Utility Work Zone Traffic Control

Instructor Guide

Prepared for:

United States Department of Transportation

Federal Highway Administration

Washington, D.C.

Prepared by:

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Detroit, MI

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Utility work zones are fundamentally different from most highway construction work zones. Utility work is often of a shorter duration and involves smaller crew sizes, which makes a traffic control plan such as that utilized in highway construction sometimes impractical. As utility service providers often need to work on or near roadways, utility work zones pose unique challenges to the health and safety of both motorists and workers. In response to these challenges, the Utility Work Zone Traffic Control Guidelines were developed, along with a training program aimed at management and safety officials, utility workers, foremen, and supervisors.

This instructor's guide provides a set of PowerPoint slides and background material to aid in the presentation of this program to various audiences. The program provides an introduction to utility work zone operations and presents recommendations for several important aspects of safety related to utility work, including the establishment of a safety culture in the organization, the use of uniform and consistent traffic control devices and systems, and the development of a set of typical temporary traffic control plans (TTCP) that are appropriate for specific types of work sites. Two software programs developed as a part of the project are also covered.

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This document is a 'Living Document' and may be modified as needed.

Utility Work Zone Traffic Control

Instructor Guide

Utility Work Zone Traffic Control
Management and Safety Official's Module

Utility Work Zone Traffic Control: Utility Workers, Foremen and Supervisors Module

Utility Work Zone Traffic Control

Management and Safety Official's Module

I. Introduction

Utility work zones often differ from typical highway construction and maintenance work zones. They are often shorter in duration, and the extent of traffic control devices used is dependent on the work crew and their company's/agency's safety practices and their perception of risks. Long-term utility work is generally planned ahead of time and often requires maintenance of traffic (MOT) plan approval by the appropriate road agency. Therefore, such a utility work zone adheres to national and local work zone traffic control standards and practices. Shorter duration utility work zones range from a shoulder closure to an entire roadway closure with the work activities lasting from a few minutes to several hours. Emergency situations requiring a full road closure are most often controlled by local law enforcement officials which allows the work crew to address the situation efficiently.

Utility work often involves the presence of work vehicles and equipment in the travel lanes of the roadway, on the shoulder and/or within the right-of-way of active roads and highways. Although utility work is often less time consuming than highway construction and maintenance activities, it still poses similar challenges to passing motorists and workers. The Manual on Uniform Traffic Control Devices (MUTCD) provides general guidelines and minimum standards for utility work zone traffic control. The MUTCD provides significant flexibility as its requirements are applicable to the entire range of work zone situations (i.e. long-term highway construction, short-term maintenance, utility work, mobile operations, etc.). These requirements have been interpreted in many different ways by utility companies, contractors and road agencies. This has contributed to a lack of uniformity in utility work zones which may lead to increased risks for both motorists and workers, and may result in reduced mobility.

This training focuses on the *Utility Work Zone Traffic Control Guidelines*, which addresses traffic control needs for utility work activities on or near public thoroughfares that are conducted routinely, last for relatively short time periods and take place during the daytime. Long-term utility projects and nighttime work are not within the scope of the guidelines. These guidelines also include strategies to mitigate safety challenges associated with utility work zones. The guidelines have been developed to address gaps found in existing relevant guidelines/

standards and industry needs identified through literature reviews, current practice surveys, interviews of safety officials, information collected during utility work zone site visits and utility worker surveys.

II. Executive Summary

In general, utility work zones are different than typical highway construction work zones. They are often shorter in duration, and the traffic control used may be dependent on the work crew and their company's/agency's safety practices and their perception of risks. Long-term utility work is generally planned ahead of time and often requires maintenance of traffic (MOT) plan approval by the appropriate road agency. Therefore, such a utility work zone adheres to national and local work zone traffic control standards and practices. Emergency utility work zones are events that are most often controlled by local law enforcement officials and could range from a shoulder closure to an entire roadway closure. Most utility work can vary from a few minutes to several hours. The focus of this training program is to provide safety guidelines for utility work zone traffic control to management and safety officials, the decision makers of the utility companies, utility contractors and road agency maintenance departments.

III. Course Organization

The entire course is organized into two modules. The morning portion is intended for management and safety officials and is three-hours long. The afternoon portion will cover topics relevant to utility workers, supervisors, and foremen and is also three hours long. The entire one-day course including both modules should last six hours plus a one hour lunch break and may be held from 9:00 AM to 4:00 PM. A detailed agenda is provided in Section IX. The lessons for the morning sessions are shown in the table below.

Morning Session: Management and Safety Officials' Module

Lesson #	Lesson Title & Description	Est. Time (minutes)
1	Welcome, Housekeeping, Participants, and Introductions	30
1	Pre-Test	15
2	Why Follow the Guidelines?	15
3	Utility Work Zone Traffic Control and Safety / Positive Guidance / Driver Expectancy	30
3	Break	15
4	Agency-wide Safety Culture – What? Why? How?	30
5	Training, Knowledge Retention and Retraining Issues	30
5	Question and Answer	15

IV. Course Coordination

The dates and times of the course should be planned in advance so that the participants are aware of the upcoming training session. Registration forms should be made available far in advance so that participants can complete them and return them to the appropriate agency.

V. Class Size

The maximum class size is 30 participants and the minimum class size is 10 participants. A smaller class size is recommended to provide a more personal and interactive environment. A larger class size is fine as long as the facilities can comfortably accommodate the larger number of participants.

VI. Host Agency Responsibilities

Audiovisual Equipment Requirements

The visuals aids for this course include PowerPoint presentations and other computer programs. The following audiovisual equipment is required:

- LCD projector and proper cables for connection

- Spare projector bulb
- Electronic remote device, if available
- Projection screen (at least 6' x 6')
- Pointer
- Flip chart
- Large markers

Room Requirements

The room must be able to accommodate the number of participants attending the training session. The room should be set up in classroom style. The instructor should be able to adjust the lighting and temperature of the room.

Notepads and pens should be available in the room for participants. Water should also be made available to the instructors and participants.

Local Coordinator's Responsibilities

The local coordinator should make arrangements so that the room is prepared ahead of time and meets the needs of the instructor(s). The local coordinator should also make arrangements to provide refreshments during the course breaks and lunch for the instructors and participants.

Participants and Instructors

All participants and instructors should be aware of the location and times of the programs. Directions to the training facility should be provided to all participants. Hotel room accommodations and rates, for those guests traveling a far distance, should be made available to all participants and instructors.

VII. Description of Target Audience

This three-hour morning session is intended for decision makers of the utility companies, utility contractors and road agency maintenance departments including the management and safety officials.

VIII. Course Goal and Outcomes

Course Goals

- Reinforce the importance of safety for both workers and motorists.
- Understand the importance of uniformity and conspicuity of traffic control devices and equipment and how it assists motorists in early recognition of utility work zones.
- Establish a continuing agency-wide safety culture.
- Engage employees in routine safety training and retraining sessions
- Allocate resources to assist in implementing the guideline recommendations.

Course Outcomes

At the conclusion of the course, participants will be able to:

- Be aware of the contents of the *Utility Work Zone Traffic Control Guidelines* and how they can help improve safety.
- Understand the differences in utility work zone activities and highway construction and the implications on temporary traffic control needs based on an assessment of risk.
- Understand the importance of safety in a utility work zone.
- Realize how uniform and dominant traffic control devices impact motorists ability to detect changes in the roadway environment and respond to them properly.
- Understand the steps involved in establishing safety culture at their company.

IX. Course Agenda

Morning Session: Management and Safety Officials' Module

Time	Lesson Title	Length (minutes)
9:00-9:30	Welcome, Housekeeping and Introductions	30
9:30-9:45	Pre-Test	15
9:45-10:00	Why Follow the Guidelines?	15
10:00-10:30	Utility Work Zone Traffic Control and Safety / Positive Guidance / Driver Expectancy	30
10:30-10:45	Break	15
10:45-11:15	Agencywide Safety Culture – What? Why? How?	30
11:15-11:45	Training, Knowledge Retention and Retraining Issues	30
11:45-12:00	Question and Answer	15

X. Instructor: Presentation Requirements

Before the Training Event

Confirmation of the training date, time, location and participant details should be made before the event. Name tags should be made for each participant to encourage networking opportunities.

The instructor should have copies of the following CDs made and distributed to each participant:

- Utility Work Zone Traffic Control Guidelines
- Selection of Utility Work Zone Traffic Control Plans Software Program
- Drag and drop Application for the Case Study, In-Class Exercises

The instructor should have copies of the following items made for each participant:

- Agenda
- Evaluation Form
- Participant Workbook
- Pre-Test
- Post-Test
- In-Class Exercise Description

The instructor(s) should be very familiar with the information that they will be teaching. The information provided should be studied and additional resources should be examined to help better prepare the instructor.

The instructor should visit the training session venue prior to the event to make sure the room is properly set-up and that the equipment is in good working condition.

During the Training Event

During the training event it is very important that the instructor is well prepared. The instructor should arrive early to make sure everything is working properly and to ensure that they have enough time to get organized. The instructor(s) should adhere to the time schedule.

Questions from the participants should be answered in a concise and timely manner.

The pre-test should be administered to the participants at the start of the training.

After the Training Event

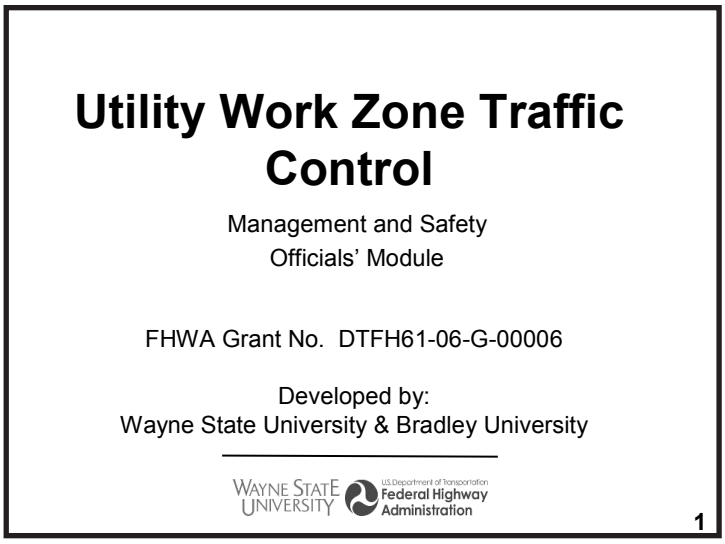
The post-test should be administered to the participants at the end of the training. Each participant should fill out the evaluation form throughout the day at the completion of each lesson. Make sure to collect all the evaluation forms at the end of the training.

XI. Lesson Plans and Visual Notes

This section contains a description of each lesson followed by the PowerPoint slides with notes for each lesson. Each lesson will be evaluated by the participant in the evaluation form. Each participant will be evaluated on their knowledge and what they had learned in each lesson by the pre- and post-test. References for the instructor are provided in Section XV and following the lecture slides, where appropriate.

Lesson 1: Welcome, Housekeeping and Introductions

Lesson Number:	1
Lesson Title:	Welcome, Housekeeping and Introductions
Performance-Based Learning Outcomes:	To understand the purpose of the training program and what will be covered.
Instructional Method:	The instructor will begin the lesson with an introduction of the instructors and address any housekeeping issues. The participants will be asked to state their name and the company that they work for. The instructor will then continue with a description of the agenda and an introduction about what will be covered in the module. The lesson will end with the instructor administering the pre-test to the participants
Time Allocation:	30 minutes

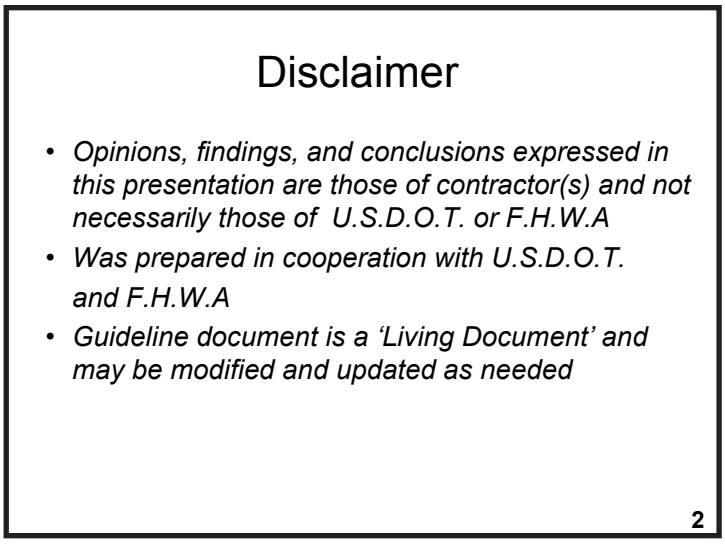


The instructor should begin by providing an introduction to the training program, including who the program is targeted for (management and safety officials), who sponsored the program development (Federal Highway Administration), and who prepared the training materials (Wayne State University and Bradley University).

The instructor should provide a brief overview of the Work Zone Safety and Mobility Rule. The Work Zone Safety and Mobility Rule supports a three-tiered approach to work zone mobility and safety, which includes an overall policy for management of work zone impacts, agency-level processes and procedures to implement the work zone policy, and project-level procedures to assess and manage work zone impacts. The first component of the Rule promotes the use of a decision-making framework and targeted strategies to address a wide range of safety and mobility impacts in work zones throughout the project development stages. The second component requires agencies to develop an agency-level work zone safety and mobility policy utilizing the work zone safety and operational data, personnel training, and process reviews to assess and manage the impacts of all project stages based on standard procedures adopted by the agency. The third component includes the identification of 'significant projects' and requires that the transportation management plans consist of a Temporary Traffic Control Plan, Transportation Operational Strategies and Public Information components.

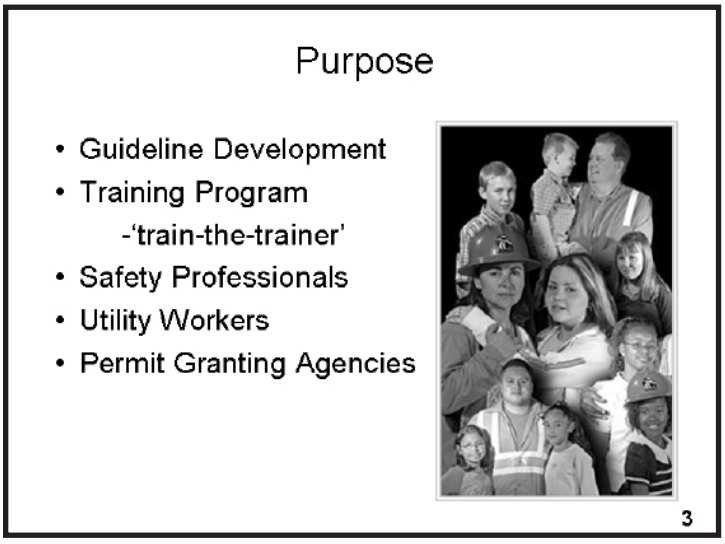
According to the Federal Highway Administration Final Rule on Work Zone Safety and Mobility, assuring compliance with work zone related guidelines includes establishing "procedures and specifications which help achieve or maintain an acceptable level of quality for traffic control plan applications, including all traffic control devices and safety appurtenances used in work zones" and using "available resources and guidance material to achieve better compliance with traffic control plans, specification, and procedures".

Additional information about the Final Rule on Work Zone Safety and Mobility can be found at: http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm.



The instructor should note that the opinions, findings, and conclusions expressed during the presentation are those of the contractors and not necessarily those of the U.S. Department of Transportation or the Federal Highway Administration. This training program and the *Utility Work Zone Traffic Control Guidelines* were prepared in cooperation with the U.S. Department of Transportation and the Federal Highway Administration.

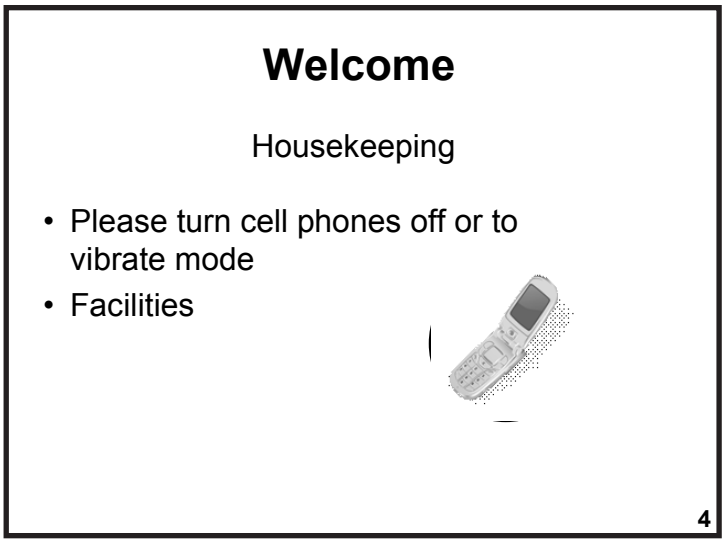
The instructor should also note that the *Utility Work Zone Traffic Control Guidelines* are a 'Living Document' and may be modified in the future as needed.



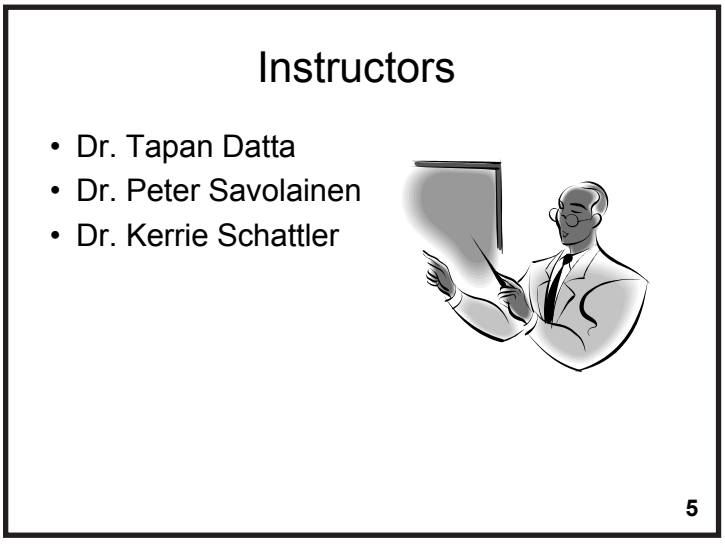
The instructor should briefly explain the purpose of the training program. The program has been developed in accordance with the accompanying *Utility Work Zone Traffic Control Guidelines*, both of which were developed through an FHWA Work Zone Safety grant. The program is intended to train safety professionals at all levels (management, supervisors, and workers) and from all applicable agencies (utility companies and contractors, federal, state, and municipal employees involved with work zones or the permitting process).

The overall objectives of this grant are:
1) To develop *Utility Work Zone Traffic Control Guidelines* to assist transportation agencies, utility companies and contractors in achieving reductions in injuries and fatalities while complying with FHWA's 'Work Zone Safety and Mobility Rule'
2) To develop a training program based on the developed *Utility Work Zone Traffic Control Guidelines*
3)To conduct 'train-the-trainer' workshops at a national level and pilot training sessions on the methods and procedures of implementing the *Utility Work Zone Traffic Control Guidelines* developed as a part of this project

The *Utility Work Zone Traffic Control Guidelines* and training program have been developed based on the "State-of-the-Art and State-of-the-Practice Review" and "Gap Study and Needs Assessment" documents.

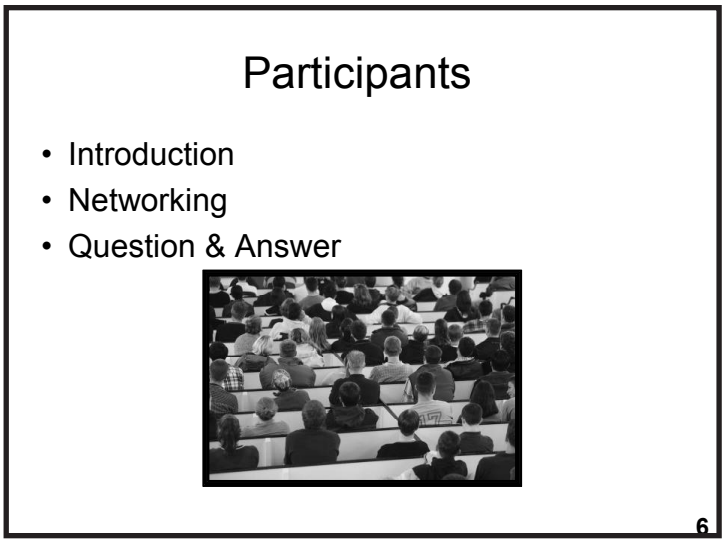


The instructor should discuss about general "housekeeping" tasks, which include reminding all participants to turn off their cellular phones and pagers, as well as explaining where appropriate facilities are located, including restrooms, food and beverages, and areas where smoking is permitted.

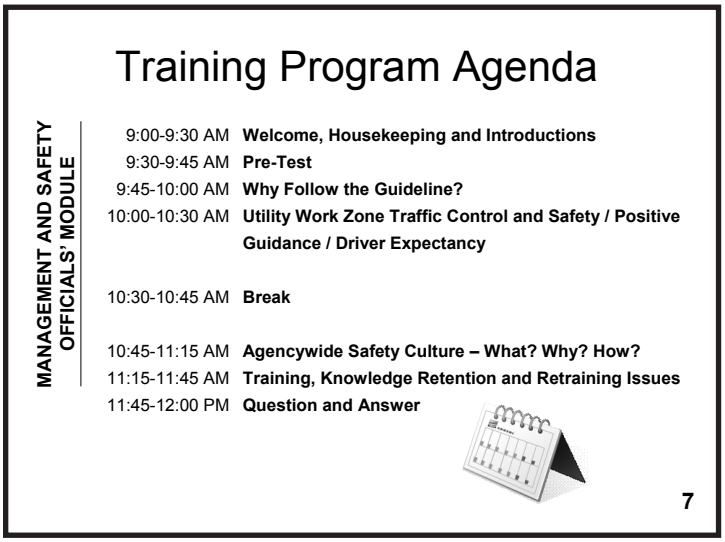


The instructors should introduce themselves, providing their background, including organizational affiliations and expertise and experience in regard to utility work zone safety and training.

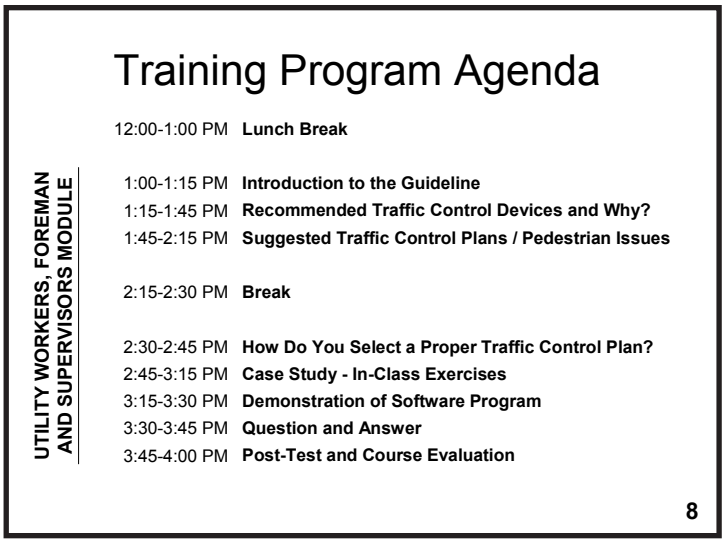
Be sure to modify the text on the slide by inserting the correct name(s) of the instructor(s) presenting at the specific training session.



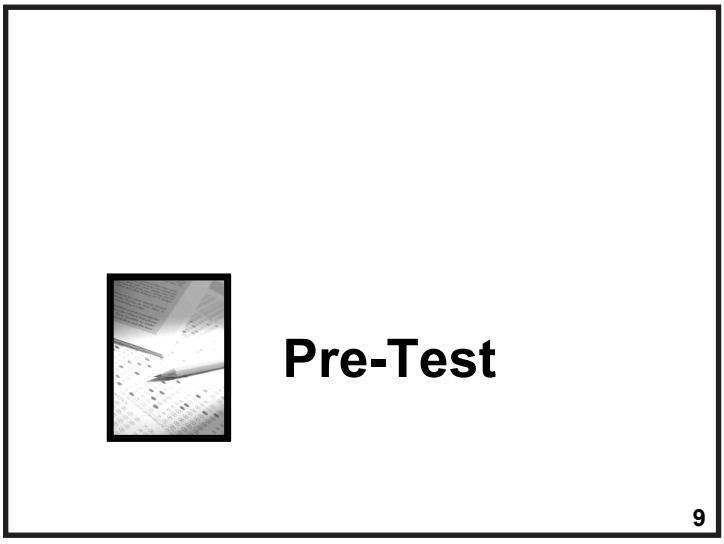
Each of the participants in the training program should be asked to briefly introduce themselves, including their company, their position, and their involvement in utility work zones. Participants should be encouraged to network with one another and also to ask questions over the course of the training program. However, they should be mindful that these questions may be answered in subsequent slides.



