones may be used to channelize road users, divide opposing vehicular traffic lanes, divide lanes when two or more lanes are kept open in the same direction, and delineate short duration maintenance and utility work.

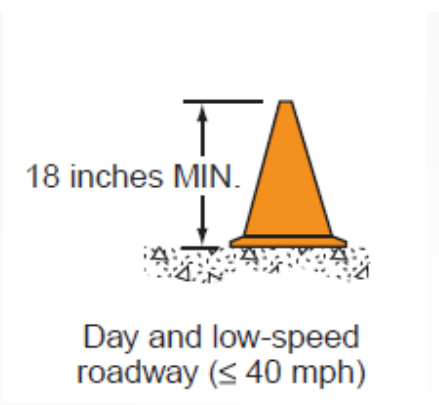


Guidance:

05 *Steps should be taken to minimize the possibility of cones being blown over or displaced by wind or moving vehicular traffic.*

Option:

06 Cones may be doubled up to increase their weight.

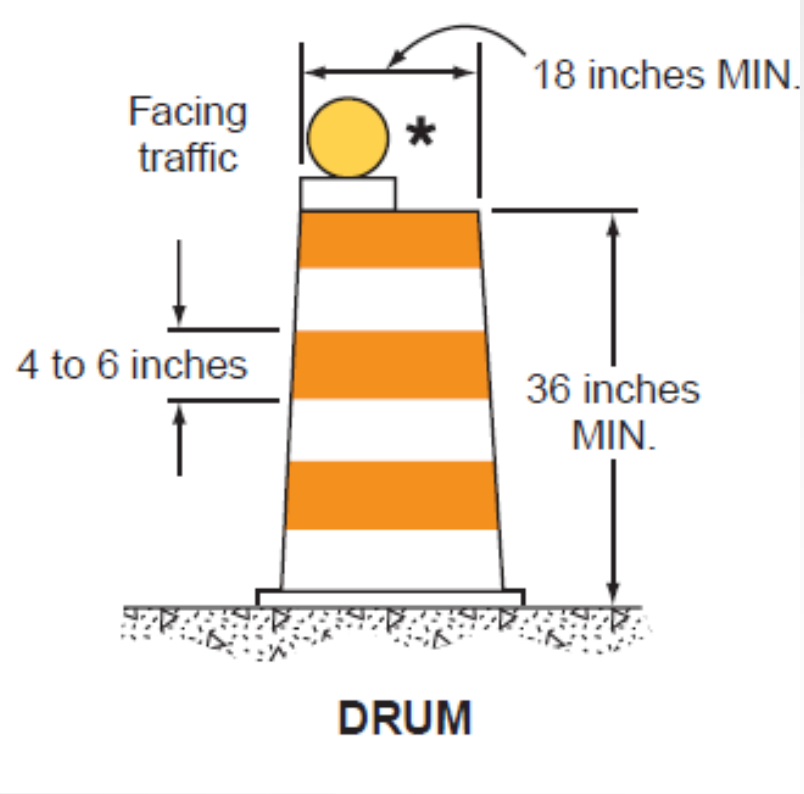


Drums Section 6F.67

- Does your department use drums?

Guidance:

04 *Drums should not be weighted with sand, water, or any material to the extent that would make them hazardous to road users or workers when struck. Drums used in regions susceptible to freezing should have drain holes in the bottom so that water will not accumulate and freeze causing a hazard if struck by a road user.*



Barricades Section 6F.68

Standard:

05 **The minimum length for Type 1 and Type 2 Barricades shall be 24 inches, and the minimum length for Type 3 Barricades shall be 48 inches. Each barricade rail shall be 8 to 12 inches wide.**

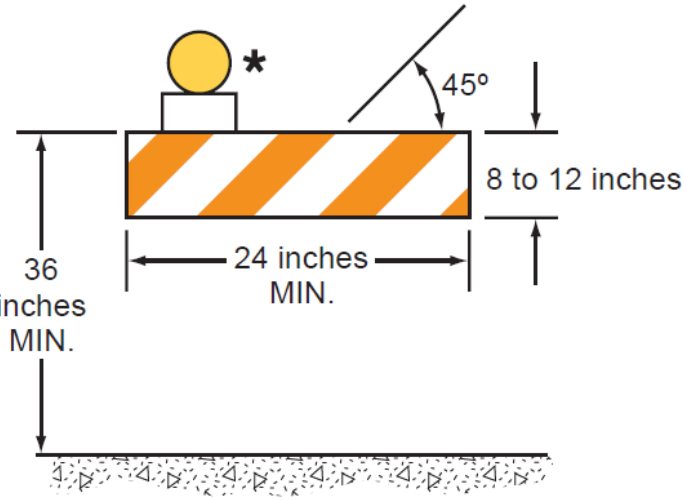
Guidance:

06 *Where barricades extend entirely across a roadway, the stripes should slope downward in the direction toward which road users must turn.*

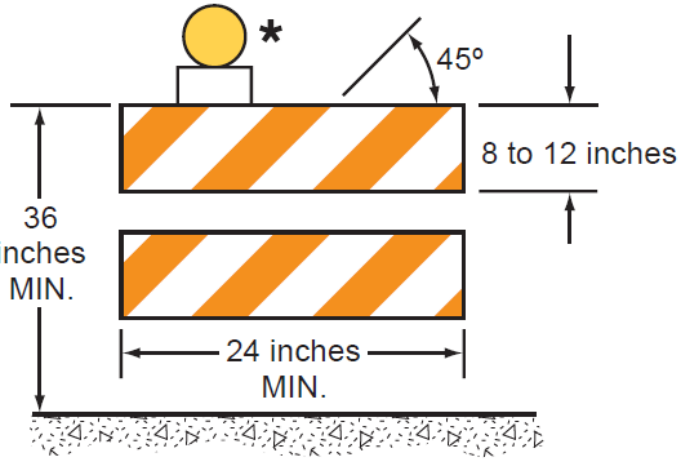
07 *Where both right and left turns are provided, the barricade stripes should slope downward in both directions from the center of the barricade or barricades.*

08 *Where no turns are intended, the stripes should be positioned to slope downward toward the center of the barricade or barricades.*

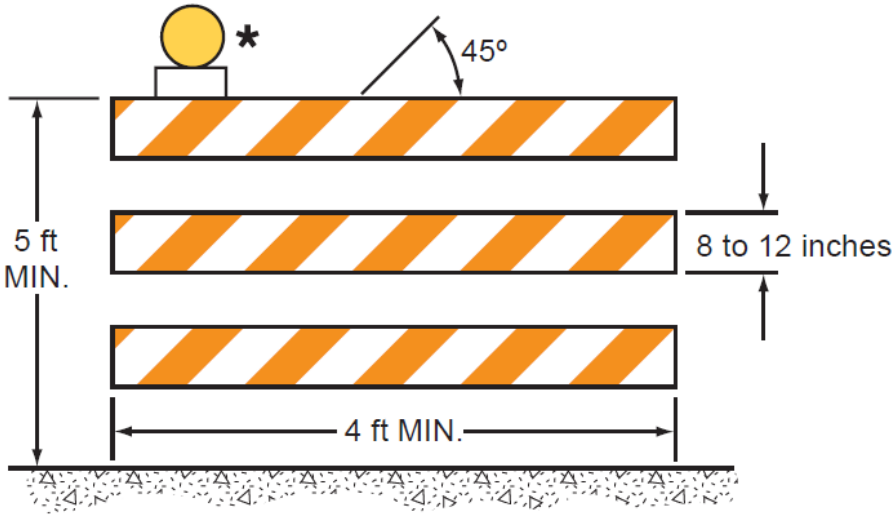
09 *Barricade rails should be supported in a manner that will allow them to be seen by the road user, and in a manner that provides a stable support that is not easily blown over or displaced.*



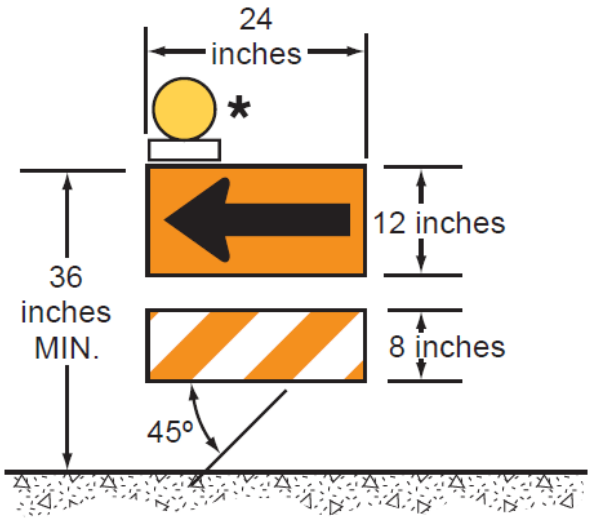
TYPE 1 BARRICADE **



TYPE 2 BARRICADE **



TYPE 3 BARRICADE **



DIRECTION INDICATOR BARRICADE **

* Warning lights (optional)

** Rail stripe widths shall be 6 inches, except that 4-inch wide stripes may be used if rail lengths are less than 36 inches. The sides of barricades facing traffic shall have retroreflective rail faces.