The instructors should briefly outline the agenda for the module (morning session) of the training program, which will be geared toward management and safety officials. The module will start with a brief pre-test which will be used to assess the gain in participants knowledge as a result of the program. Then lessons that will be covered will include: an overview of the *Guidelines*, introductory information on utility work zone traffic control and safety, positive guidance, and driver expectancy. A fifteen minute break will be provided during which time participants will be able to use the restroom or grab a snack. The program will then resume with lessons on establishing an agency-wide safety culture and knowledge retention/ training issues. A question and answer session which will conclude the management and safety officials' module.



At the conclusion of the morning session, a one-hour lunch break should be provided. The afternoon session focuses on lessons relevant to utility workers, foreman, and supervisors. This module will introduce course participants to hands-on applications in real-world scenarios in order to provide them with the knowledge and skills necessary to design and implement appropriate utility work zone traffic control plans. The recently developed guidelines will be discussed, along with recommendations for appropriate traffic control devices and the suggested temporary traffic control plans/pedestrian issues. A fifteen minute break should follow. Next, the participants will learn what factors are necessary to select an appropriate traffic control plan prior to delving into several case studies. A demonstration of the software program developed to aid in the selection of the proper utility work zone temporary traffic control plan will be presented and provided to all participants. The program should conclude with a second question and answer period, and then the post-test and course evaluation.



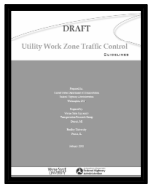
The instructor should present the participants with the pre-test to determine their background knowledge in regard to utility work zone safety and traffic control. The participants should be provided 15 minutes to complete the pre-test.

It is important to note that the test questions were carefully designed so that they were relevant and directly related to the lesson topics. Care should be taken to guard against the explicit discussion of the answers to the test questions by the instructors. The instructors are requested to present the materials in such a manner that the correct answers would be presented to the participants, but not in an explicit manner.

The instructors should carefully review the test questions and answers well before the training day and again throughout the training session to ensure that the topics included on the test are thoroughly covered.

Lesson 2: Why Follow the Guideline?

Lesson Number:	2
Lesson Title:	Why Follow the Guideline?
Performance-Based Learning Outcomes:	To understand why the guidelines were developed. To understand why they should be followed.
Instructional Method:	The instructor will discuss the rationale for developing the *Utility Work Zone Traffic Control Guidelines*, its contents, the intended audiences, and how it can be used to help improve safety.
Time Allocation:	15 minutes



Why Follow the Guideline?

10

The *Utility Work Zone Traffic Control Guideline* is a living document; it may require updating over time.

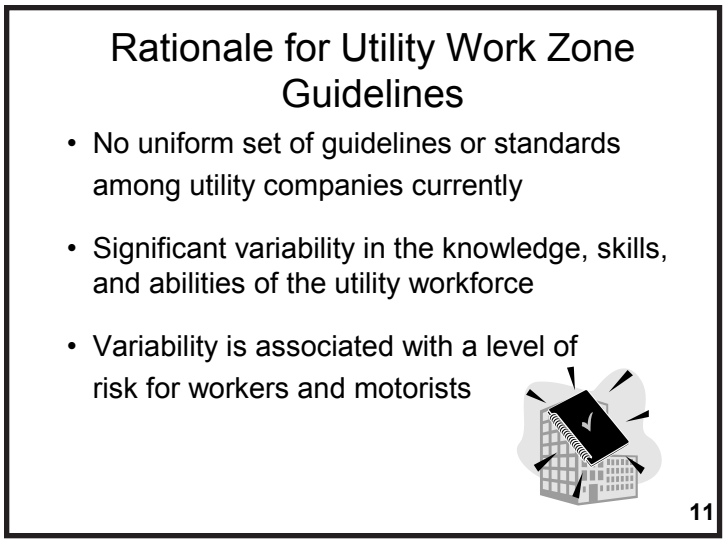
What is unique about these guidelines?
They have been developed specifically for utility related work on or near public thoroughfares. Most other manuals and guidelines are directed towards highway work zones, with suggestions that indirectly address utility work zones. This guideline ONLY addresses utility work zones.

In preparation of the guidelines, the authors went out in the field and had discussions with utility workers, the safety managers, who are involved in utility work every day. This was done to understand the nature of the utility and maintenance industry.

In addition, past studies and research results were consulted to develop the guidelines. A current practice review was also conducted to assess temporary traffic control usage by those involved in utility work, as well as the site interviews and surveys.

Note: The instructor may wish to refer to the following documents developed as a part of the preparation of this training program and guidelines:

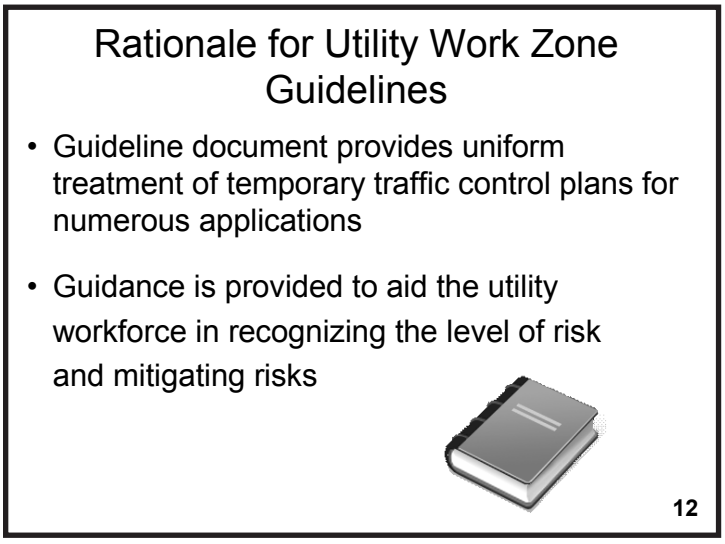
- **Utility Work Zone Safety Guidelines and Training: State-of-the-Art Synthesis and State-of-the-Practice Synthesis**
- http://wzsafety.tamu.edu/training/fhwa_wz_grant/utility_work_zone_safety/
- Utility Work Zone Safety Guidelines and Training: Gap Study and Needs Assessment
- http://wzsafety.tamu.edu/training/fhwa_wz_grant/wsu_gap



As a part of the state-of-the-art literature review, past research papers, national and state-specific manuals and other documents were reviewed. This review revealed that many utility companies and contractors use their own "in-house" guidelines for safety and traffic control procedures at utility work zones. Many of these are based on various interpretations of the MUTCD. The MUTCD does provide guidance for utility work zone traffic control; which leave room for user interpretation. The in-house temporary traffic control guides sometimes differ from agency to agency, and from state to state. No uniform set of guidelines was available and as a result there are various levels of knowledge, skills and ability of the utility workforce.

Some agencies may follow the 'typicals' in the MUTCD for highway work zones in their utility work zones, while others may be vaguely knowledgeable with respect to the MUTCD. The instructor should be familiar with the Part 6 of the MUTCD on temporary Traffic Control (http://mutcd.fhwa.dot.gov/HTM/2003/part6/part6-toc.htm) and the 'typicals' in case the audience is not familiar with them. Additional explanation may be necessary.

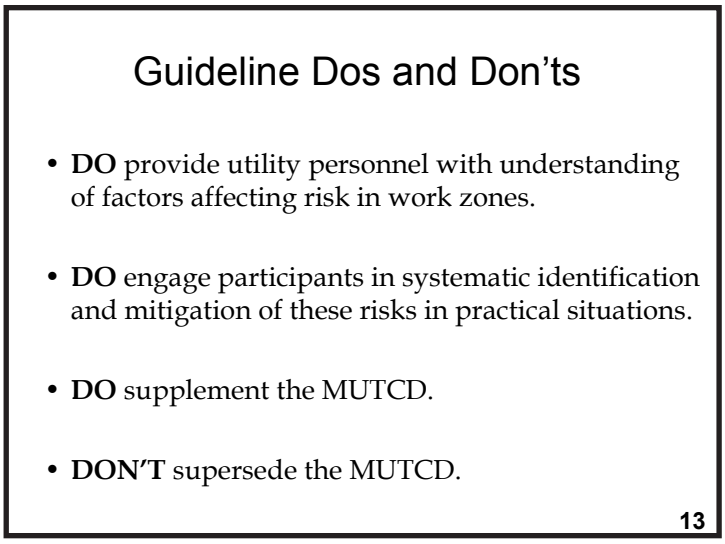
FHWA realized that this gap existed and provided a grant to researchers at Wayne State University and Bradley University to develop guidelines that fill this gap. This guideline and training program is expected to encourage uniformity among the practices of those involved in utility work, thus improving safety on our roads and streets.



This guideline provides recommendations that will promote uniformity and includes temporary traffic control plans similar to 'typicals' for numerous utility work zone applications, as well as what traffic control devices should be used in these zones.

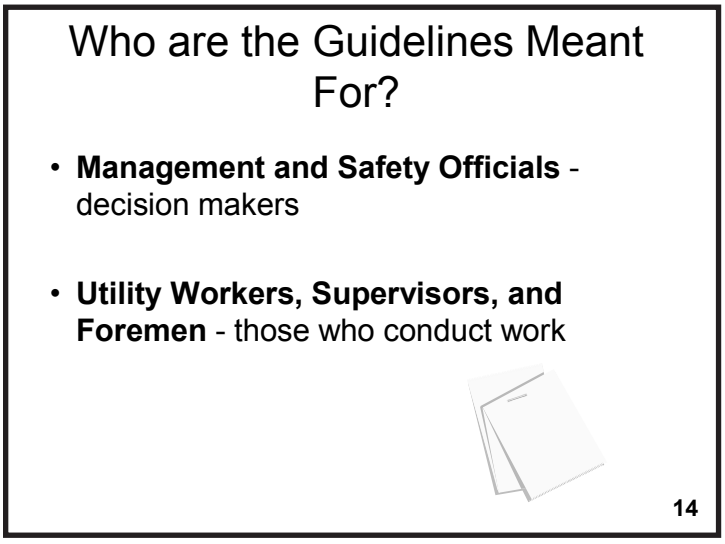
The applications and temporary traffic control plans were developed to address the level of risk associated with the work activities. This guideline is a supplement to the MUTCD and is not intended to override the MUTCD.

In order to select appropriate plans, utility workers must first be able to identify the risks associated with various work environments. Consequently, in addition to providing typical applications, these guidelines also serve to demonstrate the differences in risk between various work environments and provide course participants with the ability to assess the safety potential of various work zone scenarios.



These guidelines were developed with several objectives in mind. First and foremost, the guidelines are meant to provide utility personnel with a knowledge and understanding of the factors which affect risk in utility work zones. (Instructor may ask the audience) What are some of these factors? Secondly, these guidelines are meant to engage participants in the identification and mitigation of these risks in practical situations as will be done through the case studies presented as part of this afternoon's module. Finally, these guidelines are intended to supplement and not supersede the MUTCD. At no point do the guidelines contradict any material from the MUTCD; they simply serve to guide utility personnel in utilizing the appropriate material from the MUTCD as it applies to utility work.

So this set of guidelines contains more than just a set of plans; it contains the information and tools to train your utility workforce in identifying risk and minimizing risk to themselves and motorists.



Who are the guidelines meant for? They are directed towards two constituents:

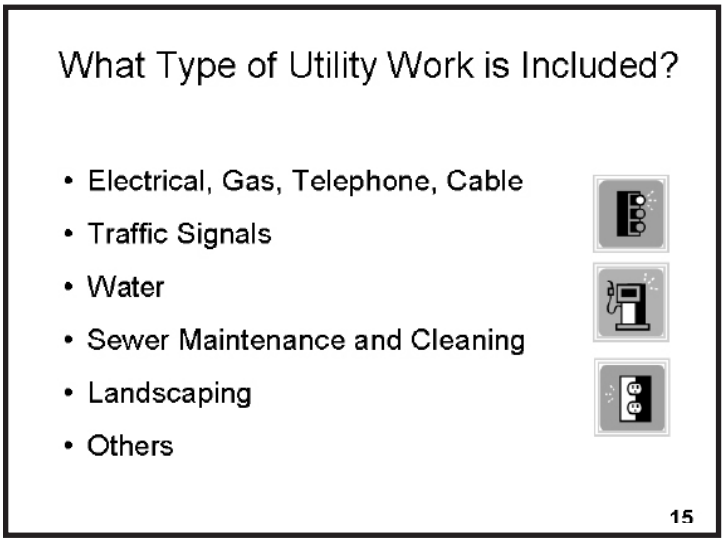
- Management and Safety Officials
- Utility Workers, Foremen and Supervisors

How can they use the guidelines?

Management can use it to:

- Estimate resources necessary for setting up temporary traffic control
- Identify types and specs of traffic control devices that may need to be purchased
- Assess and continually re-assess the training needs for the workers

Workers can use it to acquire the knowledge and tools to set up and remove appropriate utility work zones that will minimize risk to themselves, their colleagues, motorists and pedestrians.



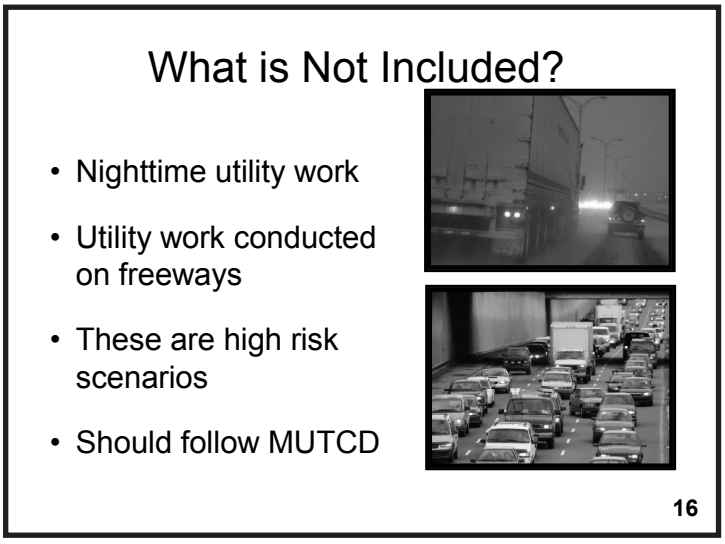
What types of utility work activities are addressed in the guidelines?

All utility work performed on and/or around road and streets, including:

- Utility work involving gas, electric, telecommunications
- Sewer cleaning
- Grass cutting, tree trimming and landscaping
- Signal work
- Changing street lights
- Others

Does it pertain only to utility companies?

No, all entities/agencies that perform utility work, such as departments of transportation's maintenance divisions, local county and city road agencies.



What applications/scenarios are not included in the guidelines?

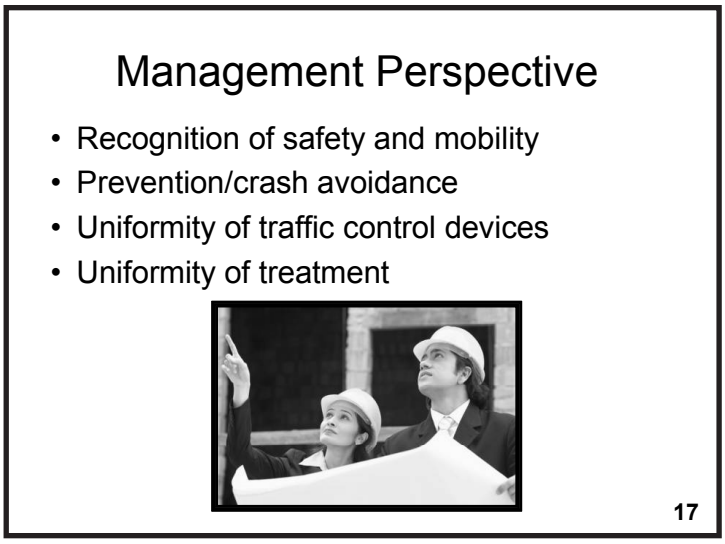
1. All scenarios that are considered high risk situations, in which case the 'typicals' in the MUTCD will apply. Such scenarios include:

- Utility work conducted during the nighttime
- Utility work conducted on freeways

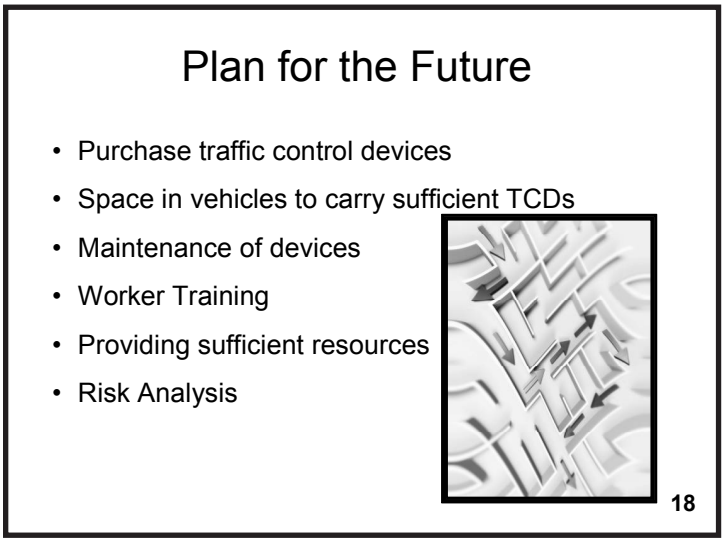
In these cases, the risk of safety to workers and road users is high, due to:

- Poor visibility during the night
- Driver response may be slower if they are fatigued
- Possible intoxication on the part of the motorist or pedestrian

2. Work on freeways where traffic volumes may be high and travel speeds are high creates additional risks, even if the duration of the work is short. It only takes a few seconds for a vehicle to enter in a work area and strike a worker, so it's best to use more safety precautions to minimize the threat of work zone related crashes.



From a manager's perspective, this guideline should be viewed as a mechanism and tool to promote, encourage and reward workers in recognizing the safety and mobility impacts of the temporary traffic control set up/removal and devices used on-site on a job. When followed, this will assist in the prevention, minimization of worker injuries by providing road users with appropriate information and cues to travel through the zone safely and minimize the likelihood of a crash. It will also promote uniformity of traffic control devices and uniformity in the treatment of a situation, which will create a safer environment on the roads over time.

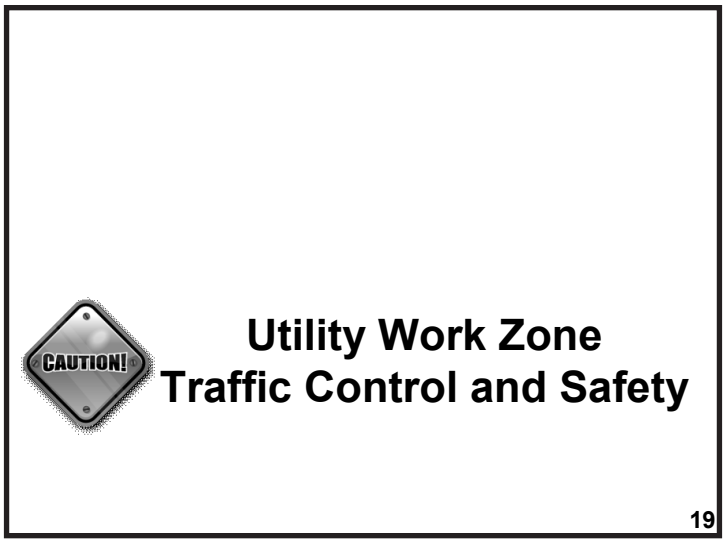


Managers should also be proactive in planning for the future:

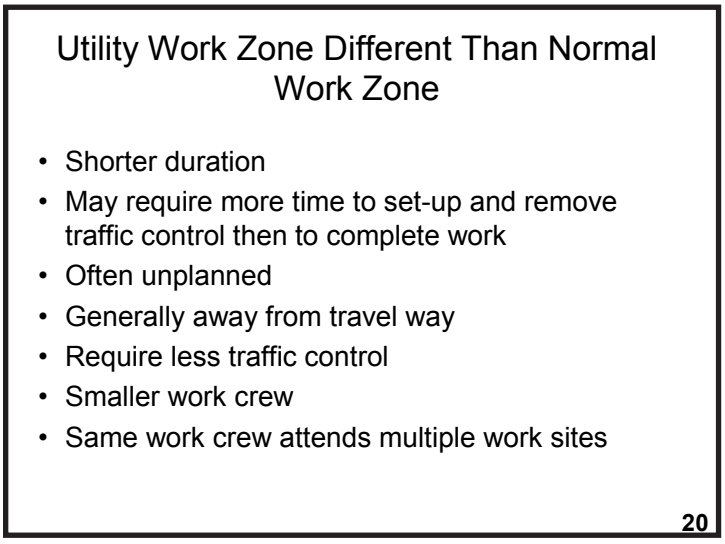
- Begin purchasing the traffic control devices recommended in this guideline in terms of the type and quantity to ensure sufficient supply is available based on workload
- Maintain these devices and ensure that they are in acceptable conditions, in terms of being clean and visible to road users, and that the retro-reflectivity is maintained for night operations
- Actively engage workers in training and retraining programs with incentives
- Promote the risk analysis process, so that workers understand and implement traffic control devices that protect them and others from unnecessary injury and devastation

Lesson 3: Utility Work Zone Traffic Control and Safety / Positive Guidance / Driver Expectancy

Lesson Number:	3
Lesson Title:	Utility Work Zone Traffic Control and Safety / Positive Guidance / Driver Expectancy
Performance-Based Learning Outcomes:	To understand the importance of utility work zone traffic control To understand how positive guidance plays a role in motorists behavior To understand why driver expectancy is important in the use of temporary traffic control
Instructional Method:	The instructor will describe utility work zones, the importance of using temporary traffic control, and how safety can be achieved. Positive guidance and driver expectancy will be discussed by the instructor using the Powerpoint presentation. The lesson will end with a 15 minute break.
Time Allocation:	30 minutes

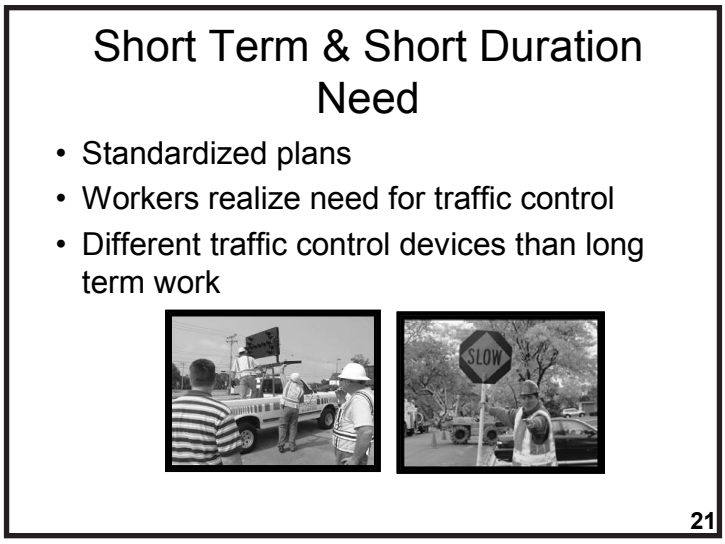


This lesson covers utility work zone traffic and safety. At this point, the instructor can involve the audience by asking the participants how utility work zones are different from other types of work zones.



Utility work is typically of a shorter duration than normal work zones, often being completed in fifteen minutes to one hour. Consequently, the time to set up and remove the traffic control may be greater than the actual time required to complete the work. Utility work is often unplanned and therefore there is often no time to prepare a temporary traffic control plan.

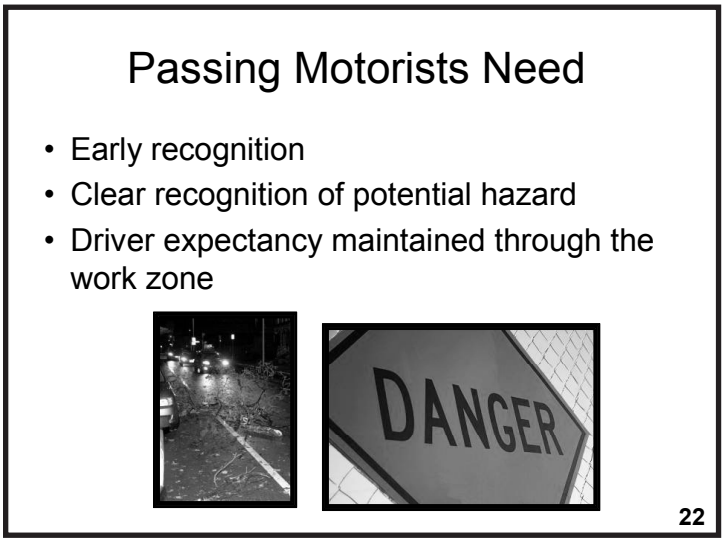
Utility work is generally conducted away from the traveled way, often times on the shoulder or off the pavement and/or right-of-way altogether. The work also generally takes up less space than typical work zones. Due to this combination of factors, less traffic control, smaller work crews, and multiple work sites per day are necessary.



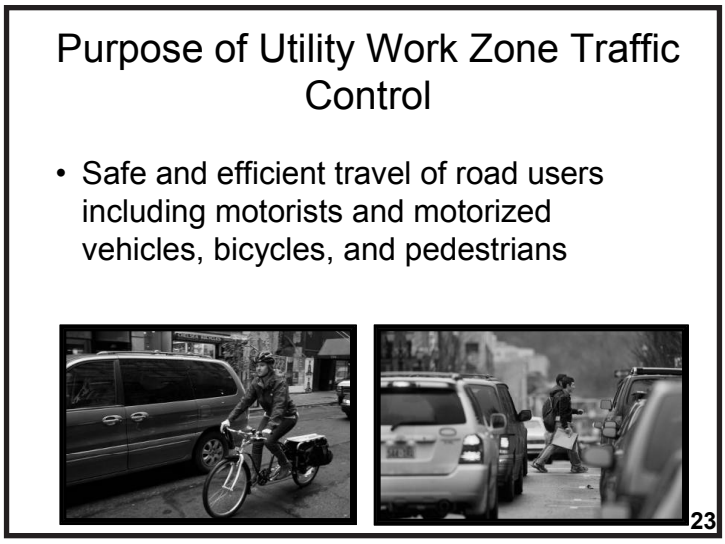
Due to the short time and duration during which the utility work will be conducted during the day, standardized temporary traffic control plans have the potential to greatly improve the efficiency of utility work. Utility workers do not have time to develop plans beforehand or while on the site.

It is important to note that even though utility work can generally be completed in short time periods, it is imperative that workers understand the importance of providing appropriate traffic control in order to protect both themselves and the traveling public. They must be trained to raise safety awareness.

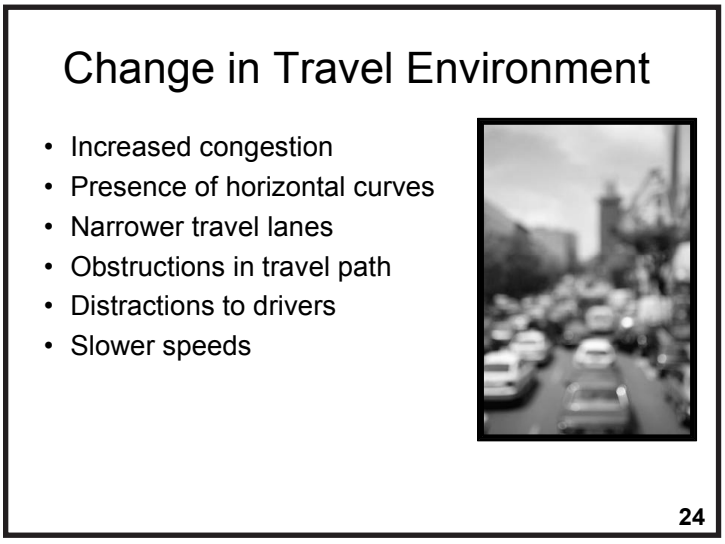
Due to the unique characteristics of utility work zones discussed previously, different types of traffic control devices may be necessary for these types of applications, as compared to long-term highway construction.



In order for motorists to safely traverse the work zone, they must be able to clearly recognize an upcoming utility work zone. This task is best accomplished through appropriate signage placed in advance of the work zone. Appropriate messages should be provided to inform motorists of what to expect upon entering the work zone. For example, the motorists should be alerted of any atypical geometry or lane closures prior to reaching these potentially hazardous areas. Driver expectancy should be maintained until they have cleared the work zone through the utilization of appropriate channelizing devices (e.g., tubular markers/taller cones). Uniformity in work zones will aid in the clear recognition by motorists.

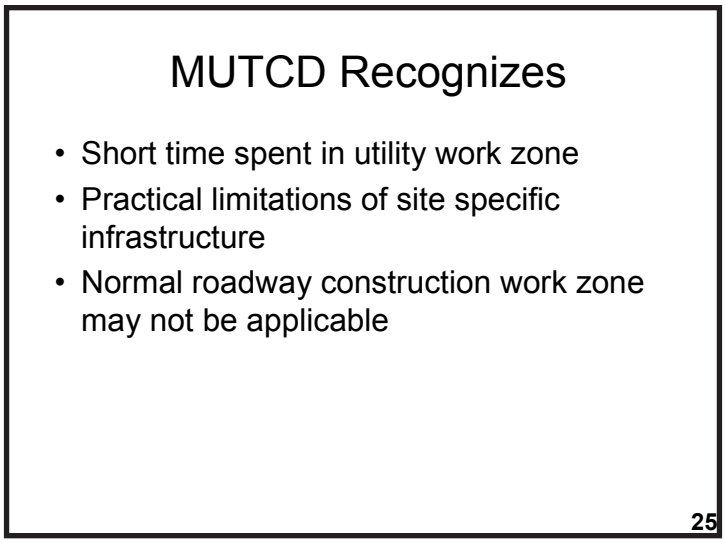


Motorists are not the only road users to be considered in the development of traffic control plans; pedestrians and bicyclists should be considered as well. Much utility work is done in urban areas where there are high volumes of pedestrians and bicyclists. The temporary traffic control plan should take these road users into consideration and ensure that appropriate facilities are provided, such as temporary sidewalks or bike lanes. Pedestrians and bicyclists should not be forced to share the travel way with motorists. Mobility of pedestrians, bicyclists and motorists through a work zone is very important.

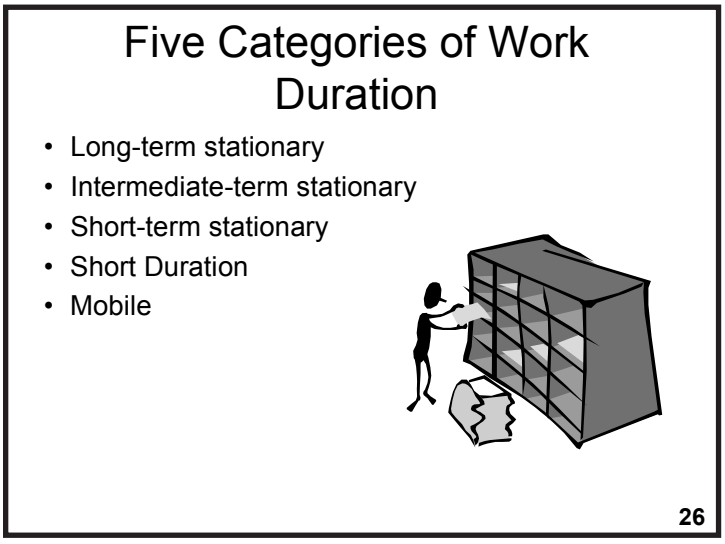


Upon entering the work zone, motorists are exposed to a variety of changes in the travel environment that may cause distractions or require increased focus and abilities in order to safely proceed through the work zone. Utility work frequently requires obstructions of the right-of-way, including the narrowing of travel lanes and presence of horizontal curves, or the presence of obstructions, such as work vehicles, equipment, or workers, within the normal travel path. Such obstructions serve to slow traffic speeds and, consequently, to increase congestion.

In urban areas, the change in travel environment is extremely noticeable. Motorists are already distracted by billboards, business signs, and other advertisements. Work zones create one more distraction for the motorist.

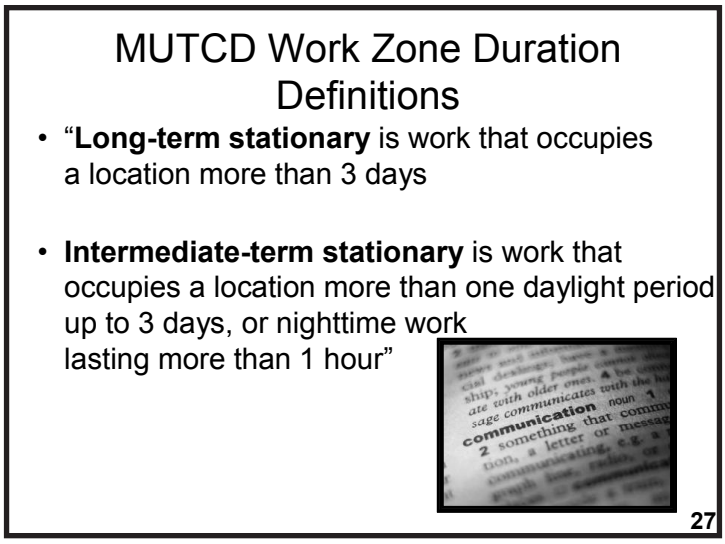


The MUTCD recognizes the short-term nature of utility work, providing allowances for reduced levels of traffic control for such short duration activities. The MUTCD outlines several typical applications, the majority of which are geared toward longer-term roadway construction work. However, due to the unique nature of utility work, many of these typical applications may not be appropriate. In addition, site-specific characteristics may introduce practical limitations that preclude the use of such typical plans.



The MUTCD defines five categories of work duration, or the time during which an activity occupies a location. The first four categories apply to work that occupies a single location for various time periods while the fifth category deals with non-stationary work zones.

In the authors' opinions, further research on the different categories of work duration should be conducted. Very little has been done in the past to justify the differences in categories.



Long-term stationary work is the duration of many highway construction applications and is the work zone situation most frequently encountered by and most easily identifiable by motorists. These work zones often require the larger traffic control devices and more of them. According to the MUTCD Section 6G.02, "at long-term stationary TTC (temporary traffic control) zones, there is ample time to install and realize benefits from the full range of TTC procedures and devices that are available to use." **MUTCD Section 6G.02:** http://mutcd.fhwa.dot.gov/HTM/2003/part6/part6g.htm#section6G02

Any work that occupies a location for more than three days is classified as long-term stationary. Work that occupies a location for more than one daylight period, but less than three days, is classified as intermediate-term stationary work. This classification also applies to nighttime work lasting more than one hour. Intermediate-term stationary typically requires less traffic control devices as compared to long-term stationary work. According to the MUTCD Section 6G.02, "it might not be feasible or practical to use procedures or devices that would be desirable for long-term stationary temporary traffic control zones, such as altered pavement markings, temporary traffic barriers, and temporary roadways. The increased time to place and remove these devices in some cases could significantly lengthen the project, thus increasing exposure time."

MUTCD Work Duration Definitions

- "**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"

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Short-term stationary work is work that occupies a location for more than one hour, but less than an entire daylight period.

The shortest stationary work type is short duration work, which occupies a location for one hour or less. Although the time is less according to the MUTCD, "safety in short-duration or mobile operations should not be compromised by using fewer devices simply because the operation will frequently change its location" (MUTCD Section 6G.02).

"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. Considering these factors, simplified control procedures may be warranted for short-duration work. A reduction in the number of devices may be offset by the use of other more dominant devices such as high intensity rotating, flashing, oscillating, or strobe lights on work vehicles." (MUTCD Section 6G.02)

Utility work often falls within one of these work zone duration categories. Certain types of applications such as striping operations, move intermittently or continuously and do not occupy a single area for prolonged periods of time. These work zones are known as mobile

work or mobile operations.

"Mobile operations often involve frequent short stops for activities such as litter cleanup, pothole patching, or utility operations, and are similar to short-duration operations." (MUTCD Section 6G.02) .

"Warning signs, high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle, flags, and/or channelizing devices should be used and moved periodically to keep them near the mobile work area" (MUTCD Section 6G.02).

Short Duration Work

"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."

Source: MUTCD Section 6G.02

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Many utility applications are classified as short duration work, which can be completed in less than one hour. In such instances, setting up traffic control devices may take longer than performing the actual work. Consequently, in such applications, the MUTCD specifies that colored or marked vehicles with appropriate warning lights are sufficient and no signage or channelizing devices are necessary.

The instructor should ask the participants: What color comes to mind when thinking about work zones? This will lead into a discussion later in the day about the importance of orange painted vehicles and traffic control devices.

Short Duration Work

"Simplified control procedures may be warranted for short-duration work. A reduction in the number of devices may be offset by the use of other more dominant devices such as high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles."

Source: MUTCD Section 6G.02

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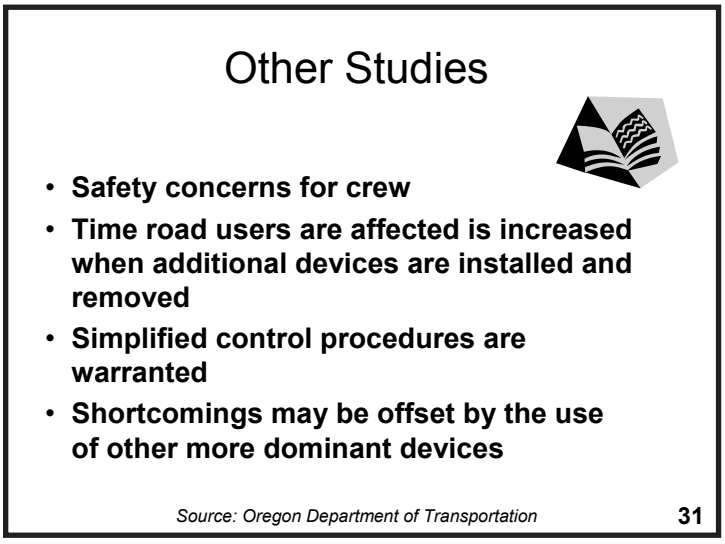
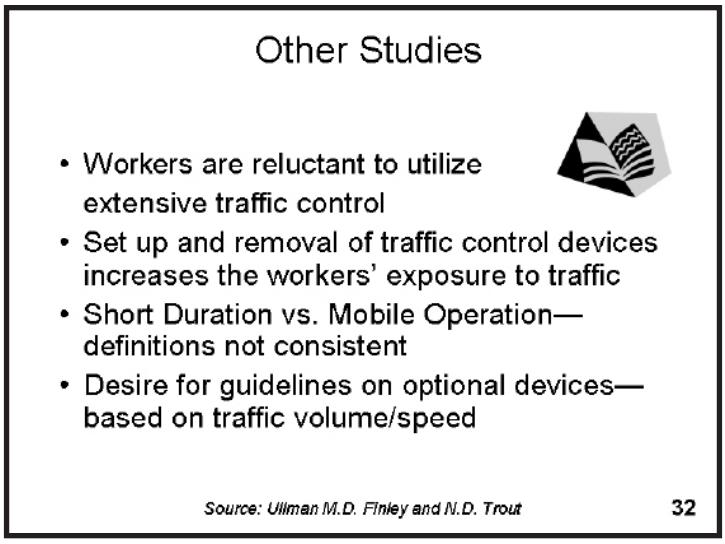
Other changes may be made to the temporary traffic control plan for short duration work, as well. Rather than using the standard control procedures required of intermediate—or long-term stationary work, fewer devices may be used provided that they are more dominant (i.e., more conspicuous and easier to identify by road users).



A study conducted by Ullman, Finley and Trout (*Identification of Hazards Associated with Mobile and Short Duration Work Zones,* TTI Report No. 4174-1: http://tti.tamu.edu/documents/0-4174-1.pdf) found that the Oregon Department of Transportation's *Traffic Control on State Highways for Short Term Work Zones* highlights several issues of concern affecting work zone safety:

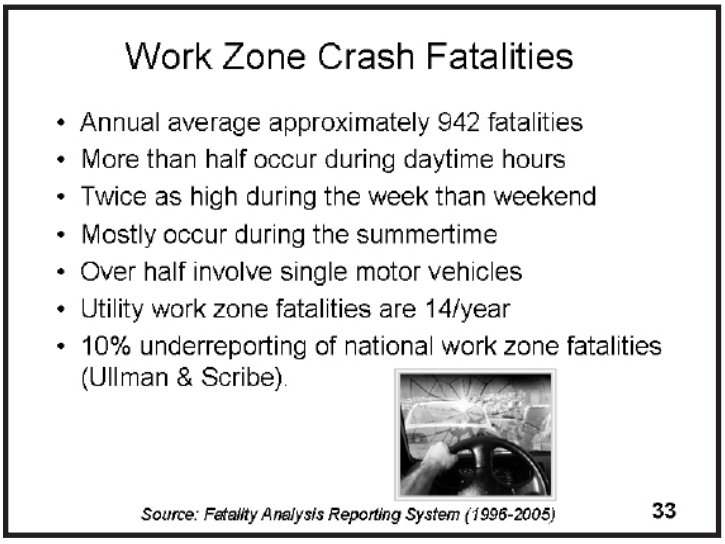
- The more traffic control devices that need to be installed and removed, the greater the exposure of the workers to potential hazards.
- Work zones should be designed so that they provide adequate safety while being setup and taken down in as small a time period as possible. By simplifying the temporary traffic control plan, the amount of worker exposure is reduced and so is the probability of a crash. Using a smaller number of more visible devices has the potential to create such improvements.
- "There are safety concerns for the crew in setting up and taking down traffic control zones. Since the work time is short, the time during which road users are affected is significantly increased when additional devices are installed and removed. Considering these factors, it is generally held that simplified control procedures are warranted for short duration activities. Such shortcomings may be offset by the use of other more dominant devices such as special lighting units on work vehicles".



Research conducted through the Texas Transportation Institute showed that workers are reluctant to use elaborate traffic control due to safety concerns involved with the setup and removal of traffic control devices. (Ullman, Finley and Trout, *Identification of Hazards Associated with Mobile and Short Duration Work Zones,* TTI Report No. 4174-1: http://tti.tamu.edu/documents/0-4174-1.pdf).

In terms of definitions of short duration and mobile operations, there was not much consistency amongst Texas Department of Transportation personnel. "These variations make it difficult for field personnel to select the proper traffic control for maintenance operations. In addition, participants indicated a desire to have guidelines concerning the use of optional devices based on traffic volume and/or roadway speed" (Ullman, Finley and Trout).

The Washington Department of Transportation's *Work Zone Traffic Control Guidelines* advise, "remember, short duration work is not a 'short-cut'; it's a traffic control method that reduces worker exposure to traffic hazards by using larger, more mobile equipment instead of many smaller devices" (http://www.ci.seatac.wa.us/services/workzone.pdf).



Each year from 1996 to 2005, nearly 950 fatalities are experienced in work zones across the country. The majority of these crashes and fatalities occur during the daytime on summer weekdays when most construction activities occur. Utility work zones comprise a small subset of these activities, though the annual average of fourteen fatalities per year is quite large based on the limited exposure of utility workers in comparison to similar levels of exposure in normal work zones.

References:
Antonucci et al., Guidelines for the Implementation of the AASHTO Strategic Highway Safety Plan Volume 17: A Guide for Reducing Work Zone Collisions, NCHRP Report 500, TRB, National Research Council, Washington D.C., 2005 &.

Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Program, http://www.cdc.gov Accessed January 9, 2007.

Due to the nature of utility work, workers are generally much less frequently exposed to potential hazards in comparison to normal work zones. However, even though the frequency and duration of exposure to risks is less, there is a substantial potential for loss in terms of crashes, injuries, and fatalities. Since utility work generally occupies a smaller space and takes place over a shorter interval, motorists are less likely to be able to identify such work zones.

Risk Factors of Utility Work Zone Crash

- **Traffic volume on the roadway**
- **Travel speed**
- **Lateral distance from travel lanes**
- **Work duration – time to complete the work**
- **Sight distance and work area visibility**
- **Others**

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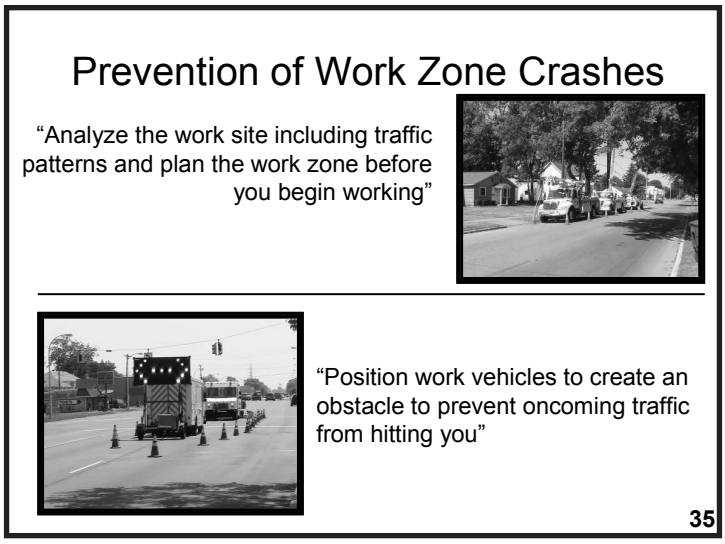
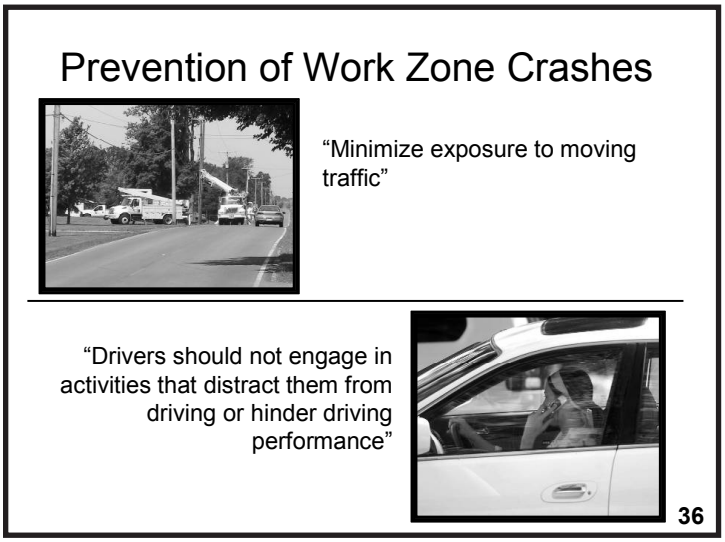
Risk can be broadly defined as being either pure or speculative risk. Speculative risk involves situations where there is a chance of either a gain or loss. For example, gambling is a classis example of speculative risk where participants can either win or lose money depending on the outcome of the event. On the other hand, pure risk represents the situation where there is only a chance of loss, but no chance of gain. This is the type of risk faced from a utility work zone standpoint. If a crash occurs, there is only a chance of loss in terms of property damage, injuries, or fatalities. By identifying the risks involved with utility work zones, those involved are taking a proactive approach towards achieving safety.

There are numerous factors that affect the level of risk faced by workers and motorists in utility work zones. To minimize these risks, work zones should be designed to separate the ongoing work from adjacent traffic to the extent possible. Risk increases as worker exposure to traffic increases. The longer the work duration, the greater the opportunity for a crash to occur. Similarly, the higher the traffic volume, the greater the exposure of risks to both motorists and workers. In addition to creating more opportunities for crashes, there are several factors that increase the potential of severe injury given that a crash has occurred. The closer work is occurring to travel lanes, the higher the speed of traffic adjacent to the work zone, and the more restricted the site distance in and around the work area, the greater the hazard potential. All of these factors should be accounted for in the design of utility work zones.