Lighting Devices Section 6F.81

- When used to supplement channelization, the maximum spacing for warning lights should be identical to the channelizing device spacing requirements.
- Although vehicle hazard warning lights are permitted to be used to supplement high-intensity rotating, flashing, oscillating, or strobe lights, they shall not be used instead of high-intensity rotating, flashing, oscillating, or strobe lights.

Signs Section 6F.02

03 Where the color orange is required, the fluorescent orange color may also be used.

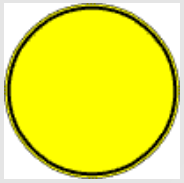
Support:

04 The fluorescent version of orange provides higher conspicuity than standard orange, especially during twilight.

Option:

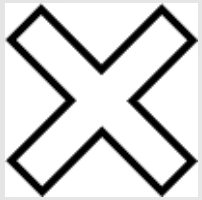
05 Existing warning signs that are still applicable may remain in place.

Common signs seen in and around work zones cautioning drivers.



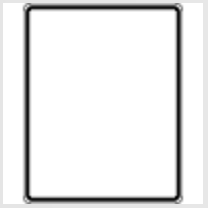
RR Advance Warning & Evac. routes

Stop



Railroad Crossing

Warning



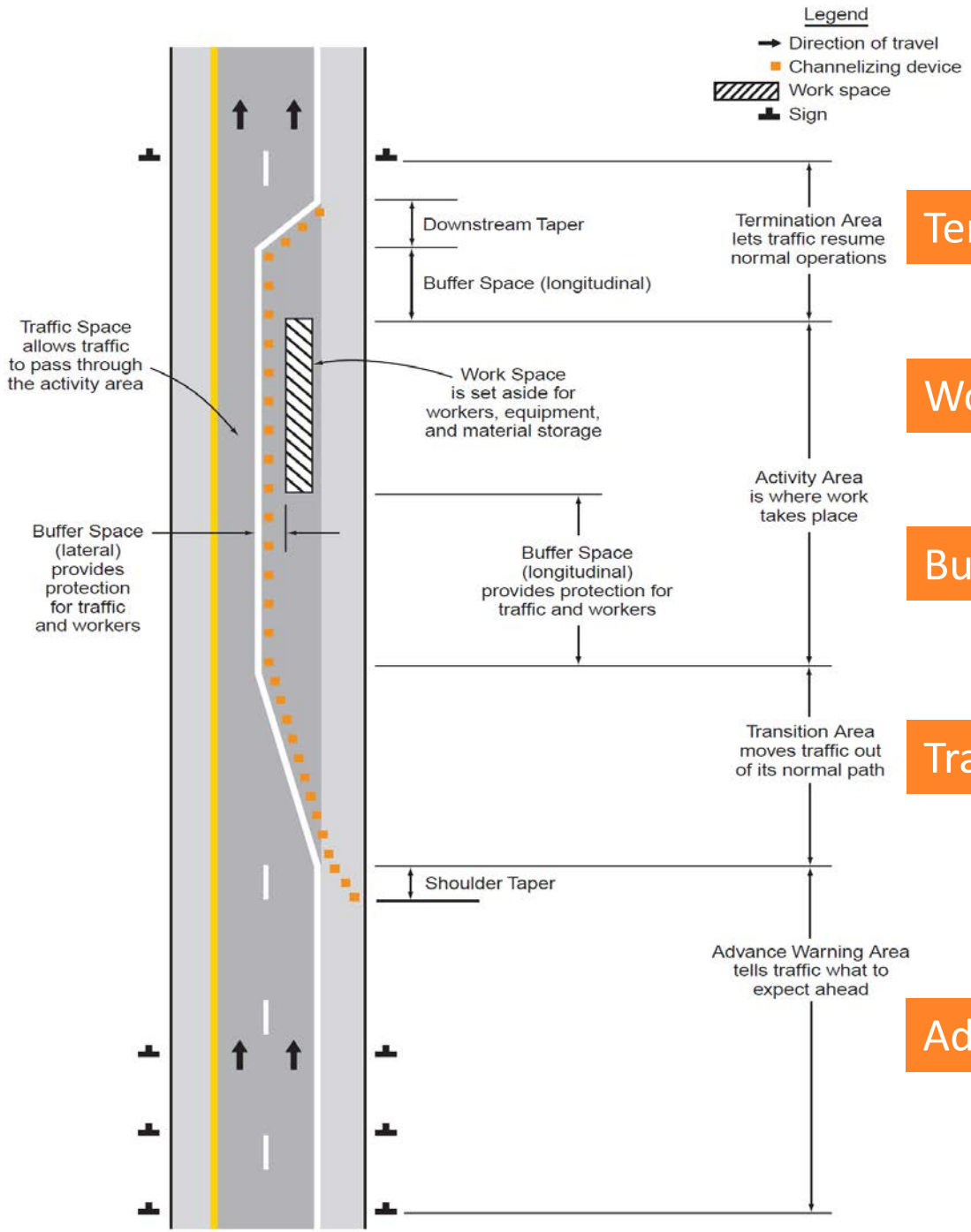
Regulatory Signs

Guide Signs, Warning Signs and TTC

Components of TTC Zone Section 6C.03

Most TTC zones are divided into four areas:

1. Advance Warning
2. Transition
3. Activity
   - Work
   - Buffer
4. Termination



Termination Area

Work Area

Activity Area

Buffer Area

Transition Area

Advance Warning Area

Advance Warning Area Section 6C.04

Table 6C-1. Recommended Advance Warning Sign Minimum Spacing

Road Type	Distance Between Signs**		
	A	B	C
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

- May include 1 to 3 signs, depending on duration of work.

* Speed category to be determined by the highway agency

** The column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC zone.)

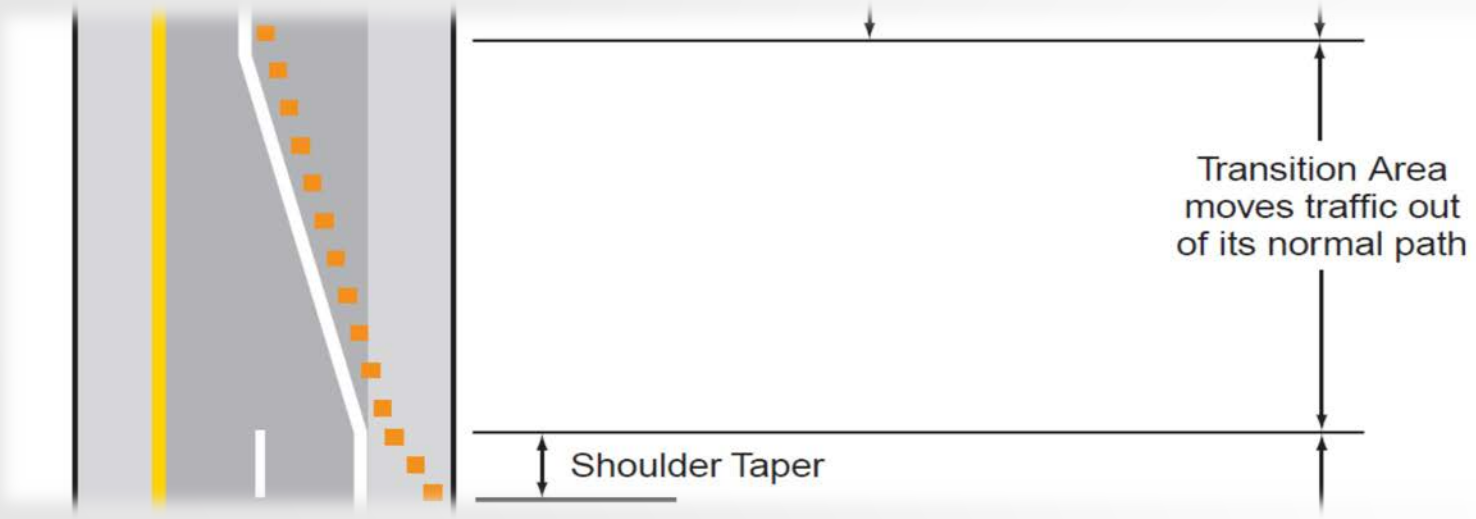
Transition Area Section 6C.05

Support:

01 The transition area is that section of highway where road users are redirected out of their normal path. Transition areas usually involve strategic use of tapers, which because of their importance are discussed separately in detail.