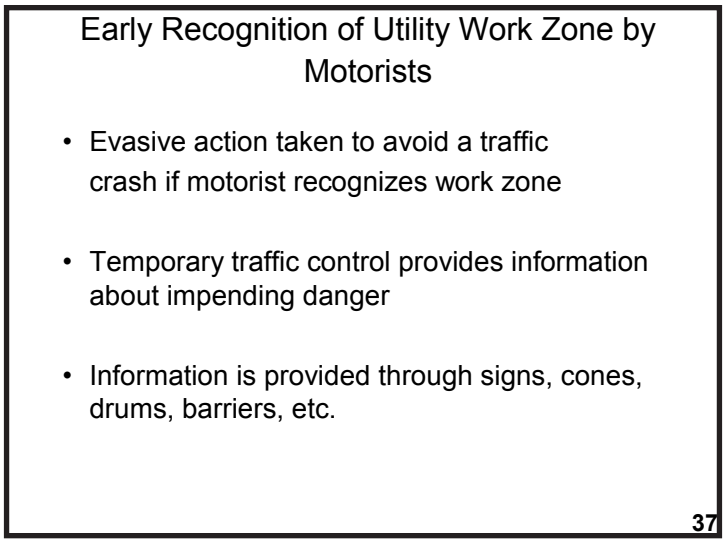
A risk analysis was performed in order to determine what type of work should be included in the development of the guidelines and training. It was determined that for utility work zones with high risk (nighttime and freeway work), the MUTCD should be used to determine the temporary traffic control plan.



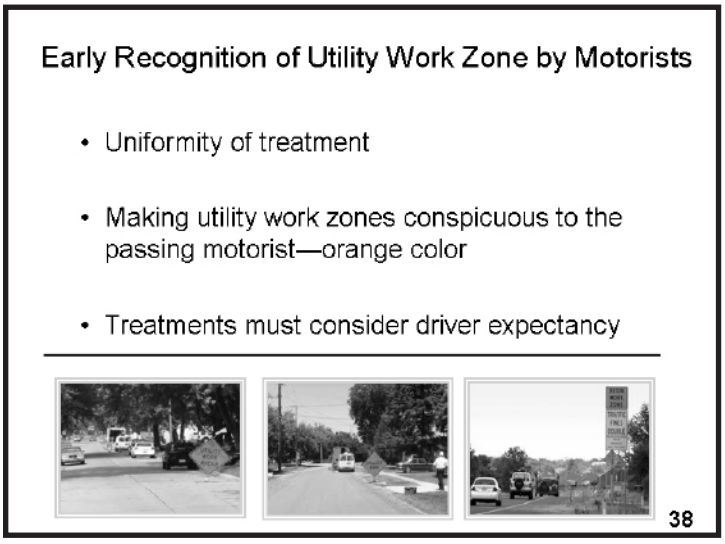
There are several general procedures which can help to mitigate the risk of utility work zone crashes. The first step to ensuring work zone safety is to develop an appropriate temporary traffic control plan. To do so, the site where the work activities will occur should be analyzed beforehand so that potential hazards may be identified and mitigated prior to sending workers into the field. This may be done by visiting the site, or by viewing an aerial photograph of the site, which may be readily available through Internet map providers such as Live Search Maps (http://maps.live.com/), Google Maps (http://maps.google.com/maps), etc. Once the workers arrive at the work site, they should position their vehicles such that they help to shield the work area from oncoming traffic. Work vehicles have the potential to create an effective safety barrier for workers in addition to providing an additional visual cue to approaching motorists of ongoing work activities.



Where possible, the work should be conducted in an area that minimizes the exposure to moving traffic. In the photo above, notice that the work is being conducted past the shoulder and a barrier has been created by an adjacent vehicle as suggested in the previous slide. In addition, channelizing devices (i.e., cones) have been provided to guide oncoming drivers through the work zone. The work vehicle and channelizing devices serve to create a physical separation between the traffic stream and the work area. Other means of preventing work zone crashes are often beyond the control of the utility work force. For example, many crashes are caused by driver distraction, a problem that has become more prevalent in the era of cell phones, pagers, iPods, navigation devices, DVD players, and other in-vehicle technologies. In light of this fact, it is increasingly important that appropriate advance warning is provided so that drivers may be less apt to engage in such risky behavior with the knowledge that a work zone is forthcoming.



Early recognition of the utility work zone is essential. In order for motorists to be able to safely navigate a work zone, they must be provided with sufficient information in a timely manner so that they can react accordingly. In order for drivers to obtain this information, they must observe a series of visual cues which they associate with potential danger. From a work zone standpoint, this is accomplished through the usage of signage, lighting, and delineation devices.



The more frequently a motorist encounters a particular type of warning device, the more familiar they will become with it and the appropriate actions to take when similar devices are encountered in the future. This is one of the primary motivations behind the standards and guidelines presented in the MUTCD. If traffic control devices are uniform in their design and appearance, motorists will be able to more easily anticipate what actions will be required when encountering these devices. Consequently, the work vehicles, signage, lighting, and other traffic control devices should be designed to be conspicuous and easily identifiable. The color orange has long been established as the primary color denoting work activities.

Positive Guidance

"Positive guidance information increases the driver's probability of selecting the speed and path most appropriate to the operating conditions of the highway"

Source: A Users' Guide to Positive Guidance - FHWA

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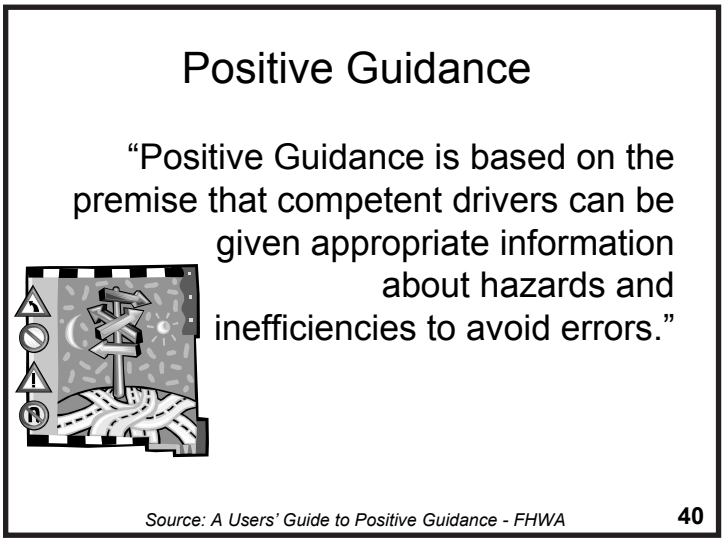
In order for motorists to be able to safely navigate a work zone environment, traffic control should provide positive guidance.

Information should be provided to the motorists according to the principles of "positive guidance", whereby motorists are given sufficient, timely and appropriate information via traffic control devices. This allows drivers to process that information and decide upon an appropriate course of action based on their existing knowledge. Positive guidance involves providing meaningful information at the right place and right time.



It is assumed that all motorists have a certain minimum knowledge base which allows them to handle a variety of situations they encounter as part of the driving environment. Driver licensing standards help to ensure these minimum standards are met. With this knowledge in mind, traffic control devices can be utilized to relay important messages to motorists, who should then be able to process this information and act accordingly in order to avoid potential work zone hazards.

Basic Driving Task

- Control – driver's interaction with vehicle
- Guidance – driver's ability to maintain safe path on highway
- Navigation – driver's ability plan and execute trip from origin to destination

Source: Alexander, G.J., "Some Factors Affecting Reception and Use of Information by Drivers", Public Road, Vol. 37, No. 1

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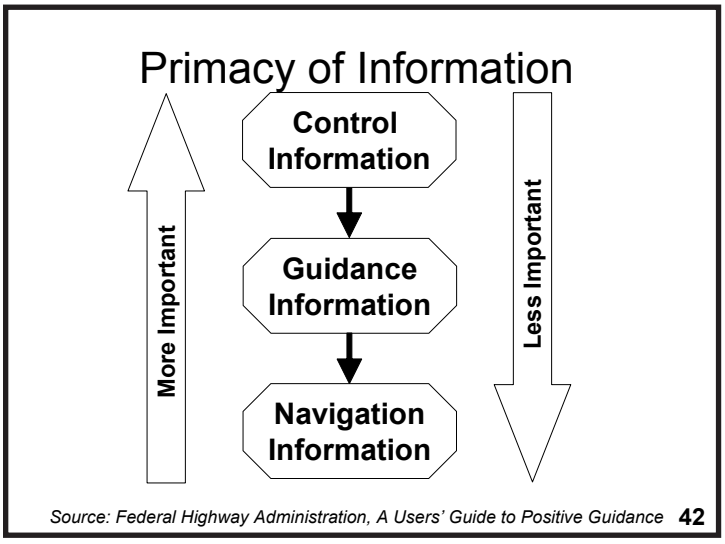
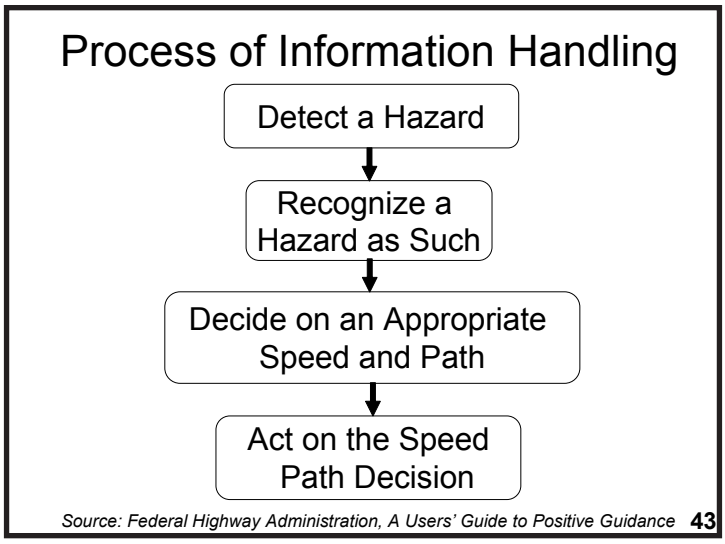
There are three processes involved in the basic driving task: control, guidance, and navigation. Control refers to the driver's interaction with his/her vehicle. This includes a variety of tasks, such as steering, accelerating, braking, and utilizing in-vehicle devices, such as the radio, windshield wipers, etc. Guidance refers to the driver's ability to maintain a safe path on the highway. It is expected that drivers, when provided with sufficient information, are able to safely travel along a designed facility. The third process, navigation, refers to the driver's ability to plan and execute a particular trip. This may include reading and interpreting maps, listening to and understanding highway advisory radio or navigation devices, or interpreting visual cues provided via work zone signage.

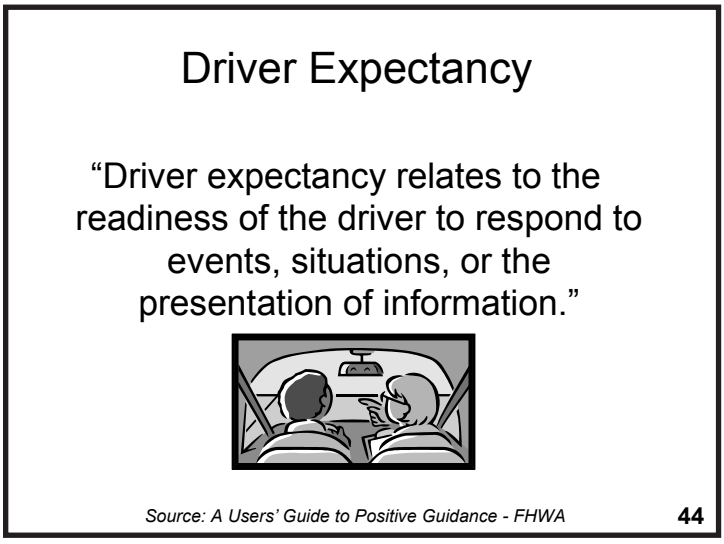


"Driver errors result from many driver, vehicle, roadway and traffic factors. Some driver errors may occur because drivers may not always recognize what actions particular roadway traffic situations require of them, because situations may lead to task overload or inattentiveness, and because deficient or inconsistent designs or information displays may cause confusion. Driver errors may also result from pressures of time, complexity of decisions, or profusion of information" (AASHTO's A Policy on Geometric Design of Highways and Streets 2004).

Thus if driver errors occur, primacy of the driving task result in terms of the likelihood of being involved in a crash as a result of the error. Control and guidance errors by drivers may contribute directly to crashes, whereas navigational errors may result in delay, inefficient operations and in some cases may lead indirectly to a crash.



There are four steps involved in the process of information handling when motorists are approaching a work zone. First, a motorist must be able to detect a hazard. Secondly, the motorist must be able to recognize that such areas are in fact hazardous. Once the hazard has been recognized, the motorist must decide on an appropriate speed and path to traverse through the work zone. Finally, once this decision has been made, the driver must physically execute or act on the decision (i.e. apply break, accelerate, maneuver, etc.).



In order for drivers to safely travel through a particular road or highway, it is important that they are not surprised by unexpected elements of the roadway environment.

Drivers should be able to anticipate what types of situations they will encounter as part of a roadway environment. For example, when traveling on a freeway, drivers do not expect to see traffic signals or at-grade intersections. Similarly, drivers do not generally expect to see a utility work zone as part of their everyday driving environment. Consequently, it is important that information relative to a work zone is presented in advance so that drivers are not surprised when they encounter it.

Driver Expectancy

- Gained through experience and training
- Guided by traffic control devices
- Occurs during repeated situations
- Drivers respond quickly and correctly
- Information must be clear
- Consistency in devices decreases reaction time
- Uniformity in devices simplifies driving tasks

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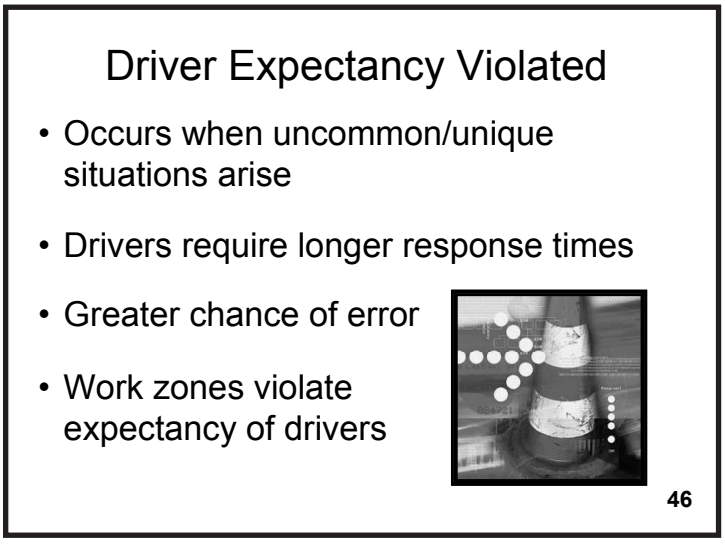
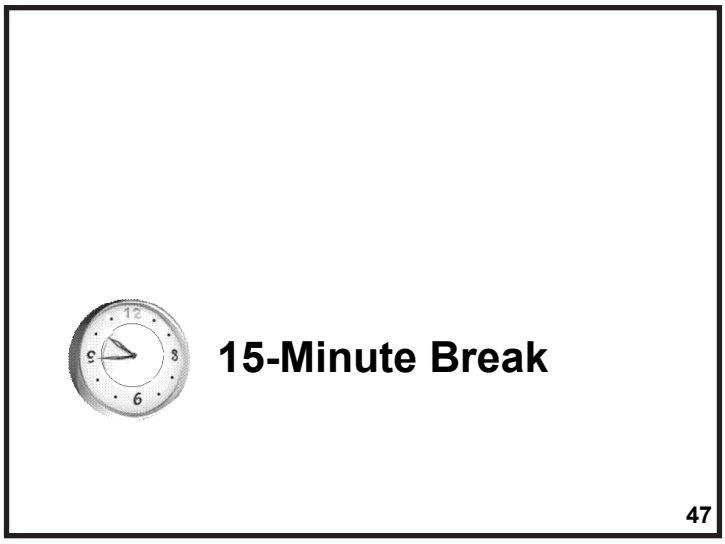
Driver expectancy improves through repeated experiences and training in similar environments. Although motorists gain many cues from the environment, most of the information is received visually through traffic signs, signals and pavement markings. The more times a driver confronts a certain situation, and responds successfully, the more effective and predictable he/she will become in handling that situation. When expectancies are met, drivers are able to perceive and handle information and respond quickly and naturally as they encounter situations on a regular basis.

In order for drivers to handle information effectively, the information should be in the driver's field of view, available when and where needed, provided by a clear message and capable of capturing driver's attention. The driver is always prioritizing information and cues that he/she receives while driving. The driver is continuously prioritizing this information and discarding the information that seems irrelevant or unimportant. The time gap between information is critical to a driver in order for him/her to retain the relevant information, and take appropriate action when circumstances demand. Traffic control devices that are consistent and uniform simplify the driving task and enhance safety.



Unexpected situations have the potential to create critical hazards for motorists. Drivers do not expect uncommon situations to occur in their typical driving environment. If an atypical situation arises, drivers will take longer to respond because they are unfamiliar with such scenarios. Consequently, there is a greater likelihood of making an error and potentially becoming involved in a crash.

As alluded to previously, work zones violate the expectancy of drivers because they are not part of the everyday driving environment at a given location. In order for work zones to be successfully navigated, drivers must be informed of what to expect when reaching the work zone. Will there be lane closures or lane shifts? Will they be required to stop? Will flaggers be present? There are a number of such questions which must be addressed so that drivers are not taken by surprise. This information must be clear, concise, and in adherence with the MUTCD. By utilizing uniform traffic control devices, drivers will be able to react more quickly and their tasks will be simplified.



At this point, a 15-minute break should be provided so that participants can use the restroom or grab a snack or beverage prior to beginning the next section of the program.

Lesson 4: Agency-Wide Safety Culture – What? Why? How?

Lesson Number:	4
Lesson Title:	Agency-wide Safety Culture – What? Why? How?
Performance-Based Learning Outcomes:	• To understand what safety culture is. • To understand the importance of having an agency-wide safety culture. • To determine how a safety culture can be achieved at the participant's company.
Instructional Method:	The instructor will describe what a safety culture is and why is should be developed. The instructor will also discuss what constitutes a good safety culture and provide recommendations for how this can be achieved.
Time Allocation:	30 minutes

Agencywide Safety Culture – What? Why? How?

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What is a "Safety Culture"? Ask the audience what they know about safety cultures.

What is a "Safety Culture"?

"The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management."

Source: Health and Safety Commission, 2003

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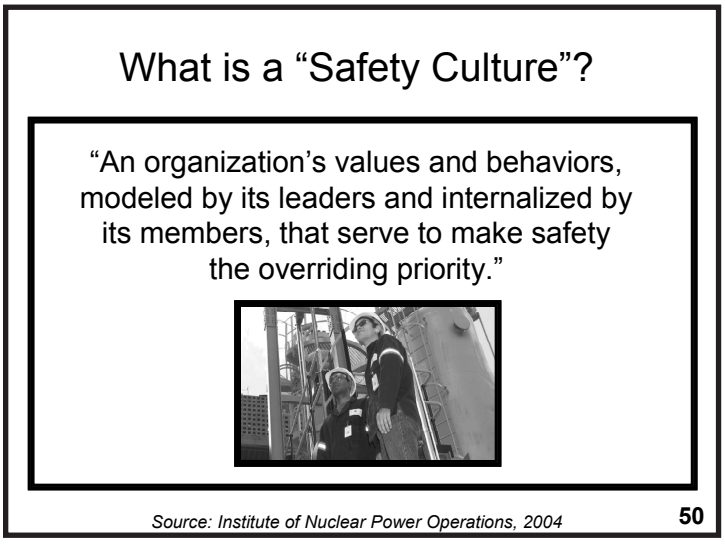
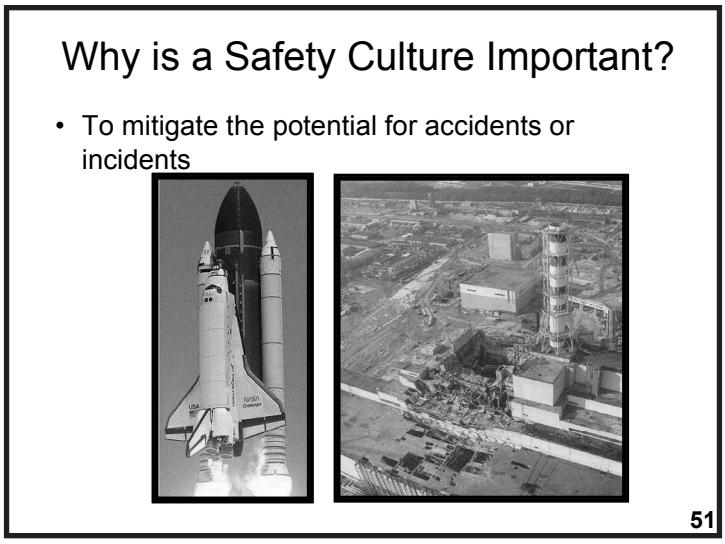
The term "safety culture" has been defined in a number of forums. The basic tenets of a safety culture are the establishment of core principles, values, and attitudes within an organization aimed at emphasizing safety at all times.



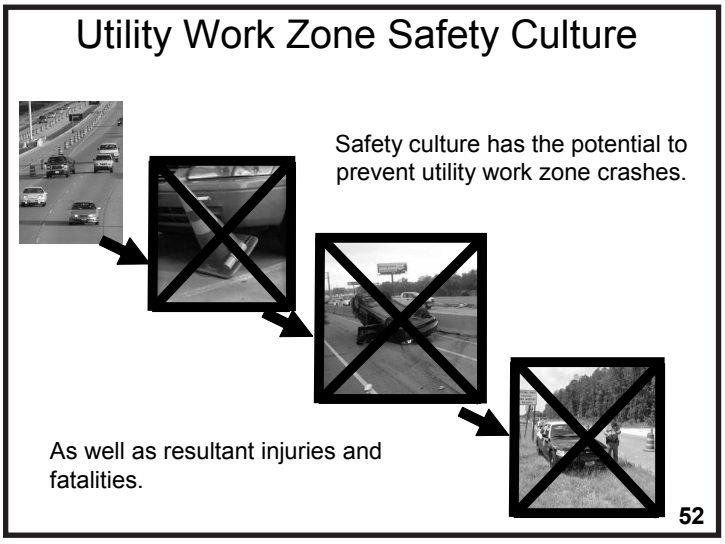
Each company is responsible for delivering its safety message from the top level management down to the worker level.

Regardless of what guidelines, standards, or training programs are in place, for utility work to be optimally effective, a safety culture must be in place that prioritizes safety from all aspects of the agency. All agency employees must eat, drink, and sleep safety, on the clock AND off the clock.

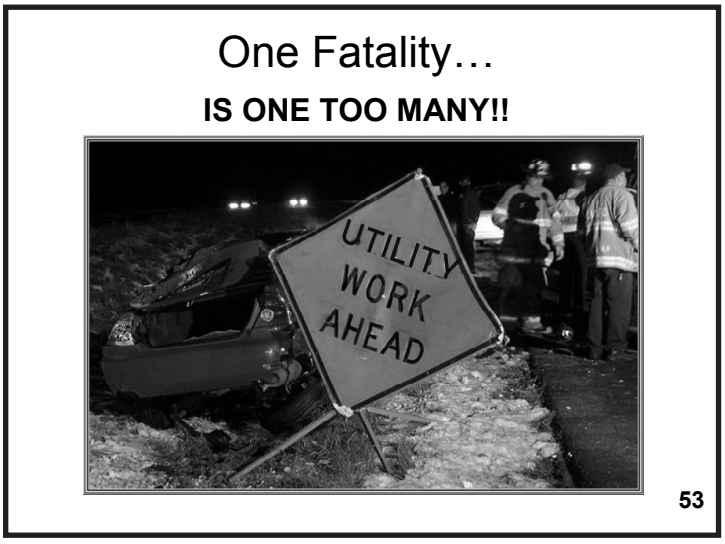


Why is a safety culture important? Pose this question to the audience. From a utility work zone perspective, a safety culture helps to prevent the occurrence of crashes and the resultant injuries, fatalities, and associated costs to motorists and workers. These same elements are true of a variety of other occupations, as well. The term "safety culture" originated with the Chernobyl disaster and has been illustrated by several other failures, such as the Challenger space shuttle disaster. Each of these catastrophes was the result of several organizational failures, not just a single mistake by a particular individual. The purpose of a safety culture is to create an organizational structure that facilitates the timely identification and mitigation of risks and hazards posed to or by the organization.