Standard:

02 **When redirection of the road users' normal path is required, they shall be directed from the normal path to a new path.**



Activity Area Section 6C.06

Section of the highway where the work activity takes place. It is comprised of Work, Traffic, and Buffer spaces.

- Workspace is that portion of the highway closed to road users and set aside for workers, equipment, and material, and a shadow vehicle if one is used upstream.
  - May be stationary or may move as work progresses.
- Traffic space is the portion of the highway in which road users are routed through the activity area.
- Buffer spaces may be positioned either longitudinally or laterally with respect to the direction of road user flow.

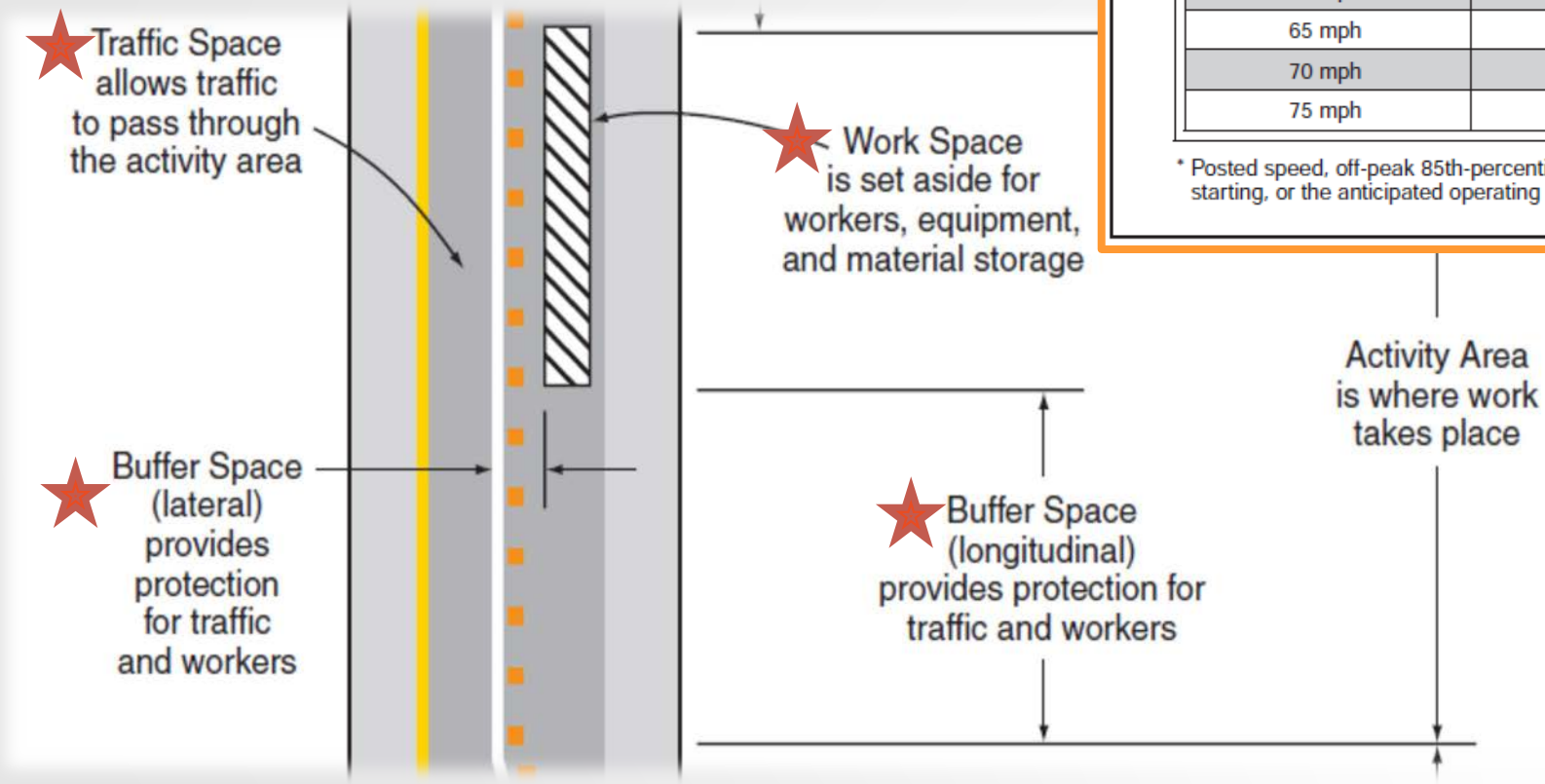
Activity Area consists of four (4) area

- Traffic Space
- Workspace
- Buffer Space
  - Lateral and Longitudinal

Table 6C-2. Stopping Sight Distance as a Function of Speed

Speed*	Distance
20 mph	115 feet
25 mph	155 feet
30 mph	200 feet
35 mph	250 feet
40 mph	305 feet
45 mph	360 feet
50 mph	425 feet
55 mph	495 feet
60 mph	570 feet
65 mph	645 feet
70 mph	730 feet
75 mph	820 feet

* Posted speed, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed



Termination Area Section 6C.07

02 An END ROAD WORK sign, a Speed Limit sign, or other signs may be used to inform road users that they can resume normal operations.

Planning Your Work Zone, your Most Vulnerable Times

TTC SET UP

- Set all devices at proper distances on shoulder of road
- Starting at first device motorist encounters, move devices onto roadway

TTC BREAKDOWN

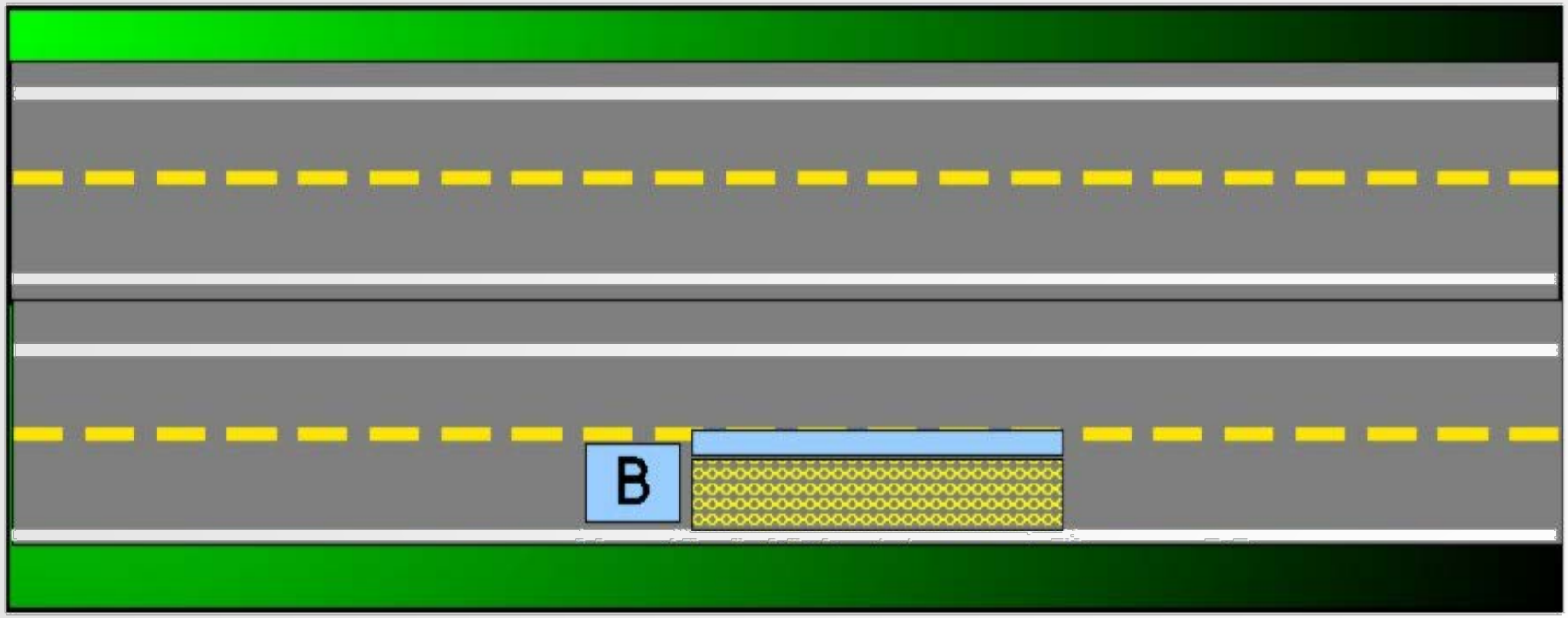
- Reverse procedure:

  Start at Termination Area and work to first warning sign

- Cover, turn down, or remove signs not needed for short periods

Planning Your Work Zone

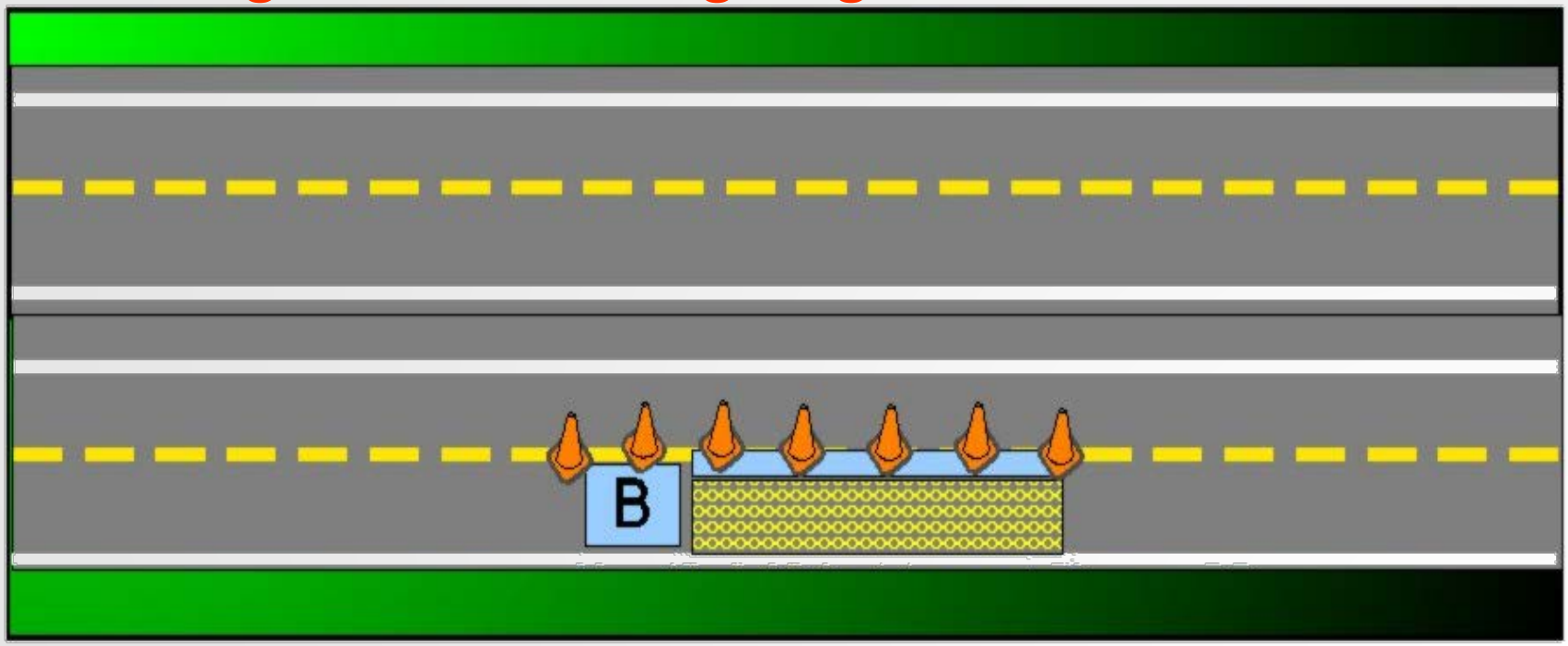
Here is our work zone and buffers



Planning Your Work Zone

Work Outward

First diagram cones along length of work zone

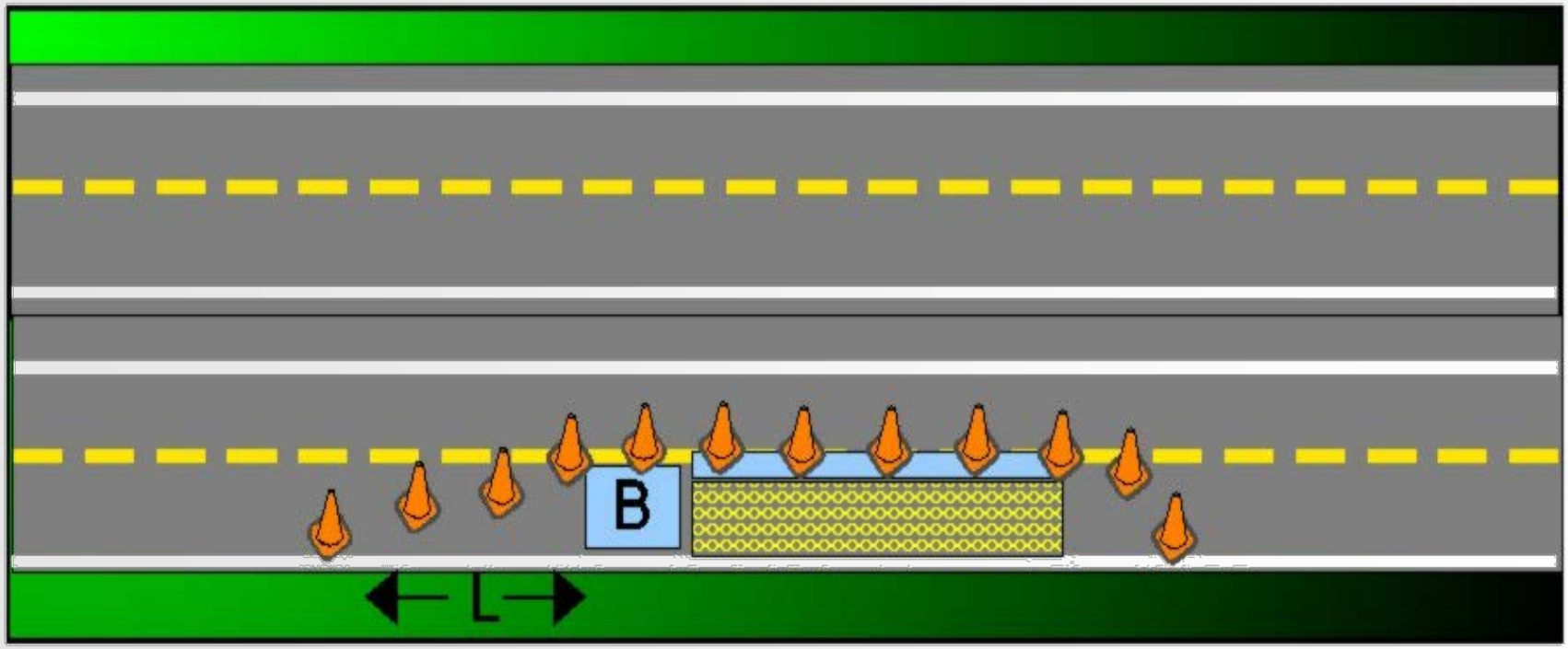


Planning Your Work Zone

Work Outward

Next diagram tapers by drawing a line of cones

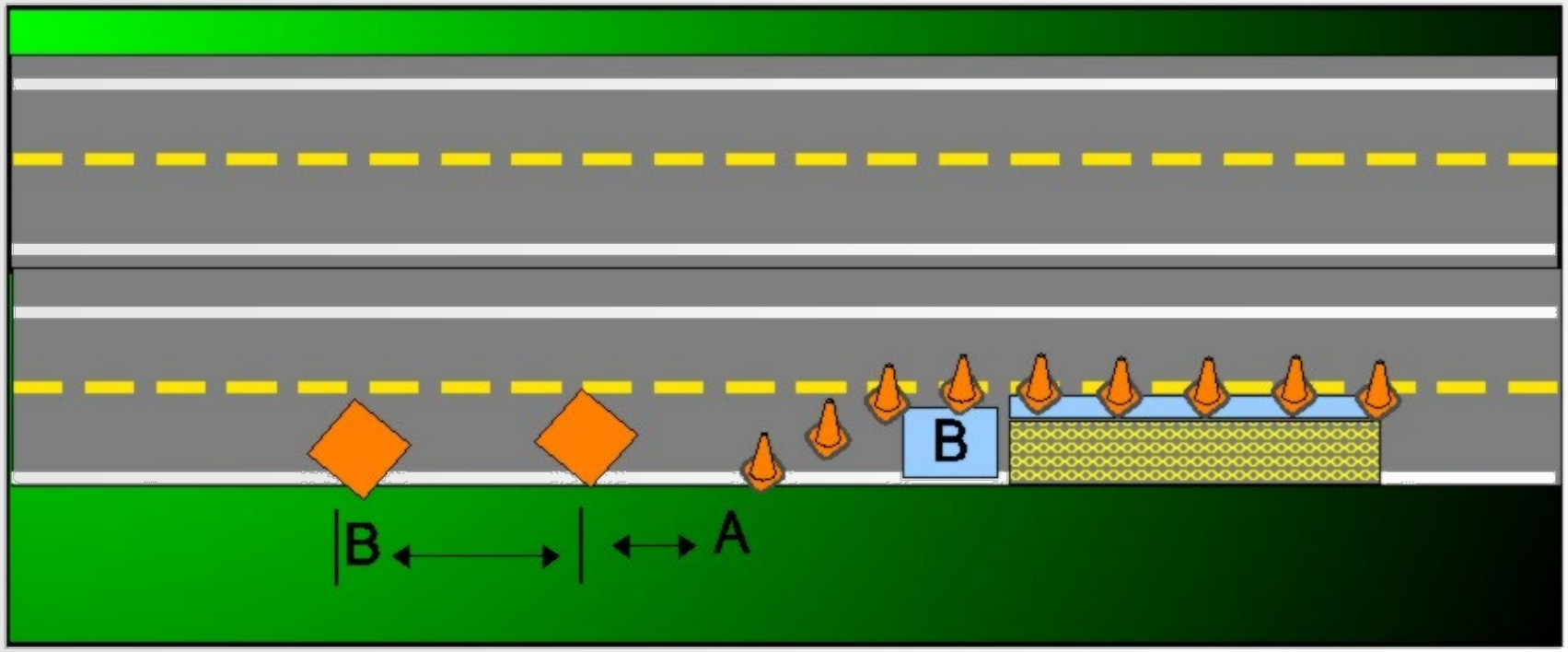
Then calculate length of tapers



Planning Your Work Zone

Work Outward

Finally diagram signs and determine spacing



Work Duration

- Work duration is a major factor in determining the number and types of devices used in TTC zones.
- The duration of a TTC zone is defined relative to the length of time a work operation occupies a spot location.
- The **five categories** of work duration and their time at a location shall be:
- **Long-term stationary** is work that occupies a location more than 3 days.
- **Intermediate-term stationary** is work that occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than 1 hour.
- **Short-term stationary** is daytime work that occupies a location for more than 1 hour within a single daylight period.
- **Short duration** is work that occupies a location up to 1 hour.
- **Mobile is work** that moves intermittently or continuously.

Typical Mobile Work Zones

- Leaf Collection
- Hot and Cold Patching
- Vacuuming Basins
- Bulk Pickup

Mobile Operations

- As compared to stationary operations, mobile and short-duration operations are activities that might involve different treatments. Devices having greater mobility might be necessary such as signs mounted on trucks. Devices that are larger, more imposing, or more visible can be used effectively and economically. The mobility of the TTC zone is important.
- **Guidance:**
- Safety in short-duration or mobile operations should not be compromised by using fewer devices simply because the operation will frequently change its location.
- **Option:**
- Appropriately colored or marked vehicles with high-intensity rotating, flashing, oscillating, or strobe lights may be used in place of signs and channelizing devices for short-duration or mobile operations. These vehicles may be augmented with signs or arrow boards.