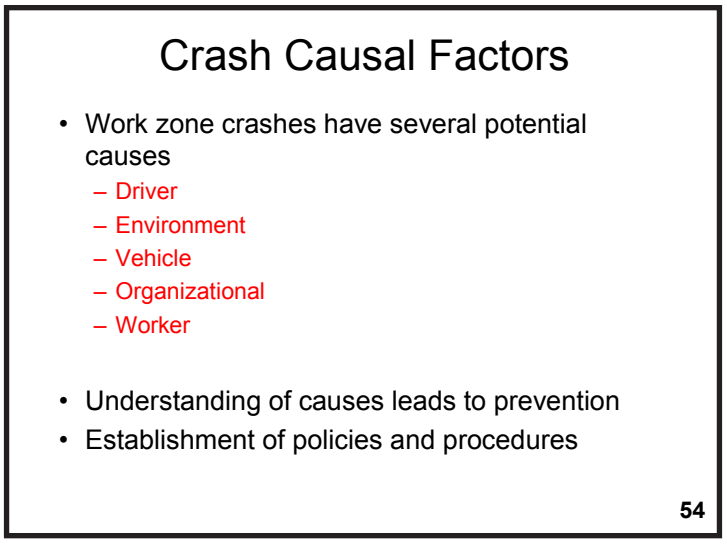
Why is a safety culture necessary? Ask the participants this question. A safety culture is necessary to improve safety for both utility workers and motorists. It is the responsibility of each utility agency to ensure the safety of their workers, as well as the traveling public. In order for the workers to buy into such a program, it is imperative that an example is set by leaders, including supervisors and upper level management.



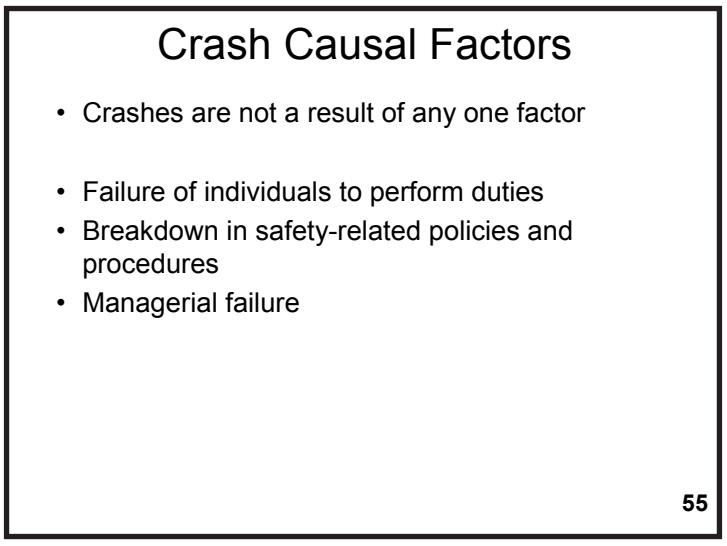
Setting up an appropriate utility work zone environment has the potential to prevent crashes and the resultant injuries and fatalities. There are a number of factors which lead to work zone crashes which must be considered by utility agencies.



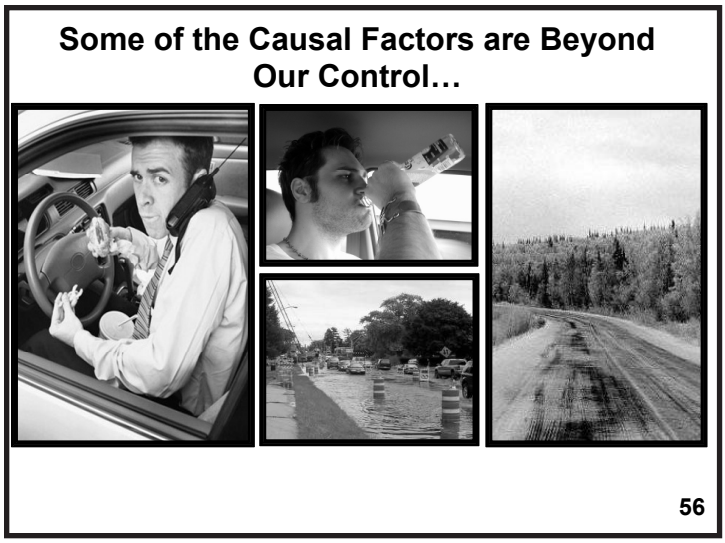
Every year, millions of dollars are lost due to utility work zone crashes. These costs are associated with property damage, injuries, fatalities sustained as a result of a crash, as well as the time and productivity lost by the rest of the traveling public due to delays.



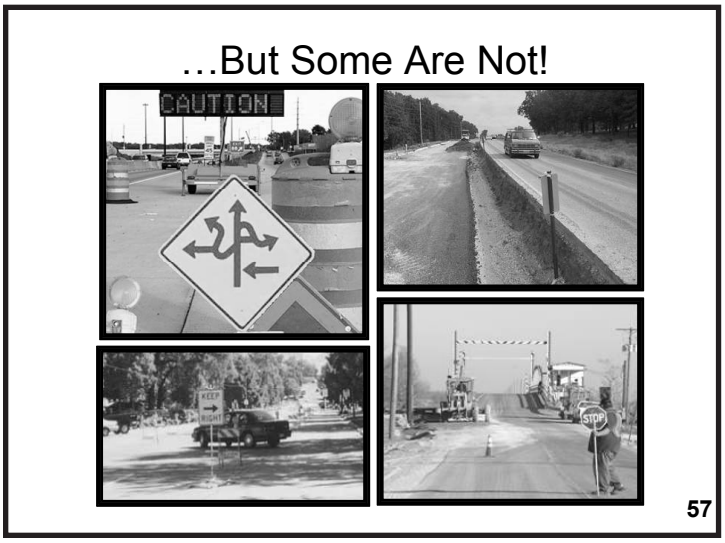
The primary factors contributing to traffic crashes include the driver (e.g., distraction, impairment, loss of control, etc.), the roadway environment (e.g., precipitation/wet pavement, potholes, sight distance, etc.), and the vehicle (e.g., flat tire, engine failure, etc.). In a utility work zone environment, additional factors come into play as workers, equipment, and temporary traffic control devices become part of the roadway environment. It is important to understand how utility work-related factors may contribute to the occurrence of crashes. With an understanding of these factors, appropriate policies and procedures may be established to minimize the risk faced by both workers and motorists.



It is important to note that any single individual factor is rarely the cause of a traffic crash, particularly one which occurs in a utility work zone. If the actions of a utility worker contribute to the occurrence of a crash, there are numerous related factors which may potentially lead indirectly to these inappropriate worker actions. At a fundamental level, there may be a breakdown in the policies and procedures of the particular utility agency which has allowed such an incident to occur. Or perhaps the managerial staff responsible for a particular work site was negligent in his/her duties to ensure the safety of their workers and the traveling public.



Some of the crash causal factors are beyond our control. For example, risky driver behaviors such as talking on a cellular phone or eating while driving create distractions which divert motorist attention from the work zone. Drinking and driving creates similar problems in terms of driver focus. Other factors, such as weather, are also beyond the control of utility agencies and make utility work increasingly difficult from a safety perspective.



However, there are numerous elements that are under the control of utility agencies. For example, providing appropriate signage and establishing appropriate temporary traffic control are important elements. The figures above show an exaggerated example of a sign that shows too much information or would be confusing to motorists. The other pictures show poorly placed vehicles, poorly visible signs, lack of appropriate channelization and traffic control, as well as various other problem elements.

Improving Workplace Safety

- To date, most programs have focused on technical aspects (e.g., temporary traffic control) and human behavior (e.g., worker training, protective equipment)
- Both are aspects of a safety culture …but there is more!

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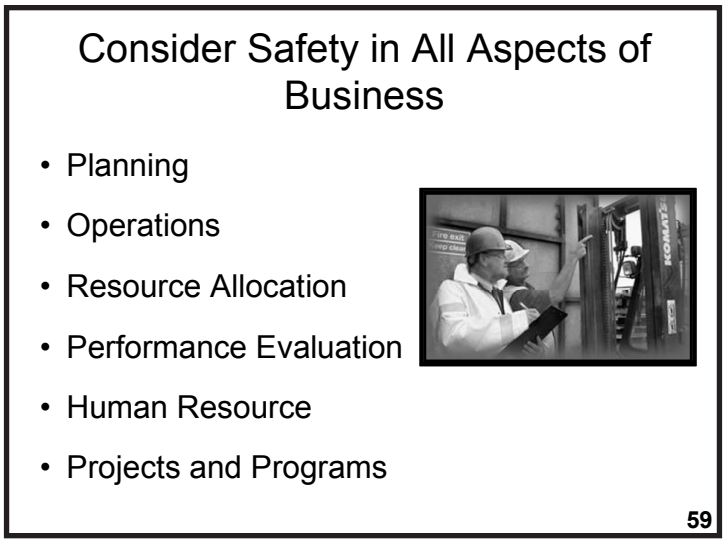
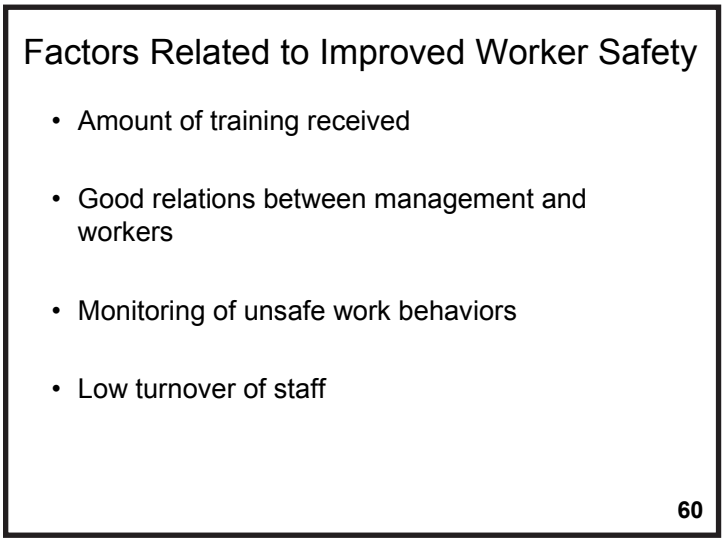
In order to address these potential work zone hazards, much emphasis has been placed upon the technical aspects associated with work zones, specifically the establishment of appropriate temporary traffic control. In addition, various training programs have been developed in order to address the worker behavior. Standards have also been developed in regard to the use of appropriate protective equipment for all workers. However, there are various other elements important to a safety culture, as well.



Safety should be an explicit consideration in all elements of an agency's operations. During the planning process, site-specific safety issues should be addressed in addition to various procedural tasks that should be completed as a part of all projects. From an operational standpoint, workers should be trained on how to safely setup and remove temporary traffic control devices, as well as how to work safely within the work area and zone. Resources should be allocated in a manner that will maximize the safety potential for the utility agency. This includes providing worker training, purchasing effective safety equipment, and continually monitoring and evaluating progress toward the company safety goals. Projects should include safety implicitly and explicitly and specific safety programs should be developed to ensure that the agency is effectively managing risks and preventing the likelihood of crashes and subsequent losses.



Past research has shown a number of factors to be positively correlated with safety. As one would expect, the more training a worker receives, the greater the level of safety that person will exhibit as part of his/her work tasks. In addition to providing adequate training opportunities, there must be an open line of communication between management and the workers. Management needs to stress the importance of safety and allow for dialogue with the workforce in order to identify ways in which safety may be improved.

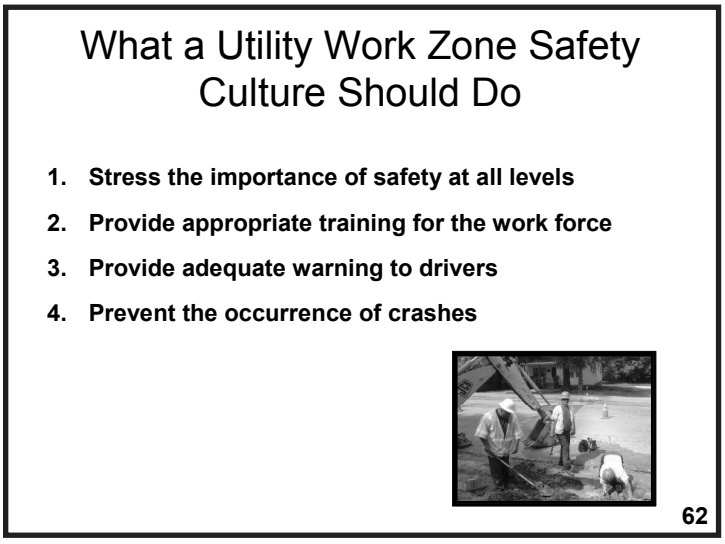
To insure that work is being conducted safely in the field, some form of monitoring or evaluation should be conducted. This may include unannounced site visits or a tracking system of all crashes, accidents, or incidents which occur on the job.

Generally, work is conducted in a safer manner if staff turnover is low. This is a likely result of experiential learning as workers become safer the more times they are asked to conduct a particular task. Unfortunately, the utility industry faces a large amount of staff turnover from year to year or even month to month, making the importance of periodic training increasingly important.

From a managerial standpoint, there are various ways to improve the safety culture within an agency. First and foremost, safety must be prioritized so that workers feel their safety is of equal or greater importance than productivity.

Workers should be informed about the importance of safety issues on a continuing basis. This can be done in a number of ways. Posters may be placed around the office, safety messages may be communicated via company e-mail or flyers, and management may stress safety at periodic meetings. Management must also be receptive to feedback from workers at the grass roots level and encourage their participation in facilitating changes to agency safety policies.

A monitoring system which tracks the occurrence of unsafe behaviors, as described in the previous slide, provides further incentive for workers to act safely. When job announcements are posted for utility positions, safety can also be emphasized in the associated job descriptions to let workers know up front that safety is an agency priority.



The main focus of a utility work zone safety culture should be in preventing crashes and establishing a safe environment for both motorists and workers. In practice, this is done by providing adequate warning to drivers and appropriate training to workers as alluded to in the previous slide. In addition, it is important that the safety message is stressed at all levels of the organization.

There are several common elements that constitute a good safety culture.

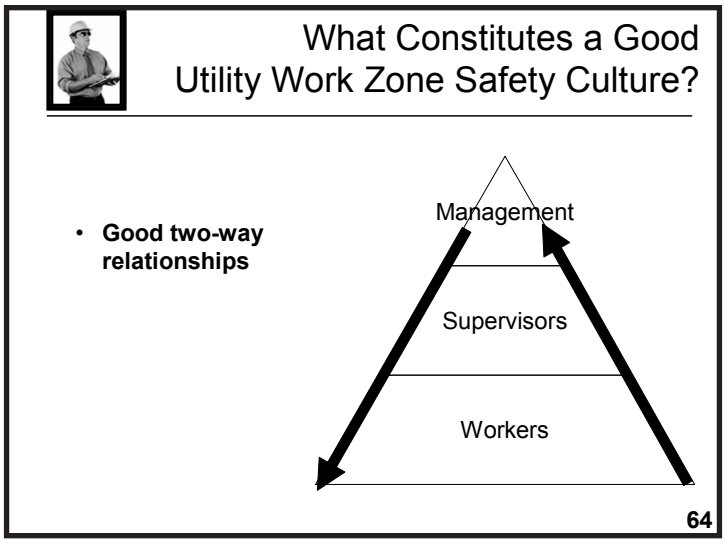
First, there must be a strong commitment to safety at the management level within all utility agencies. This commitment includes the utilization of utility work zone traffic control guidelines, such as those developed through the Federal Highway Administration, which is the focus of this training program. There are also various training programs available in addition to today's modules, such as those offered by ATSSA and ARTBA. In addition, the National Work Zone Safety Information Clearinghouse (www.workzonesafety.org) provides a plethora of information on work zone safety that is freely available to the public.

By establishing a safety culture at the top levels, these behaviors can filter down to the workers at the grassroots level. In order for safety programs to be effective, there must be 'buy-in' by those who will actually be performing the work in the field. Optimally, workers will attend classroom and field-based training programs, become familiar with company and national guidelines and standards for utility work, and implement such knowledge and skills through daily operations.

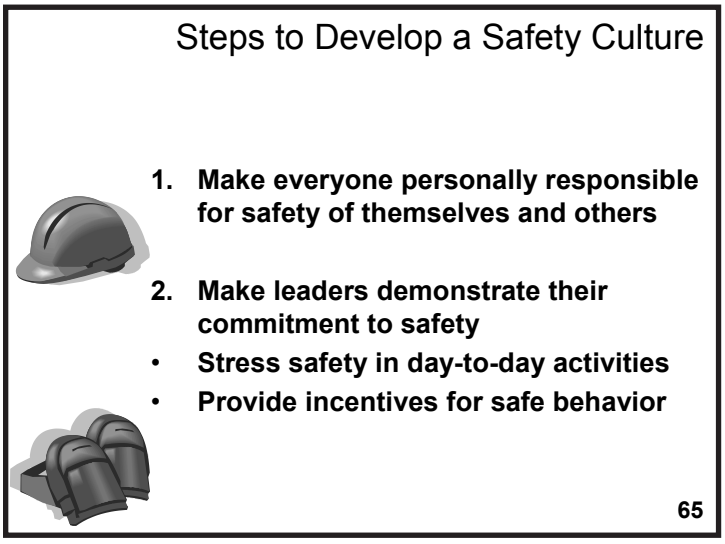
Safety in work zones should continue on and off the clock. Workers and management should set a good example for others while they are not at work especially when driving through a work zone.

In order to facilitate this safety culture, it is imperative that realistic rules and guidelines be established that can guide agency and worker decisions in regard to safety. The *Utility Work Zone Traffic Control Guidelines* and the MUTCD provide such rules and regulations based on various studies conducted over the past thirty years.

It is not sufficient to simply develop a safety culture. Agencies must strive to constantly improve their safety performance by continually monitoring their performance and aiming to address any potential weaknesses. Such monitoring includes the tracking of any crashes or incidents which occur as part of the agencies work zone operations. This monitoring can be conducted internally or through regulatory agencies, such as the Occupational Safety and Health Administration (OSHA).

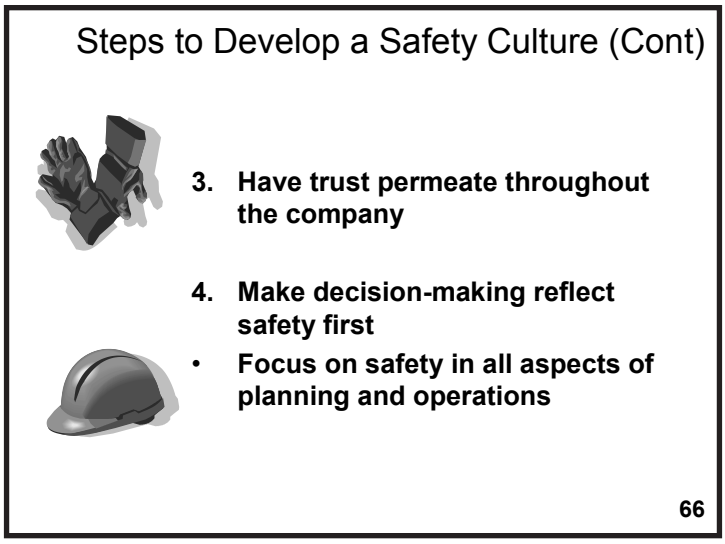


In order for a safety culture to be effective, it is imperative that a good two-way relationship exists between employees from various levels of the organization, including management, supervisors, and field workers. A protocol should be in place that will allow for open lines of communication between each of the groups and all employees within the organization should view safety as a vital element of the agency's mission.



The following slides contain seven key steps in the development an effective safety culture. The most important step is to establish an environment in which everyone feels personally responsible for not only their own safety, but the safety of their fellow workers, as well. This point should be stressed by leaders at the management level who stress the agency's commitment to safety. If management makes safety a priority, the workers at the other levels of the organization are more likely to follow suit. Whenever decisions are made, either at the policy level by management or at the project level by supervisors and workers, safety should be stressed above all other factors.

Safety should become a focus of an agency's daily activities, both in the office and on the job site. Furthermore, safe behaviors should be rewarded by providing workers with incentives for periods during which they demonstrate exceptionally safe work behaviors. Similarly, workers exhibiting unsafe behaviors should be reprimanded or penalized in some way to make it clear that such risks will not be tolerated.



Personnel must be able to trust their co-workers in order to ensure a safe working environment. All members of a work crew should be concerned with one another's safety and should hold one another responsible for any breaches in the safety policies and procedures established by their agency.

Workers should be encouraged to question decisions which may compromise safety and should be rewarded, not reprimanded, for such behaviors. Agencies should embrace the

concept of organizational learning and all employees should be encouraged to improve their safety knowledge and skills and they should encourage co-workers to do so, as well. The establishment of training and certification programs helps to ensure that workers have the necessary knowledge, skills, and abilities to work safely and effectively.

Finally, even companies with exceptional safety records have room for improvement. By examining agency progress over time, including the monitoring of incidents, accidents, and crashes, steps can be taken to improve safety by preventing the future occurrence of such events.

How to Motivate Workers

- **Adopt guidelines and inform workers**
- **Continuous training**
- **Worker certification**
- **Unannounced on-site investigations**
- **Incentives and Reprimands**

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In order for workers to be willing to accept the policies and procedures outlined by management, they must be properly motivated to do so. This requires an understanding of the agency safety initiatives and why they are important. How do they impact each individual worker? How do they impact the agency as a whole? There should be a continual awareness campaign aimed toward addressing safety within the work place. Training opportunities should be provided on a continual basis. At a minimum, this should include some initial on-the-job training while targeted job-specific training and periodic retraining are also encouraged. Individual projects and job sites should be subject to random inspections from company safety officials or from external agencies, such as OSHA. The demonstration of exceptional performance under these inspections should be rewarded.

Additional Resources

- American Road and Transportation Builders Association (ARTBA)
- Federal Highway Administration (FHWA)
- Institute of Transportation Engineers (ITE)
- Manual on Uniform Traffic Control Device (MUTCD)
- National Highway Institute (NHI)
- National Work Zone Safety Information Clearinghouse
- Occupational Safety and Health Administration (OSHA)
- Texas Transportation Institute (TTI)

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The instructor should point out that additional resources are available through many other organizations especially the ones mentioned on this slide.

ATSSA Training

- Temporary Traffic Control for Utility Operations
- Visit: www.atssa.com for more info

ATSSA
SAFER ROADS SAVE LIVES

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The instructor should mention the training that is provided by the American Traffic Safety Services Association (ATSSA). ATSSA provides training on temporary traffic control for utility operations.

Lesson 5: Training, Knowledge Retention and Retraining Issues

Lesson Number:	5
Lesson Title:	Training, Knowledge Retention and Retraining Issues
Performance-Based Learning Outcomes:	To understand the importance of training and retraining. To understand how knowledge is retained.
Instructional Method:	The instructor will describe the issue of knowledge retention and how participants can retain their knowledge. The instructor will then stress the importance of training and retraining.
Time Allocation:	30 minutes

Training, Knowledge Retention and Retraining Issues

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Training is an integral piece of the utility work zone safety puzzle. However, training is only effective if the knowledge and skills gained are retained over time. Past research has shown that, regardless of trainee abilities, knowledge retention is not possible without continual reinforcement or retraining.

How do We Ensure That Knowledge is Retained?

- **Knowledge is only beneficial if maintained - Not forgotten!**
- **Participants must see importance of information and be able to interpret and apply information**
- **Several factors affect these abilities**

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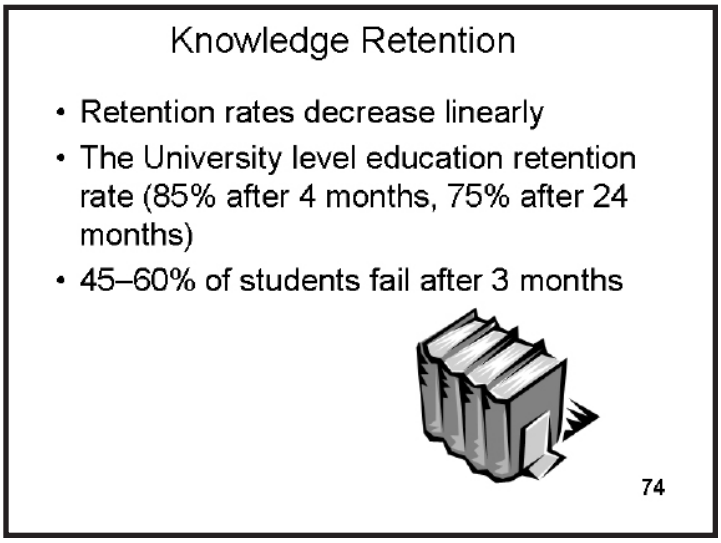
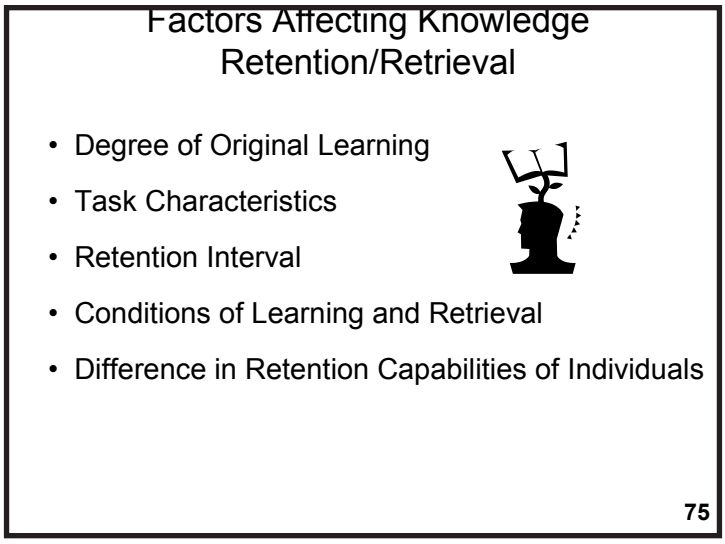
There are several factors that help to facilitate the retention of knowledge. First, trainees need to understand why the training they receive is important. This refers back to the importance of establishing a safety culture. If workers are able to see the importance of what they have learned, they will be more likely to retain it.