- **Support:**
- During short-duration work, it often takes longer to set up and remove the TTC zone than to perform the work. Workers face hazards in setting up and taking down the TTC zone. Also, since the work time is short, delays affecting road users are significantly increased when additional devices are installed and removed

Mobile Operations

- **Guidance:**
- Warning signs and high-intensity rotating, flashing, oscillating, or strobe lights should be used on the vehicles that are participating in the mobile work.
- **Option:**
- Flags and/or channelizing devices may additionally be used and moved periodically to keep them near the mobile work area.
- Flaggers may be used for mobile operations that often involve frequent short stops.
- **Support:**
- Mobile operations also include work activities where workers and equipment move along the road without stopping, usually at slow speeds. The advance warning area moves with the work area.

Mobile Operations

- **Guidance:**
- When mobile operations are being performed, a shadow vehicle equipped with an arrow board or a sign should follow the work vehicle, especially when vehicular traffic speeds or volumes are high. Where feasible,
- warning signs should be placed along the roadway and moved periodically as work progresses.
- Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours.

Considerations

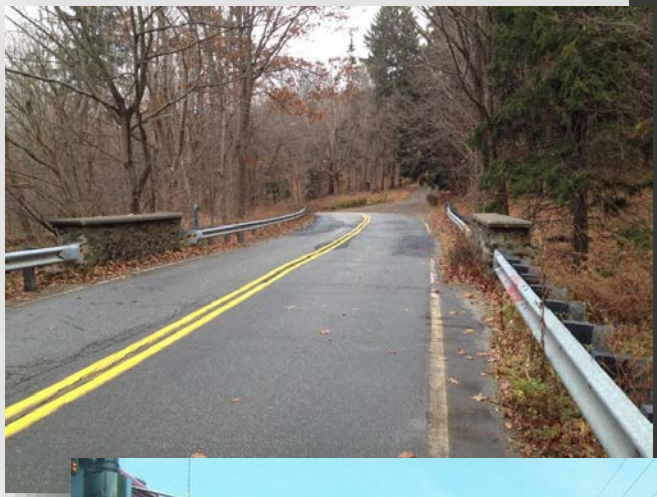
- Planning – What resources are available?
  - Traffic Counts
  - Neighborhood Information re: schools and stores
  - Timing of Traffic Signals
  - Local Events
- Everyone must know what is happening for the day and best times to conduct work.

Work Zone Planning

- **Considerations:**
- Where is the work?
  - Location – How Wide Are the Lanes
  - Road Configuration
  - Surrounding Activity – Daily or Special Events
  - Other work being conducted in area
- What will be used?
  - Equipment
  - Material
  - PPE
- Who will be working?
  - Available staff
  - Outside help – PD
  - Subcontractors

Traffic Issues

- Sight Distance – Blind Curves
  - Need extra signage
- High Speed – High Traffic Volume
  - No gaps for merging vehicles
  - Stopping traffic is impractical and unsafe
- Tailgating
  - Motorists following trucks into work space
  - Panic stops
- The motorist NEEDS MORE information



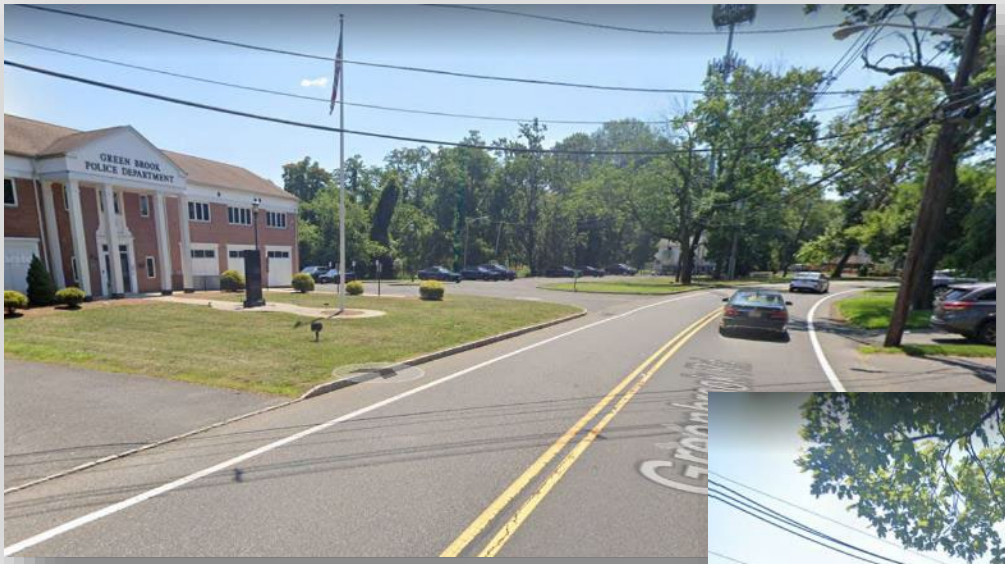
Planning for Emergency Vehicles

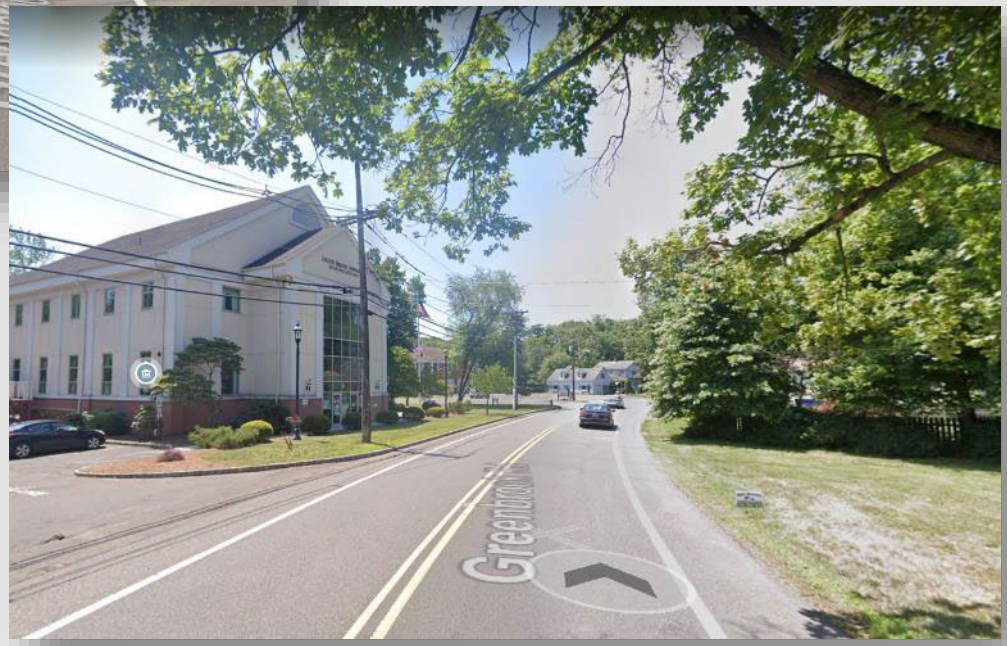
The best way to handle emergency vehicles is to plan ahead for them.

- The supervisor should call the 9-1-1 dispatcher to alert them before starting work.
- If a flagger hears an emergency vehicle approaching, bring all traffic and construction work to a halt and open the road up for the emergency vehicle to pass through.

Considerations – Discuss!

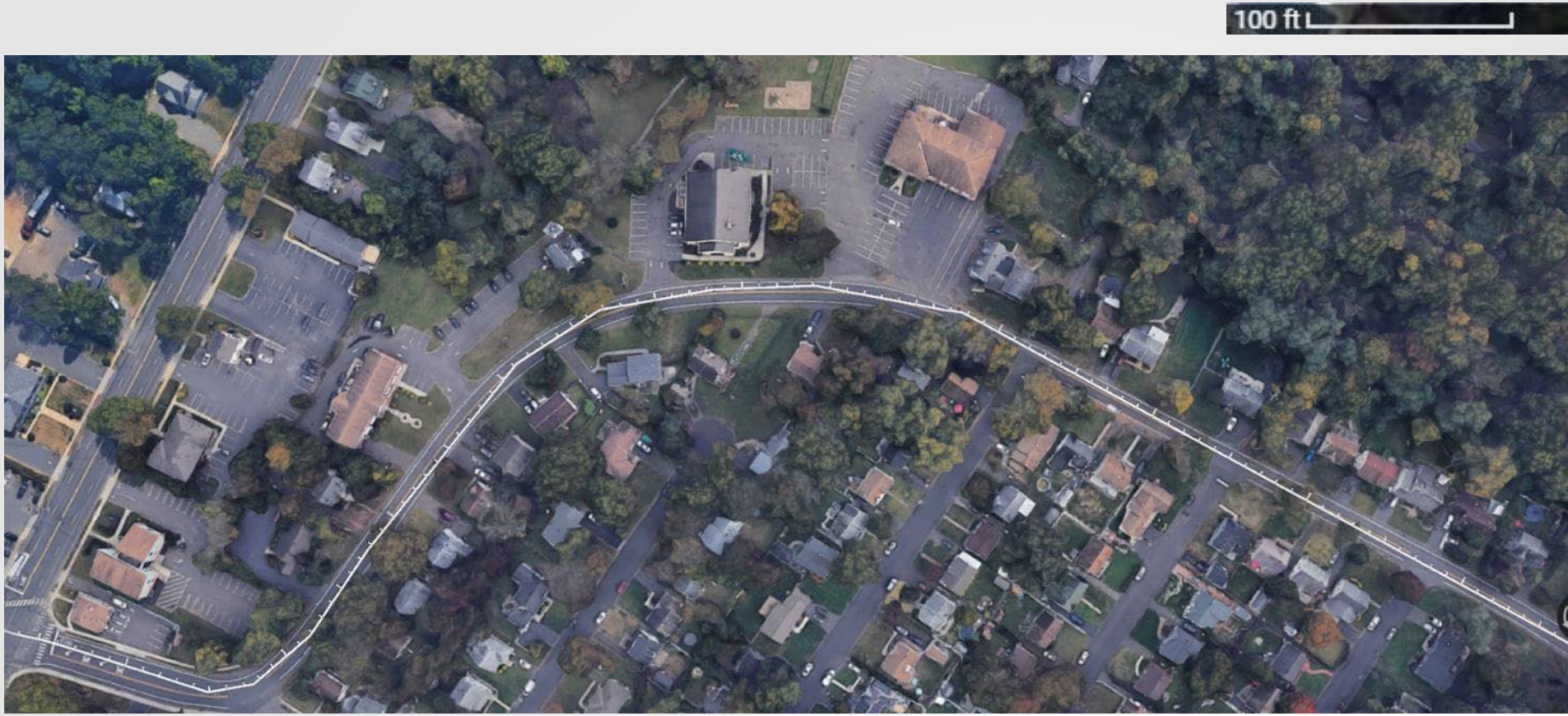
- Pre-shift meeting with all involved.
- Everyone must know what is happening for the day.