Research has shown that knowledge retention rates decline linearly over time. Four months after completing this training program, fifteen percent of what you have learned will likely be forgotten. After two years, approximately twenty-five percent of your knowledge will have decayed. Based on these facts, it is imperative that a program of lifelong learning be established where workers have the opportunity to re-learn past material in a variety of training environments. The more often a particular topic is presented, the easier it is for that information to be recalled in the work environment.



The most useful resource found on this topic was a book written by Marshall J. Farr entitled, "The Long-Term Retention of Knowledge and Skill: A Cognitive and Instructional Perspective" published in May 1986. This book contains a review of several other published literature reviews on this topic. There are several factors that help to facilitate the retention and retrieval of knowledge gained through training programs. The following slides discuss five factors which have the potential to improve knowledge retention and retrieval: (1) degree of original learning, (2) task characteristics, (3) retention interval, (4) conditions of learning and retrieval and (5) difference in retention capabilities of individuals.

Strengthen the Degree of Original Learning

- Provide extensive learning during initial training (information overload)
- Material must be learned well initially
- This can be done through practice and repetition!!!

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Past research has shown the most effective means of facilitating knowledge retention is by strengthening the degree of original learning. What this means is that trainees must learn the material well initially, during the period of original learning, in order for them to recall it in the future. This is best done through repetition of important information and concepts. If trainees are overwhelmed with information, they are more likely to retain that information later. If the knowledge can be applied through practice in real-world scenarios or via case studies, learning can be further enhanced.

Task Characteristics

- **Control tasks better retained than procedural tasks**
- **Tasks must be applied:**
  In proper (realistic) contexts
  Under various scenarios
- **Knowledge decays if tasks are not repeated**

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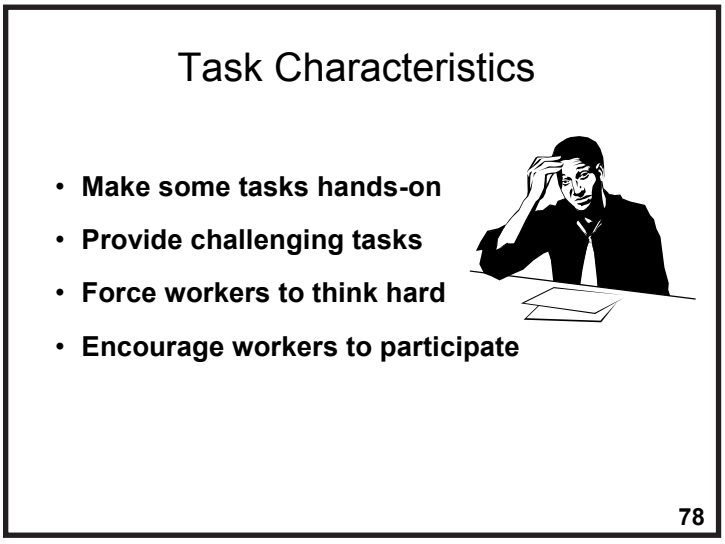
The characteristics specific to various work tasks also have an impact on knowledge retention. Motor skills are retained more easily than procedural tasks. In other words, doing is more effective than seeing from a learning perspective. If work tasks are presented in a typical lecture format, it is important that trainees are subsequently able to apply these tasks as part of their job.

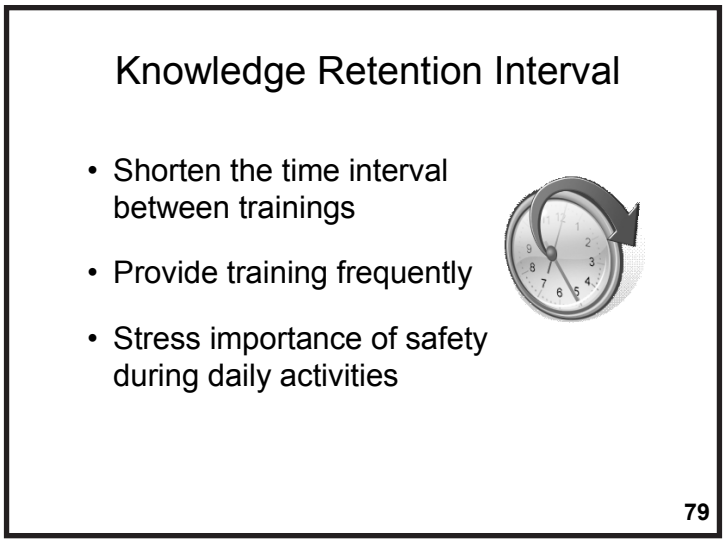
Training creates the maximum benefit when applied in proper (i.e., realistic) contexts under various scenarios. If workers are able to apply the same types of skills as appropriate under a variety of different work environments, they will be much more likely to maintain these skills moving forward. In-class exercises and example problems can be varied to expose workers to such a wide range of scenarios, allowing them to truly test their abilities to apply the skills they have learned in the training program. The more frequently tasks are repeated in different environments, the greater the ability of trainees to master these tasks. In the absence of such repetition, the knowledge and skills learned eventually decay.



Hands-on learning, where students have the opportunity to interact and put into practice the concepts that have been presented, makes it easier for knowledge to be retained. In this afternoon's session, course participants will have the opportunity to apply the concepts presented via a series of in-class exercises using two recently developed software applications. Such practice helps bring together the various elements presented in the training program and demonstrate to the trainees how all of these elements fit together.

More challenging tasks also serve to facilitate learning because if tasks are not challenging, they may seem trivial or unimportant to workers. The more thinking that is required and the greater the participation level, the more effective the training will be.

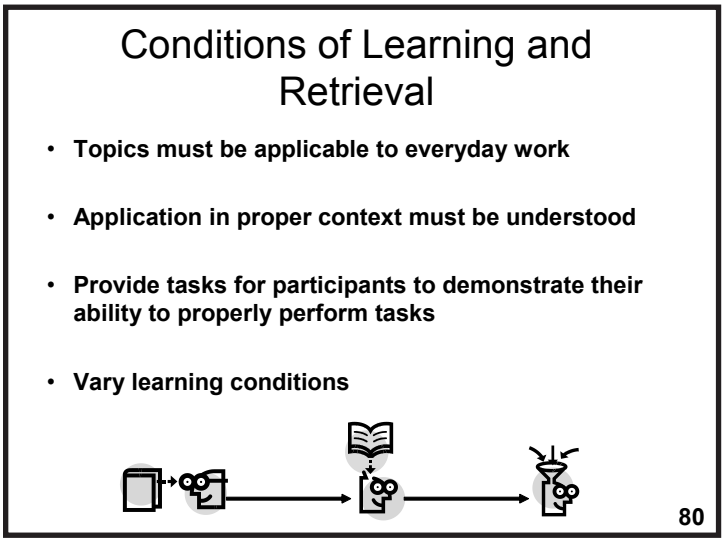
If a training program is to be effective, it is imperative that all involved trainees actively participate. Creating an interactive environment where the training is presented as a two-way discussion rather than a lecture will serve to stimulate participation. Asking questions of the audience and allowing course participants to provide their input helps to facilitate interest in the course material and increase the effectiveness of its presentation.



The ultimate goal of a worker training program is to provide participants with the knowledge and abilities to handle any potential situation they may encounter as a part of their job. In order for this to occur, the participants must apply their acquired skills as often as possible. The more frequently training is provided, the greater the knowledge retention that will result.

Similarly, the shorter the time period is between training sessions, the greater the amount of knowledge that is retained by the trainee. As the knowledge becomes more ingrained in workers, training does not need to occur as frequently. Consequently, it is important that workers learn the skills well initially as this will enhance their abilities to maintain these skills over time.

Key concepts should also be stressed repeatedly as part of a company's everyday activities. This can be done within the context of field work through contact between crew members and supervisors or by management via periodic meetings.



One of the greatest pitfalls associated with classroom instruction is an inability of students to apply theoretical knowledge and skills in a practical environment. Lecture-style presentations will have limited success if workers are not provided with an understanding of how the presented topics are applied within the context of utility work. If workers do not understand how to apply course topics in their everyday work environment, the associated knowledge will be quickly forgotten. Because of this, it is imperative that workers understand how the training applies in the "real world" under various scenarios. Such scenarios can be presented in the form of in-class assignments and practice problems as will be demonstrated in this afternoon's session.

In addition, training may be done in the field or by using specialized software or simulation tools which recreate an environment similar to that where the work will be conducted. Advances in technology are allowing instructors the opportunity to develop a learning environment which is very similar to what will be encountered on the job.

Personal Characteristics

- **Long-term retention is impacted by abilities, prior knowledge, and motivation**
- **Each of these elements can be impacted through a safety culture.**

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Ultimately, knowledge retention is a function of not only the task characteristics, but the characteristics of each individual who undergoes the training, as well. Some workers are inherently more highly skilled, more motivated, or have a greater amount of prior knowledge relative to a particular concept. In light of this fact, training will not provide the same benefit to all participants. In order to ensure that training is optimally effective, a safety culture should encourage workers to improve each of these aspects (abilities, knowledge, and motivation) as part of their everyday activities.

Retraining Issues

- **Participants forget over time**
- **Continuous learning needed**
- **Training should be frequent**
- **Safety issues should be stressed during everyday tasks**

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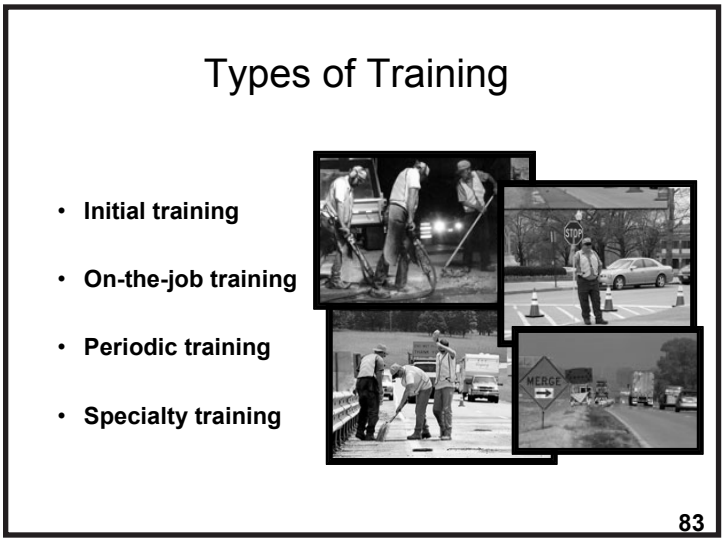
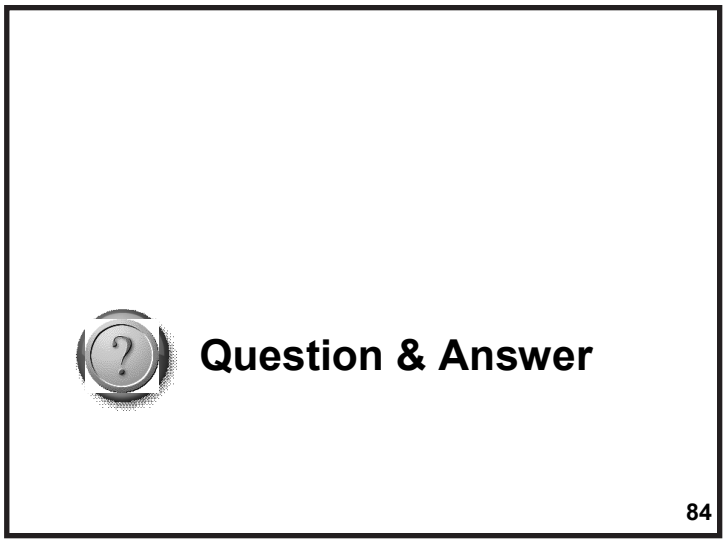
Regardless of how well the training material is learned initially, retraining will be necessary in order to optimize the amount of knowledge that is retained over the long term. In order for workers to maintain the knowledge and skills they acquire through the initial training, periodic retraining should be conducted at appropriate intervals. This retraining may include additional classroom sessions or the application of the knowledge learned on the actual job site. For more complex or specialized tasks, training should be provided more frequently. During the retraining process, the delivery method of the content should be varied to ensure that the trainees do not become bored or disinterested in the material. For example, repeating this entire training program on a periodic basis will likely not produce the benefit of integrating this program with other similar programs which present related material in a different manner or context.

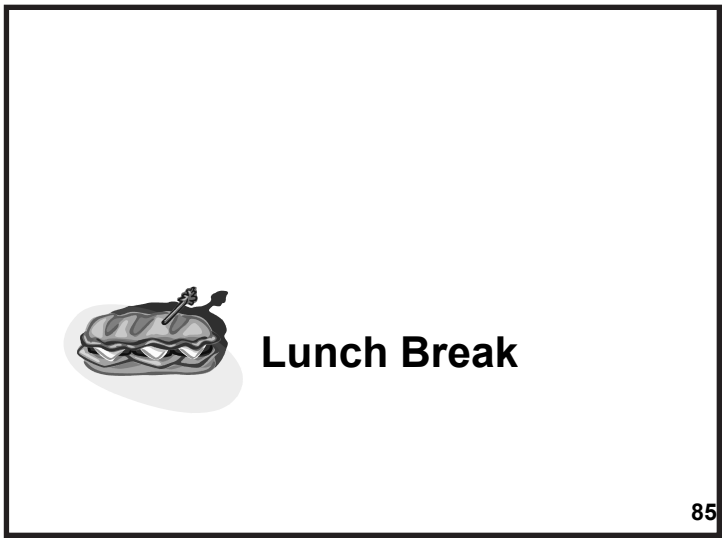


There are various types of training programs that may be utilized to enhance the safety performance of utility workers, supervisors, and management. Certain types of jobs, such as flagging, may require specialized training or certification to ensure that workers have the knowledge and skills necessary to work safely and efficiently. Regardless of the type of utility work, a period of initial training should be provided in order to familiarize workers with the utility work zone environment and what types of hazards should be expected as a part of their occupation. This initial training may be completed on-the-job or in a class room environment.

For class room training, such as that presented today, students should be exposed to realistic scenarios that they may expect to encounter out in the field. This afternoon's session will present such a module aimed at utility workers.



At this point, the audience has the opportunity to ask any questions they may have about the material presented in the morning module.



Participants will be provided with a one hour lunch break. Details should be provided on the lunch and any special dietary needs of participants should be addressed.

XII. Program Evaluation

The program evaluation is designed to allow the participants to evaluate the training program. The evaluation form should be given to each participant at the beginning of the day. The participants should be instructed to circle their evaluations at the end of each lesson. All completed evaluation forms should be collected at the end of the day before the participants leave. The evaluation form is shown on the following page.

PROGRAM EVALUATION FORM

Please circle the agency you work for: Road Agency Utility Company
Utility Contractor

Other:_____

Please provide your evaluation of the training program by circling the rank 1 (poor) to 5 (excellent) as appropriate.

Individual Sections: **Poor**
Excellent

Management and Safety Officials' Module

1. Why Follow the Guidelines? (Overall) .....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content.....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5
2. Utility Work Zone Traffic Control and Safety / Positive Guidance / Driver Expectancy (Overall).....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content.....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5
3. Agency-wide Safety Culture – What? Why? How? (Overall) .....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content.....
1 2 3 4 5

Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5
4. Training, Knowledge Retention, and Retraining Issues (Overall) .....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content.....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5

Overall Training Program:

1. Program Organization.....
1 2 3 4 5
2. Program Length .....
1 2 3 4 5
3. Program Format.....
1 2 3 4 5
4. Class Size.....
1 2 3 4 5
5. Class Layout .....
1 2 3 4 5
5. Relevance and Usefulness of Topics .....
1 2 3 4 5
6. Overall Presentation .....
1 2 3 4 5

Additional Comments: _____
__
_____
__
_____
_____
_____
_____

XIII. Pre- and Post-Tests

The pre-test should be given at the beginning of the program and the post-test should be given at the end of the program. The pre- and post-tests contain the same questions. The pre-test should be printed on a different color paper than the post-test so they can be told apart.

These tests are designed to measure the participant's improvement of knowledge. In order to compare the pre- and post-test results by person, the instructor should have the participants write the same number in the corner of both tests, such as the last four digits of their telephone number. The participants should not be asked to write their names on the tests. Instead, the four-digit numbers can be used to match the pre-test with the post-test of the same person and measure individual improvement of knowledge due to the training program. A copy of the test and the answer key is shown on the following pages.

UTILITY WORK ZONE TRAFFIC CONTROL TEST

In order to evaluate the effectiveness of this training program, it is necessary to gauge the knowledge gained by the participants after completing the course. The results of this test will be used as a part of this evaluation. Consequently, your best effort on this test would be greatly appreciated and will aid in improving the training program prior to its nationwide implementation.

1. Indicate whether utility work zones or highway construction work zones best fit the given criteria. (**circle one only**)

a.	Typically have a shorter work duration:	Utility	Construction
b.	Typically have a larger crew size:	Utility	Construction
c.	Typically require more traffic control:	Utility	Construction
d.	Typically are planned in advance:	Utility	Construction

2. As per the MUTCD, for which categories of work duration may appropriately colored or marked vehicles with high-intensity rotating, flashing, oscillating, or strobe lights be used in place of signs and channelizing devices? (**circle all that apply**)

a. Long-term stationary
b. Intermediate-term stationary
c. Short-term stationary
d. Short duration
e. Mobile

3. Utility work vehicles should be parked (**circle one only**):

a. upstream of the work area
b. downstream of the work area

4. Equipment trailers should be parked (**circle one only**):

a. upstream of the work area
b. downstream of the work area

Identify whether each of the following statements is true or false. (Circle T for true and F for false)

5. The Utility Work Zone Traffic Control Guidelines supersede the MUTCD. T F

6. Utility work zones are harder for drivers to recognize as compared to highway work zones. T F

7. Class I garments are recommended for all utility workers. T F

8. Type III barricades are used in situations where a road closure is required. T F

9. Temporary traffic control signs should be mounted at least seven feet above ground. T F

10. Taller cones provide reduced visibility in comparison to standard cones. T

F

11. Lateral and longitudinal buffer spaces are required in all utility work zones. T

F

12. White utility work vehicles provide the greatest visibility to approaching motorists. T

F

13. Police vehicles with flashers activated should be utilized for temporary road closures. T

F

14. A sidewalk diversion is another name for a sidewalk detour. T

F

15. The typical traffic control plans from the Guidelines are applicable for all utility work zones. T

F

16. How much spacing should be provided between temporary traffic control signs in the following situations? (**Indicate the answer in feet**)

a. An urban area with a 25-mph posted speed limit : _____ ft

b. A rural area with a 25-mph posted speed limit : _____ ft

c. An urban area with a 55-mph posted speed limit : _____ ft

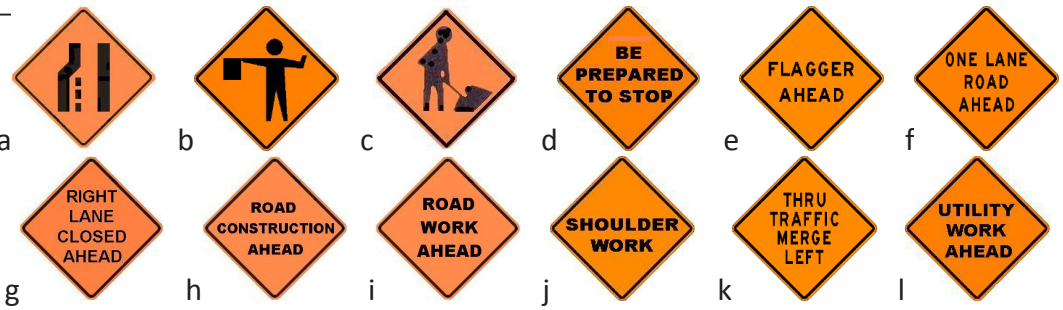
d. A rural area with a 55-mph posted speed limit : _____ ft

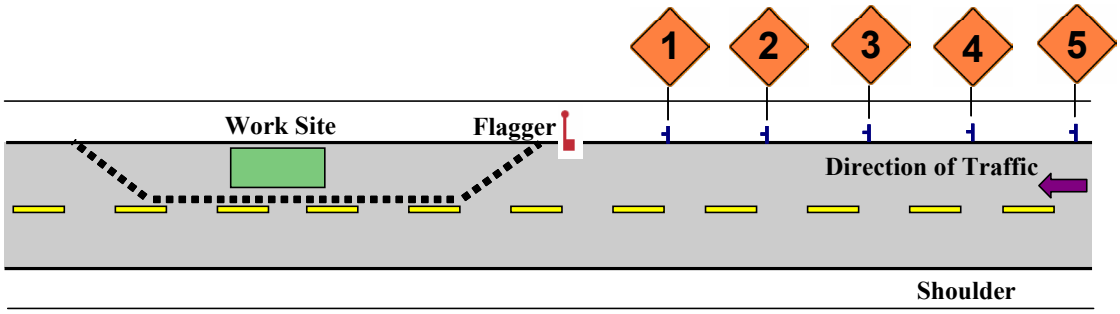
17. Indicate whether temporary traffic control signage and delineation are necessary under the following scenarios where utility work is being conducted on or beyond the shoulder.
(**Circle "Yes" or "No" in the two rightmost columns**)

Work Location	Work Vehicle Location	Volume	Speed	**Signage Necessary?**		**Delineation Necessary?**	
On Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
Beyond Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
	Beyond Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No

18. A utility project requires the use of a flagger to direct traffic at a lane closure along a section of two-lane road as illustrated in the diagram below. The following traffic control signs are available for use at the five locations indicated in the diagram. You are asked to determine how many signs are appropriate and in which sequence they should appear.
(**Write the letter corresponding to the appropriate sign at each location**)

Location 1:____ Location 2: _____ Location 3: _____ Location 4: _____ Location 5: _____





UTILITY WORK ZONE TRAFFIC CONTROL TEST (ANSWER KEY)

In order to evaluate the effectiveness of this training program, it is necessary to gauge the knowledge gained by the participants after completing the course. The results of this test will be used as a part of this evaluation. Consequently, your best effort on this test would be greatly appreciated and will aid in improving the training program prior to its nationwide implementation.

1. Indicate whether utility work zones or highway construction work zones best fit the given criteria. (**circle one only**)

a.	Typically have a shorter work duration:	Utility	Construction
b.	Typically have a larger crew size:	Utility	Construction
c.	Typically require more traffic control:	Utility	Construction
d.	Typically are planned in advance:	Utility	Construction

2. As per the MUTCD, for which categories of work duration may appropriately colored or marked vehicles with high-intensity rotating, flashing, oscillating, or strobe lights be used in place of signs and channelizing devices? (**circle all that apply**)

a. Long-term stationary
b. Intermediate-term stationary
c. Short-term stationary
d. Short duration
e. Mobile

3. Utility work vehicles should be parked (**circle one only**):

a. upstream of the work area
b. downstream of the work area

4. Equipment trailers should be parked (**circle one only**):

a. upstream of the work area
b. downstream of the work area

Identify whether each of the following statements is true or false. (Circle T for true and F for false)

5. The Utility Work Zone Traffic Control Guidelines supersede the MUTCD. T

1. F

2. Utility work zones are harder for drivers to recognize as compared to highway work zones. T

F

3. Class I garments are recommended for all utility workers. T

F

4. Type III barricades are used in situations where a road closure is required. T

F

5. Temporary traffic control signs should be mounted at least seven feet above ground. T

F

6. Taller cones provide reduced visibility in comparison to standard cones. T

F

7. Lateral and longitudinal buffer spaces are required in all utility work zones. T

F

8. White utility work vehicles provide the greatest visibility to approaching motorists. T

F

9. Police vehicles with flashers activated should be utilized for temporary road closures. T

F

10. A sidewalk diversion is another name for a sidewalk detour. T

F

11. The typical traffic control plans from the Guidelines are applicable for all utility work zones. T

F

16. How much spacing should be provided between temporary traffic control signs in the following situations? (**Indicate the answer in feet**)

a. An urban area with a 25-mph posted speed limit : 100 ft

b. A rural area with a 25-mph posted speed limit : 500 ft

c. An urban area with a 55-mph posted speed limit : 350 ft

d. A rural area with a 55-mph posted speed limit : 500 ft

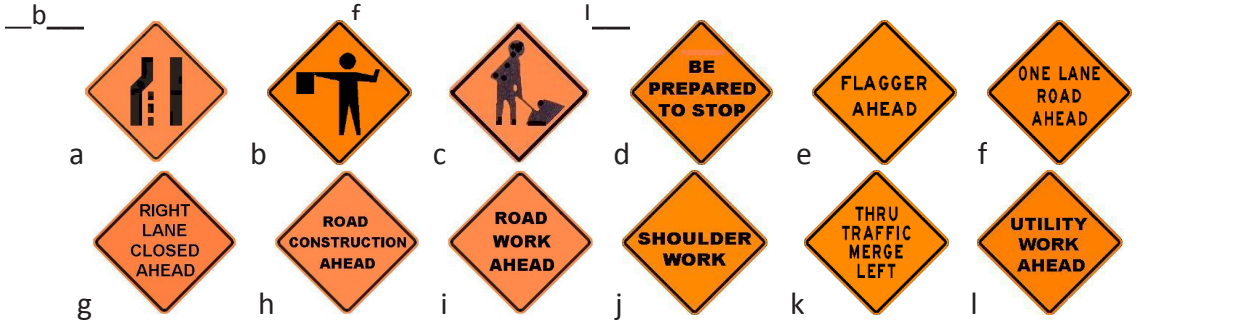
17. Indicate whether temporary traffic control signage and delineation are necessary under the following scenarios where utility work is being conducted on or beyond the shoulder.
(**Circle "Yes" or "No" in the two rightmost columns**)

Work Location	Work Vehicle Location	Volume	Speed	**Signage Necessary?**		**Delineation Necessary?**	
On Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
Beyond Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
	Beyond Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No

18. A utility project requires the use of a flagger to direct traffic at a lane closure along a section of two-lane road as illustrated in the diagram below. The following traffic control signs are available for use at the five locations indicated in the diagram. You are asked to determine how many signs are appropriate and in which sequence they should appear.
(**Write the letter corresponding to the appropriate sign at each location**)

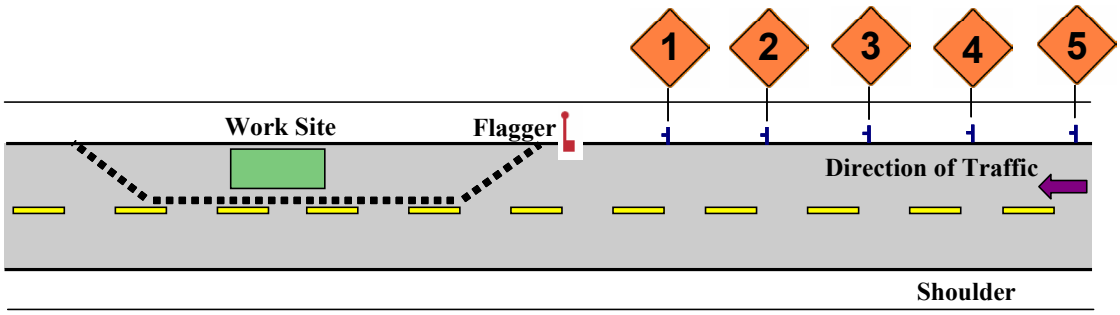
Location 1: Location 2: Location 3: Location 4: _____ Location 5: _____

__b__ f l__



a b c d e f

g h i j k l



XIV. List of Acronyms

ANSI	American National Standards Institute
ARTBA	American Road and Transportation Builders Association
ATSSA	American Traffic Safety Services Association
FHWA	Federal Highway Administration
ISEA	International Safety Equipment Association
MUTCD	Manual on Uniform Traffic Control Devices
NHI	National Highway Institute
OSHA	Occupational Safety and Health Administration
TTC	Temporary Traffic Control
TTI	Texas Transportation Institute
UWZ	Utility Work Zone

XV. List of References and Source Documents

Additional resource materials for utility work zone traffic control guidelines and training can be found at the following websites:

- American Road and Transportation Builders Association: http://www.artba.org/
- American Traffic Safety Services Association: http://www.atssa.com/

- Federal Highway Administration: http://www.fhwa.dot.gov/
- Manual on Uniform Traffic Control Devices: http://mutcd.fhwa.dot.gov/
- National Highway Institute: http://www.nhi.fhwa.dot.gov/home.aspx
- National Work Zone Safety Information Clearinghouse:
- http://www.workzonesafety.org/
- Texas Transportation Institute: http://tti.tamu.edu
- Transportation Research Board: http://www.trb.org/

Training materials and programs for traffic regulators (flaggers) can be found at the following website: http://www.workzonesafety.org/training/

A list of additional resources that may be helpful for the instructor are as follows:

1. *Manual on Uniform Traffic Control Devices for Street and Highways*. U.S. Department of Transportation, Federal Highway Administration, 2003 Edition, 2004.

2. Scriba, T., Sankar, P. and Jeannotte, K. *Implementing the Rule on Work Zone Safety and Mobility*. US Department of Transportation, Federal Highway Administration, FHWA-HOP-05-065, September 2005.

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4. Ullman B.R., M.D. Finley, and N.D. Trout. *Identification of Hazards Associated with Mobile and Short Duration Work Zones*. Texas Transportation Institute Report No. 4174-1, September 2003. http://tti.tamu.edu/documents/0-4174-1.pdf.

5. Antonucci et al., Guidelines for the Implementation of the AASHTO Strategic Highway Safety Plan Volume 17: A Guide for Reducing Work Zone Collisions, NCHRP Report 500, TRB, National Research Council, Washington D.C., 2005.

6. Chapman, P.R. and G. Underwood (1998), "Visual Search of Driving Situations: Danger and Experience", Perception, Vol. 27, pp. 951-964.

7. Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Program, http://www.cdc.gov Accessed January 9, 2007.

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11. Kamyab, A. and T.J. McDonald (2003), "Synthesis of Best Practices for Increasing Protection and Visibility of Highway Maintenance Vehicles", Proceedings of the 2003 Mid-Continent Transportation Research Symposium, Ames, Iowa.

12. Post, D.V. (1978), "Signal Lighting System Requirements for Emergency, School Bus and Service Vehicles", DOT HS-804 095, Highway Safety Research Institute, University of Michigan, Ann Arbor, MI.

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18. Wayne State University Transportation Research Group (2007), Utility Work Zone Safety Guidelines and Training: Gap Study and Needs Assessment, Report to United State Department of Transportation, Federal Highway Administration.

19. Zwhalen, H.T., and T. Schnell (1997) "Visual Detection and Recognition of Fluorescent Color Targets Versus Nonfluorescent Color Targets as a Function of Peripheral Viewing Angle and Target Size", Transportation Research Record 1605, National Research Council, Washington, D.C.

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21. Carlson, P.J., H.G. Hawkins, and M.D. Finley (2001), "Selection of Retroreflective Material as a Function of Sign Color and Critical Detail." Proceedings from the Transportation Research Board 80th Annual Meeting, Washington D.C., Preprint CD-ROM.

22. Ullman, G.L. (2000), "Special Flashing Warning Lights for Construction, Maintenance, and Service Vehicles: Are Amber Beacons Always Enough?" Transportation Research Record No. 1715, Washington, D.C., pp. 43-50.

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28. Hulbert, S. and Fowler, P, (1980), "Motorists' Understanding of Traffic Control Devices, Test II", AAA Foundation for Traffic Safety, Washington, D.C.

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Utility Work Zone Traffic Control

Utility Workers, Foreman and Supervisors Module

I. Introduction

Utility work zones often differ from typical highway construction and maintenance work zones. They are often shorter in duration, and the extent of traffic control devices used is dependent on the work crew and their company's/agency's safety practices and their perception of risks. Long-term utility work is generally planned ahead of time and often requires maintenance of traffic (MOT) plan approval by the appropriate road agency. Therefore, such a utility work zone adheres to national and local work zone traffic control standards and practices. Shorter duration utility work zones range from a shoulder closure to an entire roadway closure with the work activities lasting from a few minutes to several hours. Emergency situations requiring a full road closure are most often controlled by local law enforcement officials which allows the work crew to address the situation efficiently.

Utility work often involves the presence of work vehicles and equipment in the travel lanes of the roadway, on the shoulder and/or within the right-of-way of active roads and highways. Although utility work is often less time consuming than highway construction and maintenance activities, it still poses similar challenges to passing motorists and workers. The Manual on Uniform Traffic Control Devices (MUTCD) provides general guidelines and minimum standards for utility work zone traffic control. The MUTCD provides significant flexibility as its requirements are applicable to the entire range of work zone situations (i.e. long-term highway construction, short-term maintenance, utility work, mobile operations, etc.). These requirements have been interpreted in many different ways by utility companies, contractors and road agencies. This has contributed to a lack of uniformity in utility work zones which may lead to increased risks for both motorists and workers, and may result in reduced mobility.

This training focuses on the *Utility Work Zone Traffic Control Guidelines*, which addresses traffic control needs for utility work activities on or near public thoroughfares that are conducted routinely, and last for relatively short time periods and take place during the daytime. Long-term utility projects and nighttime work are not within the scope of the guidelines. This guideline also includes strategies to mitigate safety challenges associated with utility work zones. The guidelines have been developed to address gaps found in

existing relevant guidelines/standards and industry needs identified through literature reviews, current practice surveys, interviews of safety officials, information collected during utility work zone site visits and utility worker surveys.

II. Executive Summary

In general, utility work zones are different than typical highway construction work zones. They are often shorter in duration, and the traffic control used may be dependent on the work crew and their company's/agency's safety practices and their perception of risks. Long-term utility work is generally planned ahead of time and often requires maintenance of traffic (MOT) plan approval by the appropriate road agency. Therefore, such a utility work zone adheres to national and local work zone traffic control standards and practices. Emergency utility work zones are events that are most often controlled by local law enforcement officials and could range from a shoulder closure to an entire roadway closure. Most utility work can vary from a few minutes to several hours. The focus of this training program is to provide safety guidelines for utility work zone traffic control to the utility workers, supervisors and foremen who either assign work or actually perform work in the field.

III. Course Organization

The Utility Workers, Foremen and Supervisors module was designed to be a three-hour course. If presented in conjunction with the Management and Safety Officials module during the morning, the module for Utility Workers, Foremen and Supervisors may be held in the afternoon from 1:00 PM to 4:00 PM. A detailed agenda is provided in Section IX. The lessons for the afternoon sessions are shown in the table below.

Afternoon Session: Utility Workers, Foremen and Supervisors Module

Lesson #	Lesson Title & Description	Est. Time (minutes)
1	Introduction to the Guideline	15
2	Recommended Traffic Control Devices and Why?	30
3	Suggested Traffic Control Plans / Pedestrian Issues	30
3	Break	15
4	How do You Select a Proper Traffic Control Plan?	15
5	Case Study – In-Class Exercises	30
6	Demonstration of Software Program	15
6	Question and Answer	15
6	Post-Test and Course Evaluation	15

IV. Course Coordination

The dates and times of the course should be planned in advance so that the participants are aware of the upcoming training session. Registration forms should be made available far in advance so that participants can complete them and return them to the appropriate agency.

V. Class Size

The maximum class size is 30 participants and the minimum class size is 10 participants. A smaller class size is recommended to provide a more personal and interactive environment. A larger class size is fine as long as the facilities can comfortably accommodate the larger number of participants.

VI. Host Agency Responsibilities

Audiovisual Equipment Requirements

The visuals aids for this course include PowerPoint presentations and other computer programs. The following audiovisual equipment is required:

- LCD projector and proper cables for connection
- Spare projector bulb
- Electronic remote device, if available
- Projection screen (at least 6' x 6')
- Pointer
- Flip chart
- Large markers

Room Requirements

The room must be able to accommodate the number of participants attending the training session. The room should be set up in classroom style. The instructor should be able to adjust the lighting and temperature of the room.

Notepads and pens should be available in the room for participants. Water should also be

made available to the instructors and participants.

Local Coordinator's Responsibilities

The local coordinator should make arrangements so that the room is prepared ahead of time and meets the needs of the instructor(s). The local coordinator should also make arrangements to provide refreshments during the course breaks and lunch for the instructors and participants.

Participants and Instructors

All participants and instructors should be aware of the location and times of the programs. Directions to the training facility should be provided to all participants. Hotel room accommodations and rates, for those guests traveling a far distance, should be made available to all participants and instructors.

VII. Description of Target Audience

This three-hour course is intended for those who either assign work or actually perform work in the field including utility workers, foremen, and supervisors.

VIII. Course Goal and Outcomes

Course Goals

- Understand the importance of safety for both workers and motorists.
- Understand the contents of the *Utility Work Zone Traffic Control Guideline* and know how to apply the guideline recommendations.
- Be familiar with the recommended traffic control devices and traffic control plans, as well as why/when they should be used and how to adjust them to site-specific conditions based on a risk assessment.

Course Outcomes

At the conclusion of the course, participants will be able to:

1. Thoroughly understand the contents of the *Utility Work Zone Traffic Control Guidelines* and how they can help improve safety.
2. Understand the differences in utility work zone activities and highway construction and the implications on temporary traffic control needs based on an assessment of risk.

Know how to select and set up a proper utility work zone traffic control plan with appropriate traffic control devices to ensure safety for workers and all road users including motorists pedestrians and bicyclists.

IX. Course Agenda

Afternoon Session: Utility Workers, Foremen and Supervisors Module

Time	Lesson Title	Length (minutes)
1:00-1:15	Introduction to the Guideline	15
1:15-1:45	Recommended Traffic Control Devices and Why?	30
1:45-2:15	Suggested Traffic Control Plans / Pedestrian Issues	30
2:15-2:30	Break	15
2:30-2:45	How do You Select a Proper Traffic Control Plan?	15
2:45-3:15	Case Study – In-Class Exercises	30
3:15-3:30	Demonstration of Software Program	15
3:30-3:45	Question and Answer	15
3:45-4:00	Post-Test and Course Evaluation	15

X. Instructor: Presentation Requirements

Before the Training Event

Confirmation of the training date, time, location and participant details should be made before the event. Name tags should be made for each participant to encourage networking opportunities.

The instructor should have copies of the following three CDs made and distributed to each participant:

1. Utility Work Zone Traffic Control Guidelines

2. Selection of Utility Work Zone Traffic Control Plans Software Program
3. Drag and drop Application for the Case Study, In-Class Exercises

The instructor should have copies of the following items made for each participant:

1. Agenda
2. Evaluation Form
3. Participant Workbook
4. Pre-Test
5. Post-Test
6. In-Class Exercise Description

The instructor(s) should be very familiar with the information that they will be teaching. The information provided should be studied and additional resources should be examined to help better prepare the instructor.

The instructor(s) should visit the training session venue prior to the event to make sure the room is properly set-up and that the equipment is in good working condition.

During the Training Event

During the training event it is very important that the instructor(s) are well prepared. The instructor should arrive early to make sure everything is working properly and to ensure that they have enough time to get organized. The instructor(s) should adhere to the time schedule. Questions from the participants should be answered in a concise and timely manner.

The pre-test should be administered to the participants at the start of the training.

After the Training Event

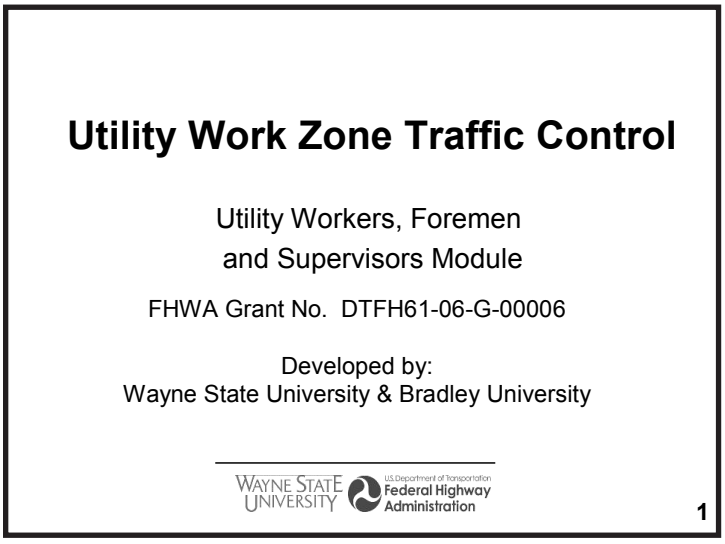
The post-test should be administered to the participants at the end of the training. Each participant should fill out the evaluation form throughout the day at the completion of each lesson. Make sure to collect all the evaluation forms at the end of the training.

XI. Lesson Plans and Visual Notes

This section contains a description of each lesson followed by the PowerPoint slides with notes for each lesson. Each lesson will be evaluated by the participant in the evaluation form. Each participant will be evaluated on their knowledge and what they had learned in each lesson by the pre- and post-test. References for the instructor are provided in Section XV and following the lecture slides, where appropriate.

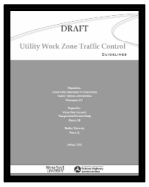
Lesson 1: Introduction to the Guidelines

Lesson Number:	1
Lesson Title:	Introduction to the Guidelines
Performance-Based Learning Outcomes:	To understand the contents of the *Utility Work Zone Traffic Control Guidelines and the reason for its development* .
Instructional Method:	The instructor will provide an overview of the *Guideline* document, its contents and how it can be used to improve safety. The instructor will also discuss why the *Guideline* was developed and cover the basic concepts of driver perception reaction time and the need for uniformity and conspicuity of traffic control devices in utility work zones.
Time Allocation:	15 minutes



This module of the training session is directed towards utility workers, foremen and supervisors and will provide an introduction to the *Utility Work Zone Traffic Control Guideline,* a document that was developed as a part of this initiative and served as the basis for the contents of this training program. The *Guideline* document includes the recommended traffic control devices, suggested traffic control plans, how one selects a utility work zone traffic control plan and supporting materials. The Guideline document and training program was prepared by researchers from Wayne State University in Detroit, Michigan and Bradley University in Peoria, Illinois through funding provided by the Federal Highway Administration.

In addition, this module of the training program will include a case study (in-class exercise) in which participants can practice how to set up a utility work zone for a given application through the use of a Drag and Drop software application. The participants will also be given an opportunity to practice how to select an appropriate traffic control plan using the software program developed as a part of this project.



Introduction to the Guidelines

2

The *Utility Work Zone Traffic Control Guidelines* were developed by the Wayne State University Transportation Research Group, in collaboration with Bradley University, through a Federal Highway Administration grant. These *Guidelines* were developed to address the unique nature of utility work zones, which are substantially different in various aspects from longer-term highway construction projects.

Utility Work Zone Traffic Control Guidelines

- Developed for FHWA
- Include recommended traffic control plans
- Temporary traffic control devices
- Meant for electrical, gas, telephone, cable, water, sewer, landscaping, others
- Not meant for nighttime or freeway work

U.S. Department of Transportation
Federal Highway Administration

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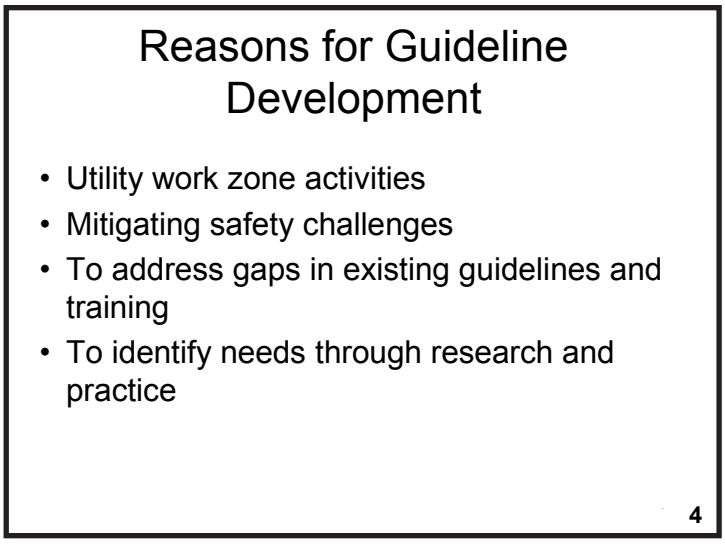
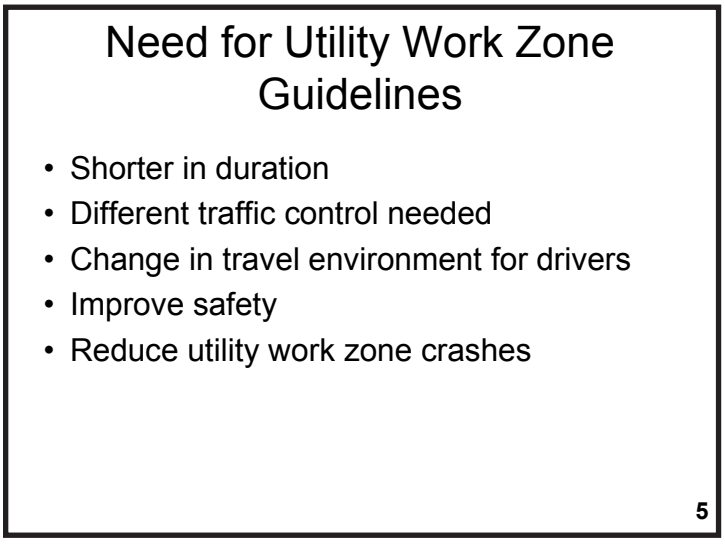
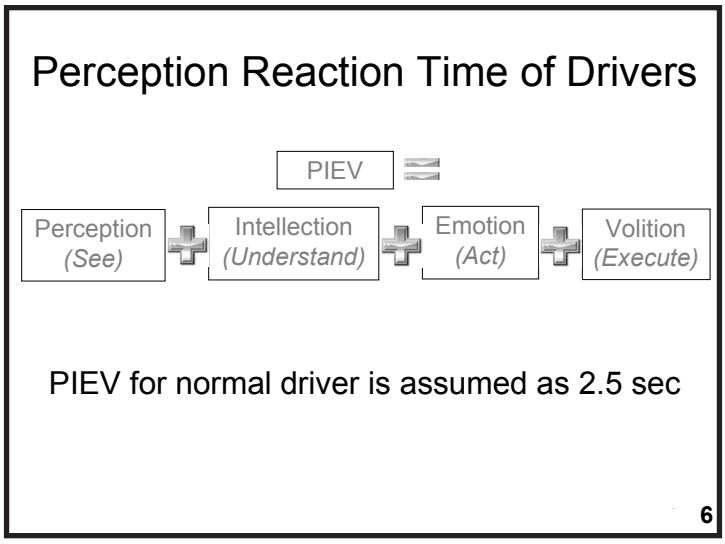
The instructor should provide a detailed description of the *Guidelines* to the participants. The guidelines contain recommended traffic control plans and temporary traffic control devices with justification for all the recommendations. The *Guidelines* are intended to be used by all types of utility work including electrical, gas, telephone, cable, water, sewer, and landscaping, to name a few. They are also intended to be used by utility companies, contractors, as well as maintenance departments within city, county and state transportation agencies. Due to the high risks involved, nighttime work and work conducted on freeways were not addressed in the *Guidelines*, as participants should directly use the recommendations in the Manual on Uniform Traffic Control Devices (MUTCD) when developing traffic control plans for these cases.