Greenbrook Township
109 Greenbrook Road

street with long curve



Greenbrook Township
Greenbrook Road

- street with long curve

Greenbrook Township
Gold Street and Greenbrook Road

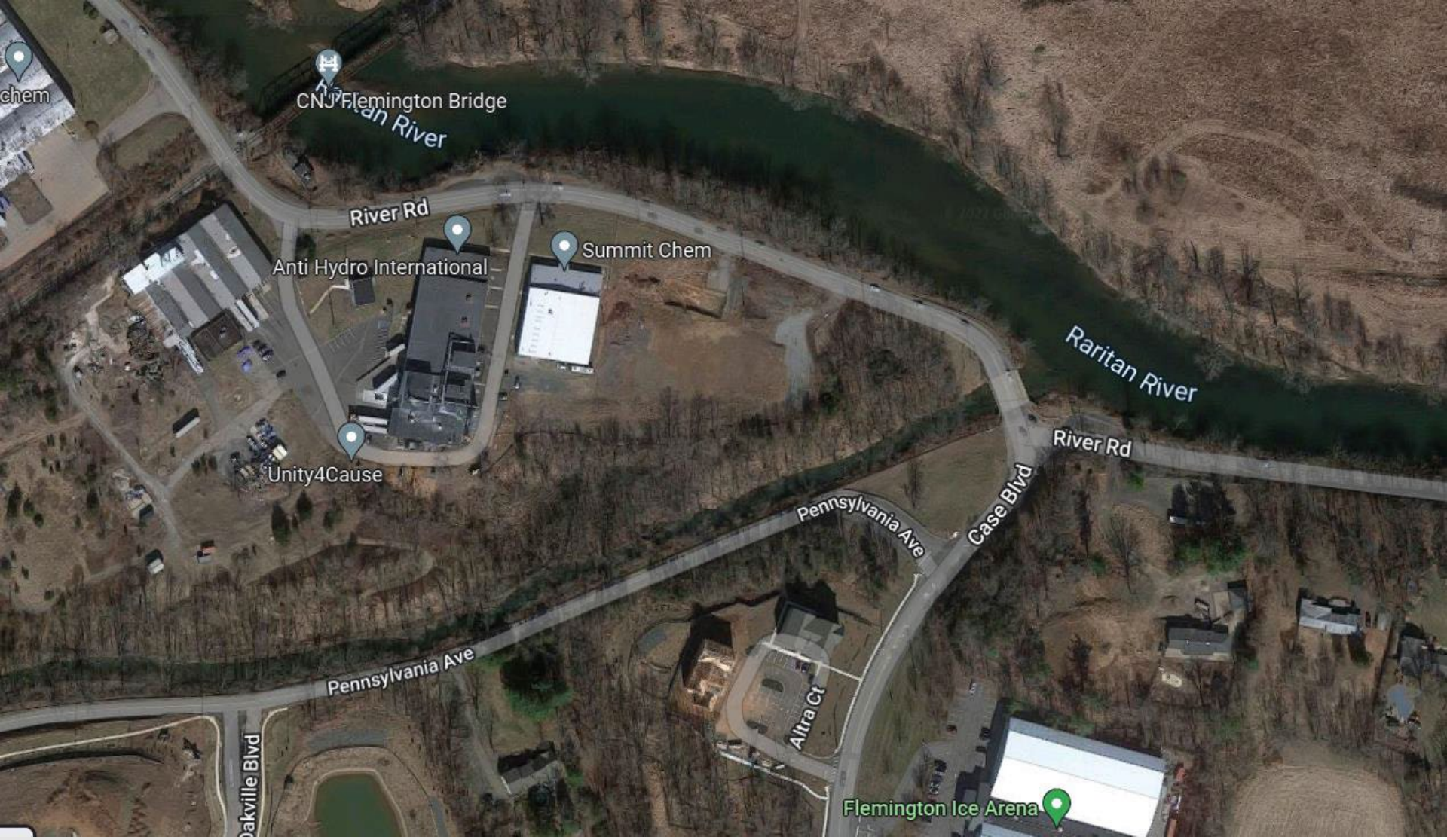
intersection of a side street with the same long curve

Greenbrook Township
Gold Street and Greenbrook Road

- intersection of a side street with the same long curve

Raritan Township
River Road

an extremely heavily traveled roadway with both autos and truck traffic



Raritan Township River Road

- an extremely heavily traveled roadway with both autos and truck traffic

Raritan Township

- specifics for trailer mounted leaf vacs collecting leaves on county roads in the township such as routes 523,579,612,613,617,650.

Flagger Safety

Flagger Control Chapter 6E

Select Flaggers Wisely

- Sense of responsibility for the safety of the public and the workers;
- Adequate training in safe temporary traffic control practices;
- Average intelligence;
- Good physical condition, including sight, mobility, and hearing;
- Mental alertness and the ability to react in an emergency;
- Courteous but firm manner; and
- Neat appearance.

Motorists kill about 20 flaggers each year, and many more are injured. Flagging is dangerous.

Flagging Operation

Flagger selection

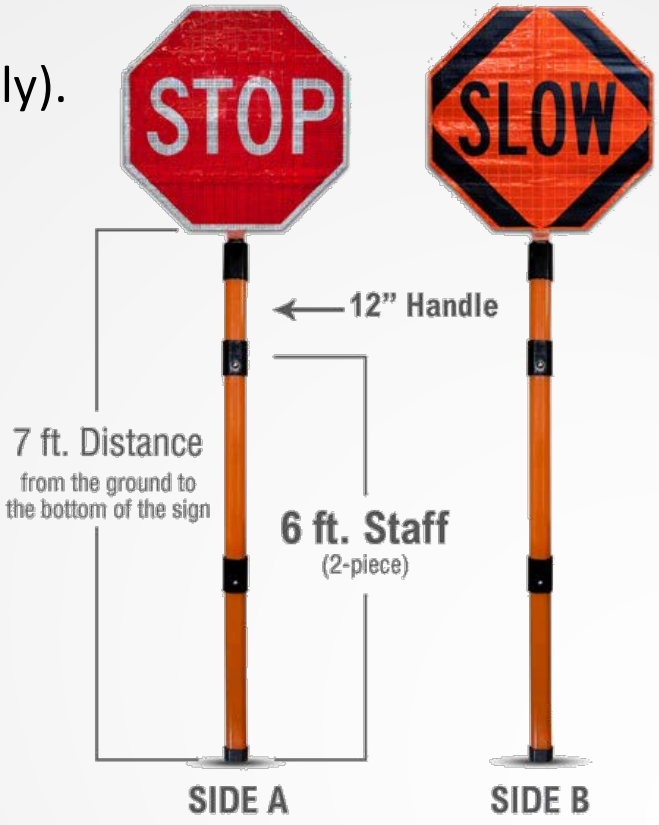
- STOP/SLOW Paddle or Red Flag
- One, two, or more flaggers?
- Communications
  - Hand Signals
  - Radios

Flaggers Tools

Section 6E.02 **High-Visibility Safety Apparel**

Section 6E.03 **Hand-Signaling Devices**

- STOP/SLOW Paddle
- Red Flag (use in emergency situations only).



Flagger Tools: Other Equipment

- **Pencil and Pad**: Used to keep records of incidents. If an crash occurs, write down any information that may apply to the crash while it is still fresh in your mind. If a problem occurs such as a driver running your stop command, first protect yourself, warn your fellow workers, return back to your working position, then try to record license plate information, brief description of vehicle, and description of the driver.
- **Whistle or air horn**: Used to warn those in the work area of an emergency situation, or dangers.
- **Communication devices**: Used to communicate with other flaggers, supervisors, or other workers.

High-Visibility Safety Apparel

Current MINIMUM Standard

- **ANSI Class 2:** on or near all roads and around work vehicles
- **ANSI Class 3:** in low visibility, high speed-high volume, or complex background conditions

When to Replace High-Visibility Safety Apparel

Acceptable

New high-visibility safety apparel is characterized by having vivid color contrast and high reflectivity.

Marginal

Characteristics: Good reflectivity although the vest has some soiling and light fading.

Unacceptable

Characteristics: little or no reflectivity, and soiled and faded material.

Acceptable

Apparel that is used but is in like-new condition is characterized as having excellent color contrast, excellent reflectivity, and is not faded or soiled.

Marginal*

Characteristics: Good reflectivity but has some soiling and light fading of material. *Note: This picture was taken with a flash and simulates nighttime conditions.

Unacceptable

Characteristics: Poor color contrast, low or no reflectivity, significant fading or soiling, and deteriorated reflective strips.

Zero, One, or Two Flaggers?

When can you not use flaggers and let traffic “Self Regulate?”

Low speed, low volume roadways where motorists can see around your spot obstacle.

When can one flagger be used?

When traffic cannot see around a small work zone and one flagger can control both directions.

When are two flaggers required?

When one flagger cannot control both directions.

Flagger Stations Section 6E.08

Standard:

01 **Flagger stations shall be located such that approaching road users will have sufficient distance to stop at an intended stopping point.**

Table 6E-1. Stopping Sight Distance as a Function of Speed

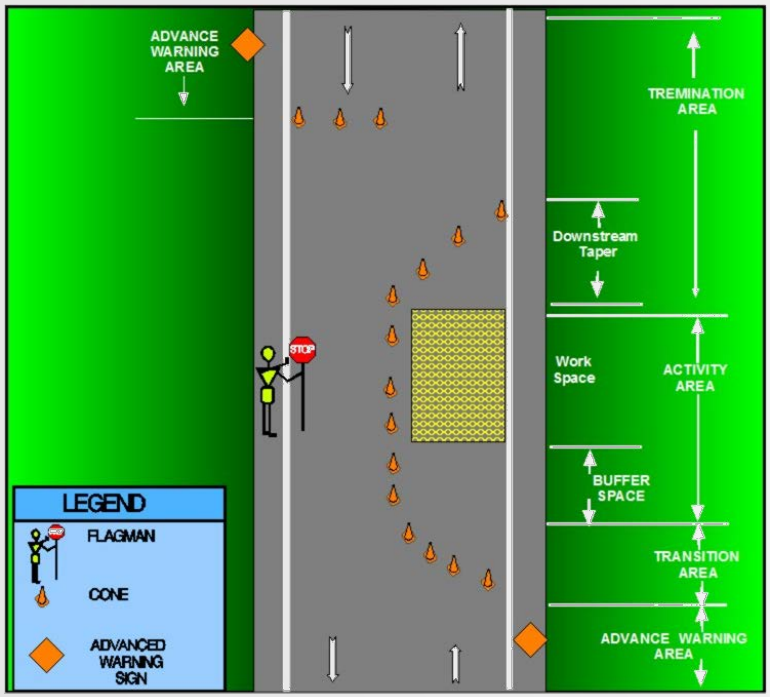
Speed*	Distance
20 mph	115 feet
25 mph	155 feet
30 mph	200 feet
35 mph	250 feet
40 mph	305 feet
45 mph	360 feet
50 mph	425 feet
55 mph	495 feet
60 mph	570 feet
65 mph	645 feet
70 mph	730 feet
75 mph	820 feet

* Posted speed, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed

Flagger Positioning

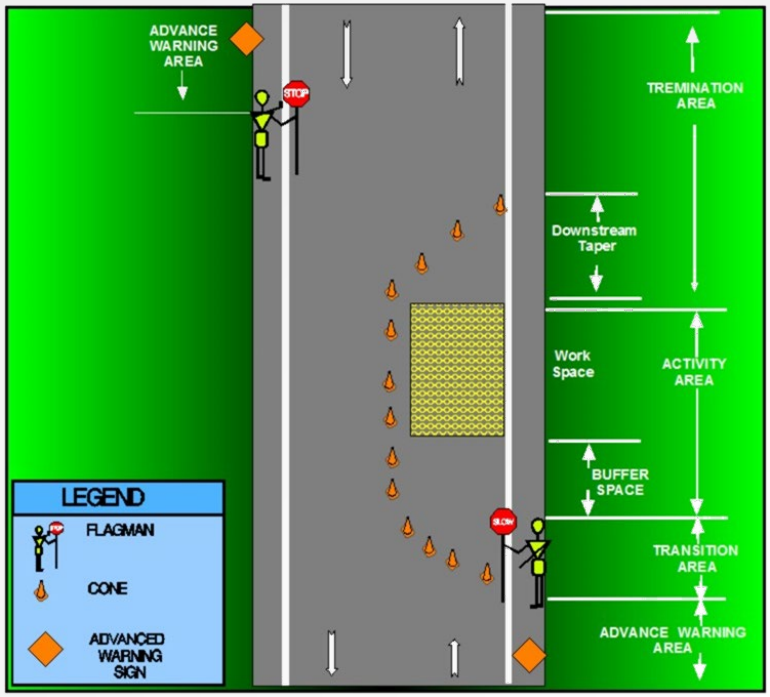
One Flagger

- Center, opposite side of work zone



Two Flaggers

- At either end of tapers



Some Flagger Don’ts

Don’t stand where you can be crushed by equipment.

Don’t stand in the shade, over a crest of a hill, around a curve, or otherwise obscured.

Don’t leave your position until properly relieved.

Don’t stand in a group or make unneeded conversation.

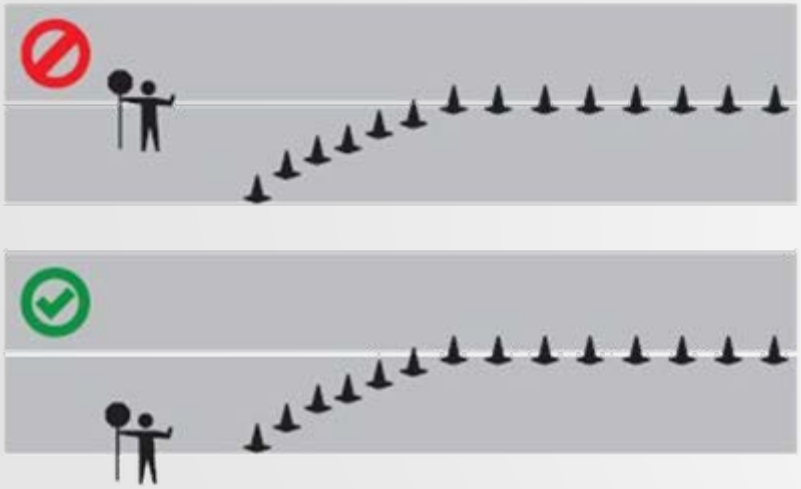
Don’t text, daydream, listen to music, or use ear phones.

Don't turn your back to the traffic!

STOP/SLOW Paddle (Preferred Method)

The STOP Position

- Hold STOP sign in hand closest to road.
- The free arm shall be held with the palm of the hand above shoulder level toward approaching traffic.
- Stand alone on shoulder of road facing traffic.



STOP/SLOW Paddle (Preferred Method)

Releasing Traffic

- Face road users.
- Turn paddle so SLOW command faces stopped traffic.
- Direct traffic to SLOWLY proceed with free hand.

STOP/SLOW Paddle (Preferred Method)

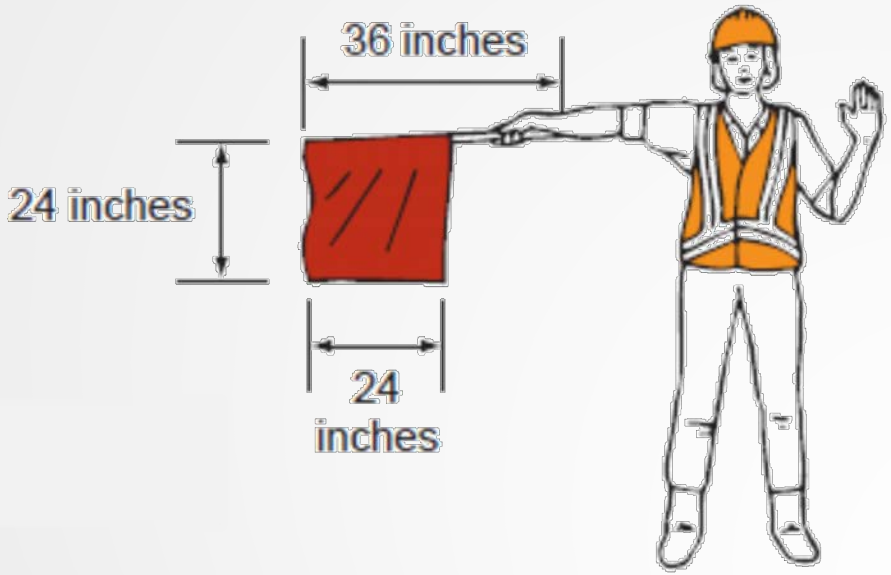
To Alert and Slow Traffic

- Face traffic with the SLOW paddle face forward.
- Get eye contact with drivers.
- Motion up and down with the free hand, palm down.
- The slower you move your hand, the slower traffic will go.

RED FLAG (Emergency Situations Only)

The STOP Position

- Red Flag horizontal to road, in hand closest to road.
- The free arm shall be held with the palm of the hand above shoulder level toward approaching traffic.
- Gain eye contact with driver.



RED FLAG (Emergency Situations Only)

Releasing Traffic

- Drop flag to side.
- Wave motorist through with other hand.
- NEVER wave motorists through with flag.

RED FLAG (Emergency Situations Only)

To Alert and Slow Traffic

- Face traffic and slowly wave the flag in a sweeping motion of the extended arm from shoulder level to straight down without raising the arm above a horizontal position.
- The flagger shall keep the free hand down.

Principles of Safe Temporary Traffic Control

- Plan for Safety
- Keep it Moving
- Communicate
- Monitor
- Plan for the Worst
- Train

Work Zone Issues

- Acceleration/Deceleration lanes
  - Short or non-existent
- Signage indicating merge/exit points
  - Signs give vague information
  - Messages left up 24/7
- Flagging operations
  - Works best with low traffic and moderate construction trucks
  - Low construction truck traffic means intermittent flagging
    - Proper rules are forgotten
- Information must be accurate and REAL TIME!

Additional Resources

Manual on Uniform Traffic Control Devices
http://mutcd.fhwa.dot.gov/index.htm

The Federal Highway Administration (FHWA)
http://safety.fhwa.dot.gov/

Library of Resources to Improve Roadway Work Zone Safety for All Roadway Users
https://www.workzonesafety.org

WORK ZONE SAFETY

WILL SAVE YOUR LIFE

AND THE LIVES OF OTHERS

EXPECT THE UNEXPECTED

The End...Questions?