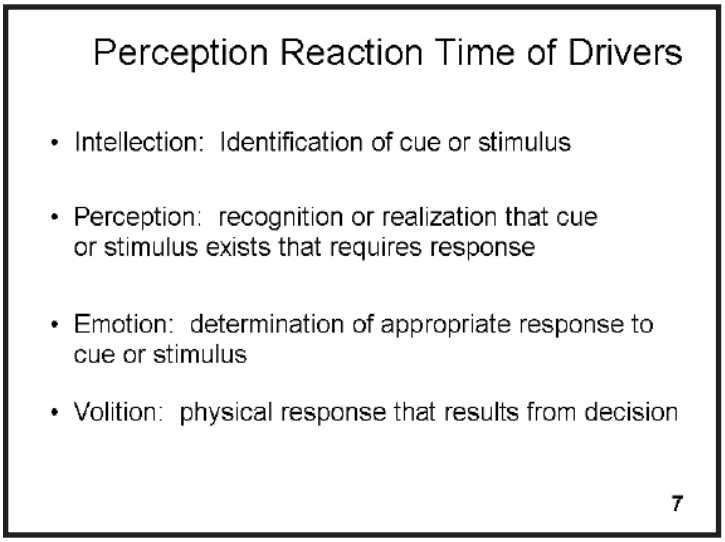
Utility work zone activities are substantially different than the activities in work zones encountered most often by motorists for highway construction projects. Generally, utility work is conducted over a shorter time period and occupies a smaller work area. Due to these factors, utility workers face unique safety challenges. In some instance, the time required to set up and remove temporary traffic control devices takes longer than the actual utility work, potentially increasing the level of risk and exposure to motorists and workers. In addition, a review of the state-of-the-practice revealed that high variability exists in the work zone practices among various utility agencies. When it came to the utility industry, there were apparent gaps in available training programs and literature on how to set up a utility work zone using appropriate temporary traffic control plans and traffic control devices. In developing the *Guideline*, extensive research was performed, surveys were conducted throughout the US, and interviews with utility companies were performed to identify ways to fill the gaps and provide recommendations for utility work zone traffic control. The resulting *Guidelines* provide a uniform set of traffic control plans, devices and practices that may assist utility agencies across the country to help improve safety of road users and protect the workers.



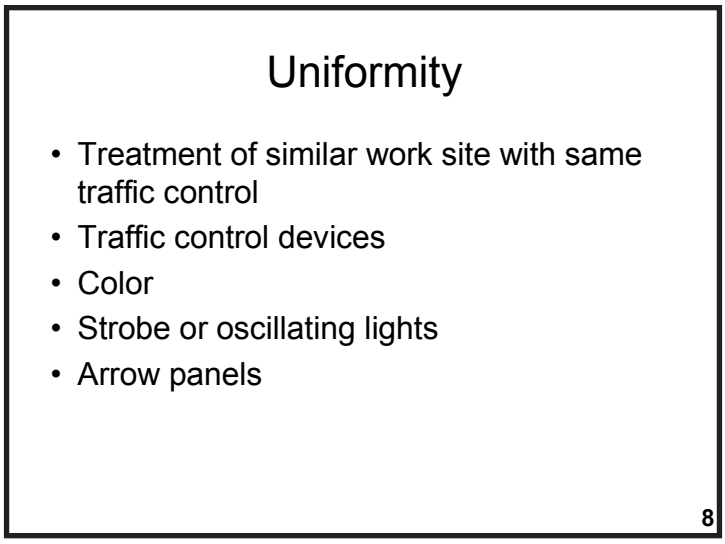
As utility work is often conducted in less than one hour, elaborate temporary traffic control plans are often superfluous. Due to this short duration, a reduced number of traffic control devices which provide greater visibility and are dominant may be used instead of many less conspicuous devices, assuming the risk is moderate to low. Most utility work by nature is less conspicuous to oncoming motorists due to a number of factors, including smaller work area, small work crews, limited advance warning and work vehicles which often blend into the roadway environment. These *Guidelines* present recommendations for improving uniformity and conspicuity of utility work zones. This will have a positive impact on drivers since, as they encounter theses "uniform" utility work zones repeatedly, they will be able to respond quickly and accurately. They will need less perception-reaction time (or PIEV time) to respond to the advanced warning since these situations will be embedded into their expectancies. Consequently, this will improve safety by reducing the likelihood of utility work zone crashes.



Uniformity of temporary traffic control helps to reduce the perception-reaction time of drivers approaching a work zone. Perception reaction time (also called PIEV time) is comprised of four components: (1) Perception, (2) Intellection, (3) Emotion, and (4) Volition.



Perception is the act of seeing. Intellection is the act of understanding the perceived stimulus. Emotion involves determining how to appropriately respond to the given stimulus. Volition is the actual physical response that results. For example, at a signalized intersection suppose a driver is confronted by a yellow light. First the driver notices or sees that the light is yellow (perception), next that visual information is processed by the driver—a change in right-of-way is about to occur (intellection). Then the driver must make a decision whether to stop or go through the yellow depending on the distance from intersection and speed of travel (emotion). The last step is to execute the decision that was made—if topping, the physical action is to apply the brakes—if going through the yellow, the physical action is to accelerate (volition).



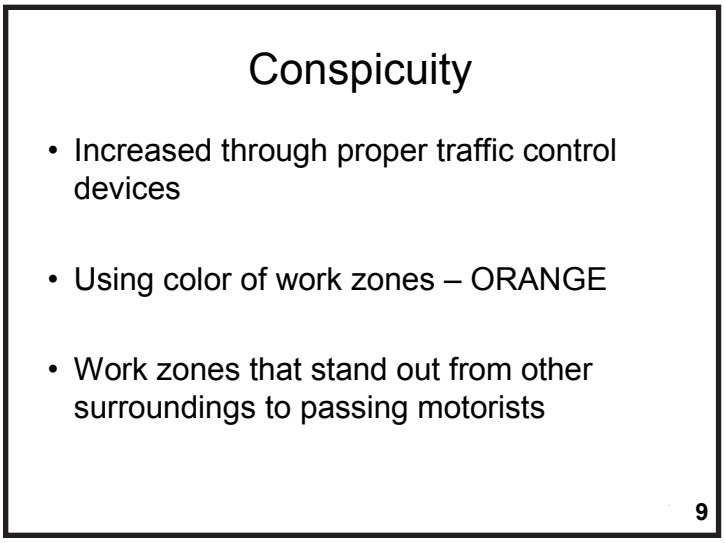
Uniformity is a key factor in drivers being able to identify work zones. Uniformity is achieved by treating similar situations the same way, with the same traffic control devices and general sequence of traffic control devices. Historically, work activities, traffic control devices, and work vehicles have generally been associated with the color orange. Consequently, whenever oncoming drivers see the color orange, they are more likely to be cognizant of associated utility work. In addition, various types of traffic control devices, including cones, arrow panels, and strobe lights have the ability of alerting drivers to work activities.

If road users are consistently provided with the same visual cues under similar situations, they will be able to process the information more quickly and efficiently than if work zones are associated with a wide range of work vehicle colors and temporary traffic control devices. In addition, the use of uniform devices aids highway officials and utility companies in the efficient installation and maintenance of these devices.

"Uniformity assists road users, law enforcement officers, and traffic courts by giving everyone the same interpretation. Uniformity assists public highway officials through efficiency in installation, maintenance, and administration" (reference: Manual on Uniform Traffic Control Devices, Section 1A.06).

Generally, 85 percent of drivers react to events in the road environment within 2.5 seconds. By providing uniformity, the time required to process the visual cues provided by the work zone environment is lessened, resulting in a shorter perception/reaction time. Shorter perception/reaction times allow drivers to navigate work zone environments more safely and efficiently.

"Uniformity of devices simplifies the task of the road user because it aids in recognition and understanding, thereby reducing perception/reaction time."



Conspicuity refers to how visible a particular cue is to approaching motorists. Colors that stand out from their background are generally easier to recognize than colors which blend in with the background environment. The color orange has traditionally been used for work zone applications as it is a vibrant color that can easily be discerned by oncoming motorists. Unfortunately, utility work vehicles are frequently painted a different color, such as white. These vehicles are not noticeably different from other vehicles on the roadway and, consequently, motorists are less likely to identify them as utility vehicles.

Lesson 2: Recommended Traffic Control Devices and Why?

Lesson Number:	2
Lesson Title:	Recommended Traffic Control Devices and Why?
Performance-Based Learning Outcomes:	To understand the recommended traffic control devices and why they should be used.
Instructional Method:	The instructor will describe the recommended traffic control devices and help the participants understand the importance of using these devices.
Time Allocation:	45 minutes

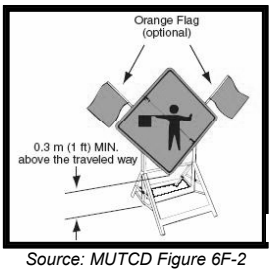
A wide range of traffic control devices (TCDs) are utilized for work zone activities. A review of the state-of-the-practice revealed that some utility work is conducted in the absence of any type of traffic control. Providing uniform and consistent traffic control devices prior to and within the work zone environment serves to enhance the abilities of motorists to recognize the work zone as was the case with the color orange as mentioned previously.

The recommended TCDs for utility work zones have proven to be effective and are considered the most desirable in eliciting proper driver action. It is expected that these devices will be procured over time, and thus the recommendations were developed with an eye for the future in improving safety on our streets and roads.

The TCDs include warning signs in advance of the work area to inform drivers of the change in operations ahead, arrow panels at the beginning of tapers for lane closures, and channelizing devices through the work zone to delineate the proper path drivers are to follow. Additional TCDs include the work vehicle itself and its flashing or oscillating warning lights/beacons.

Temporary Traffic Control Signs

- Message, layout, and configuration per MUTCD
- Construction fluorescent orange color with mircoprismatic retro-reflective characteristics
- Two orange supplemental flags may be mounted
- Size = 36” x 36”
- Crashworthy



Source: MUTCD Figure 6F-2

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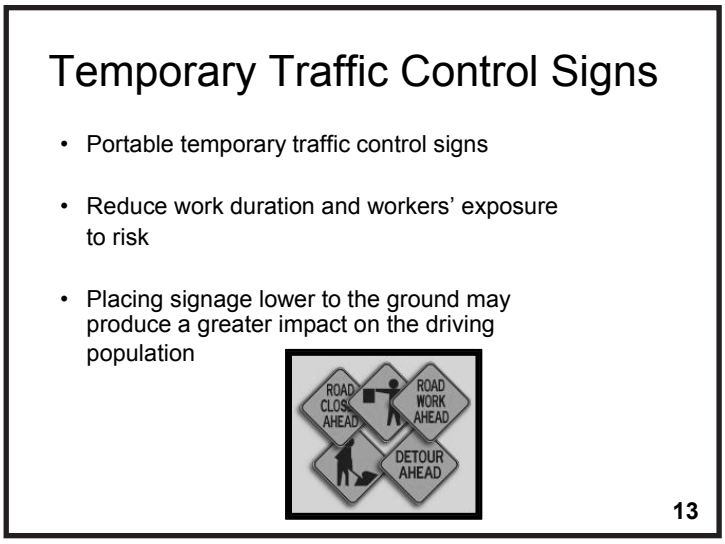
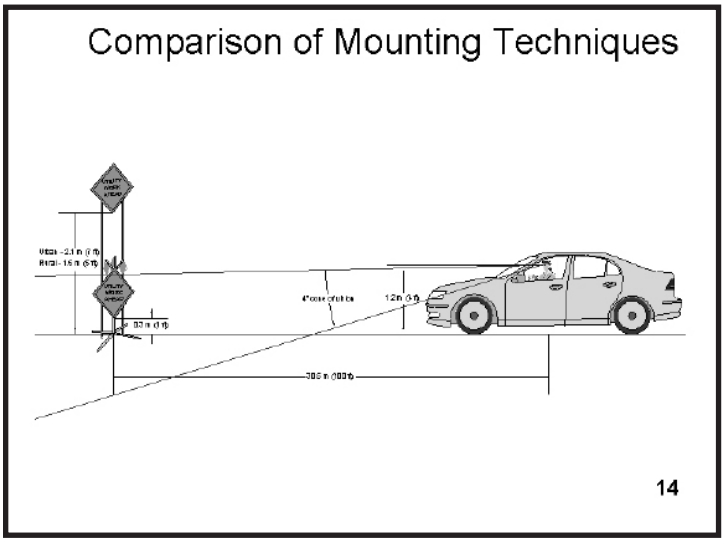
The signs recommended for utility work zones must follow MUTCD standards in terms of the sign messages and layouts. In addition, the sign should be fluorescent orange color with microprismatic retro-reflective characteristics to aid in the conspicuity of the signs.



Portable signs are desirable in utility work zones for several reasons.

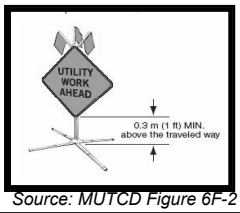
- The message provides warning to drivers.
- TTC in work zones is typically set up and removed in a day, thus their portability and ease in installing and removing is essential. Requiring post mounted signs would not be practical, safe, or necessary for that matter as the perceived benefits would not be comparable to the added risk and exposure to the worker.
- Portable signs are lower to the ground, which is desirable for utility work zones on lower speed roads. Past studies have found that drivers tend to fixate their eyes lower to the ground. This is beneficial in urban settings, due to greater visual clutter that these signs would have to compete with if mounted higher with the rest of the signage.



Drivers have an acute cone of vision of three to five degrees. Fairly clear sight is achieved at a 10 to 12 degree cone; while peripheral vision is between 120 to 180 degrees. Generally, drivers focus their sight on objects near the ground as mentioned previously. Consequently, it is recommended that signs be placed nearer to the ground where possible so that motorists can more easily see them.

Comparison of Mounting Techniques

- Drivers tend to look at pavement in front of them
- 4º better than 12º cone of vision
- Easier recognition of work zone when signs are mounted different than typical signs
- Retractable stands for parked vehicles



Source: MUTCD Figure 6F-2

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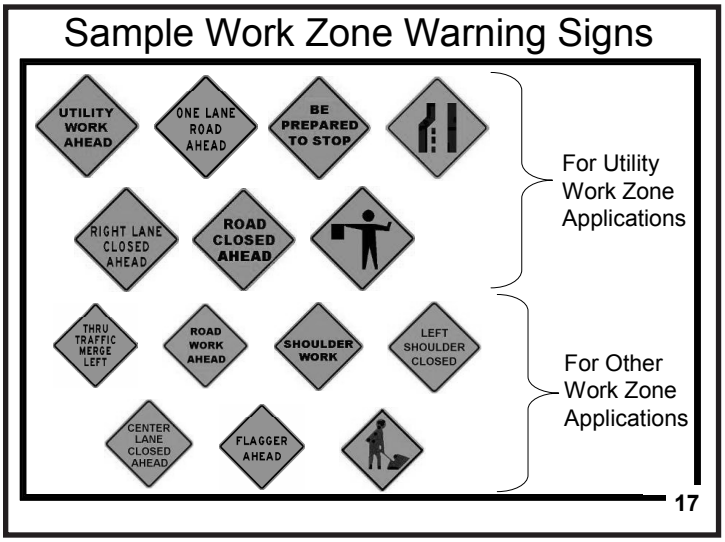
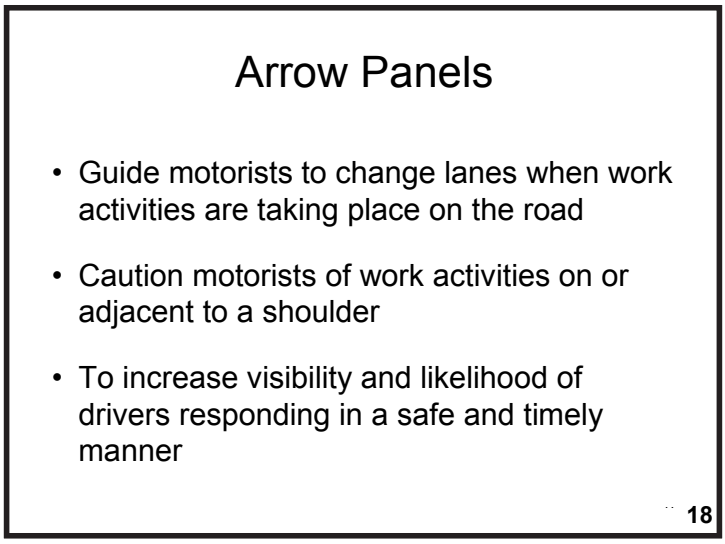
Generally, traffic control signs are mounted at a height of seven feet in urban areas and five feet in rural areas. Placing utility work signs at lower heights serves to differentiate these signs from standard traffic control signs. This serves to inform motorists to expect something different in the upcoming road environment. The traffic control signs should have retractable stands. For locations where there are parked vehicles, sign should be mounted at a height of seven feet to be seen above parked vehicles.

These photos show a variety of poorly mounted temporary traffic control signs. (Ask the course participants to identify what the problems are with each of the six mountings.) Some of the problems exhibited include damaged or unreadable signs, signs posted too low to the ground or too far from the traveled way, or signs that are blocking other temporary traffic control devices.



This slide illustrates a variety of typical utility work zone warning signs. (Ask the participants to briefly describe the meanings and typical applications of each of these types of signs.) Discuss and draw sketches of sample applications as per the recommendations of the Guidelines.



Arrow panels may be utilized to alert motorists of the start of a work zone or to inform motorists of an impending lane shift or merge. Providing highly visible devices such as arrow panels allows for drivers to respond to an upcoming work zone in a safe and timely manner. Unfortunately, there is currently little uniformity in the design of arrow panels utilized by utility companies. By providing for greater uniformity, drivers will be able to quickly and easily identify and react to arrow boards when encountering them on the road with greater sufficiency.

In terms of utility work zone traffic control, it is desirable to use them in intersection applications where there is a lane closure; however in the recommended traffic control plans, they are optional. When used, they should be placed at the start of the taper, or as close as feasible if mounted on a truck.

Arrow Panels

- Support panel 48” H x 96” W
- Minimum of 15 lamps
- Front panel with flat, non-reflective black background
- Mounted at minimum of 7’ from roadway to bottom of panel

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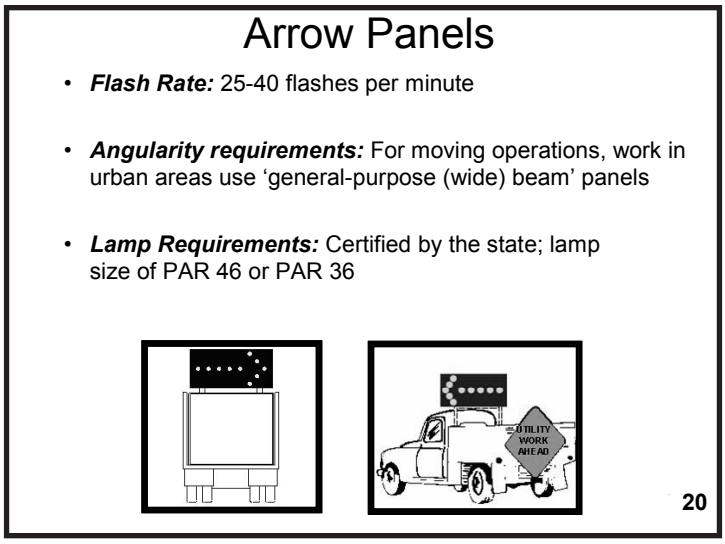
These recommendations are MUTCD requirements for Type C arrow panels. Arrow panels should be 48 inches high by 96 inches wide, contain a minimum of 15 lamps mounted on a non-reflective black front panel, and be mounted a minimum of seven feet from the roadway. Arrow panels may be mounted on independent trailers or mounted on the back of a truck or work vehicle. In the latter case the MUTCD recommends mounting on vehicles as high as practical. It is also desirable to equip the arrow panels with a system to raise them into position when in operation and lower them into travel position when not needed, which should be provided with remote controls.



Arrow panels should flash at a rate of 25 to 40 flashes per minute and meet the other guidelines indicated above from the MUTCD.

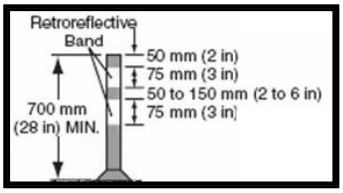
For moving operations, work in urban areas (which encompass most utility work), use 'general-purpose (wide) beam' panels as opposed to 'narrow beam' panels.

Lamp requirements and other requirements must be met including those related to power supply, minimum recognition distance, and intensity requirements.

- ***Power Supply:*** Provide power necessary for lamps to meet the intensity requirements
- ***Minimum Recognition Distance:*** Based on decision sight distance requirements of 1500 feet for roads with posted speeds > 45 mph and 980 feet for roads with posted speeds ≤ 45 mph
- ***Intensity Requirements:***
  - -Low speed road, daytime conditions min. on-axis = 300 candelas (cd), max. off-axis = 60 cd
  - -High speed road, daytime conditions min. on-axis = 500 cd, max. off-axis = 100 cd
  - Low speed road, nighttime conditions min. on-axis = 90 cd, max. off-axis = 18 cd, max. hot-spot = 370 cd
  - -High speed road, nighttime conditions min. on-axis = 150 cd, max. off-axis = 30 cd, max. hot-spot = 370 cd

Channelizing Devices

- Provides guidance/delineation to motorists
- Need to be easily installed and removed
- Must be orange and contain retro-reflective bands
- Made of a material that will not damage a vehicle if impacted
- 36" taller cones or tubular markers are more desirable



Source: MUTCD Figure 6F-7

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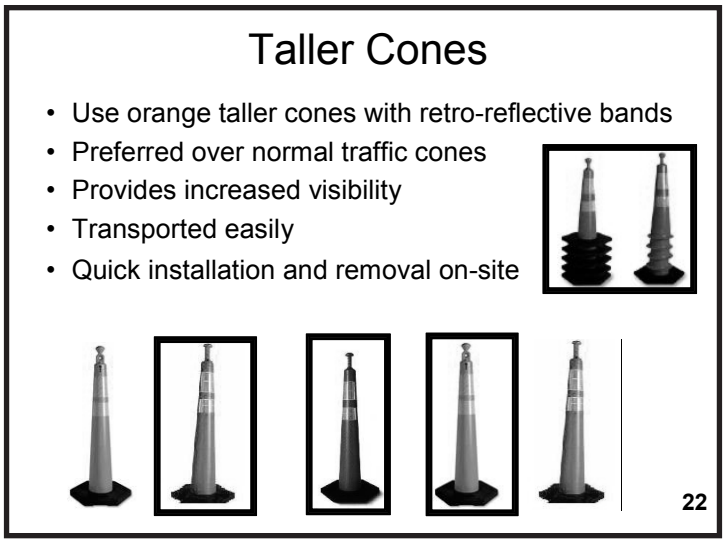
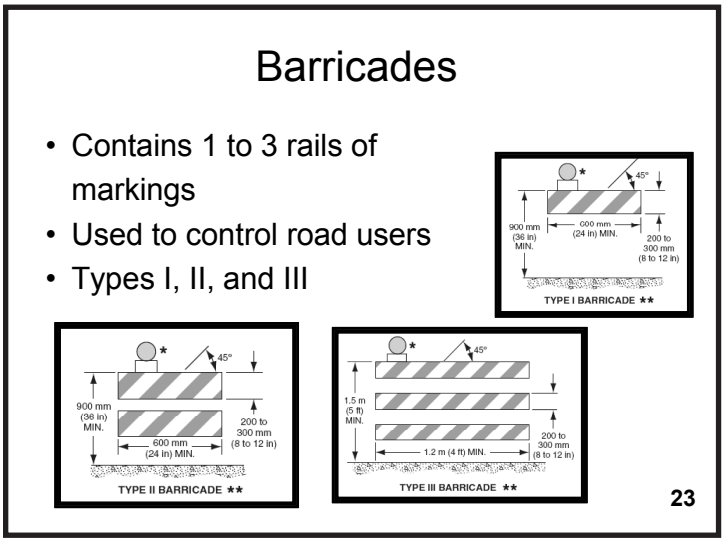
As with the other traffic control elements mentioned previously, cones should be orange in color to increase conspicuity. In addition, retro-reflective bands should be affixed to all cones to increase visibility. The cones should be made of strong ductile materials which will not be damaged if impacted by a passing vehicle. The MUTCD requires a minimum of 28-inch height for such cones, but a 36-inch height is recommended in the Guidelines.



In utility work zones, cones are typically used as channelizing devices rather than barrels as they require much less time to setup and remove. However, there is much variability in the types of cones utilized by utility companies across the country. The guidelines recommend the use of taller cones, such as the one illustrated in this photograph. Taller cones have several advantages over conventional traffic cones.

Taller cones are recommended to be used as the channelizing device for all the applications. They have a minimum height of 28 inches (although 36 inch height is more desirable), and are orange in color with retroreflective bands around the top. They have a unique handle on top which allow one to easily 'grab' them (where the nickname grabber cone arose from). This makes them easy to place and pick up and stack, even from a slowly moving vehicle. They are preferred over traditional traffic cones, since they are taller and more visible to road users.



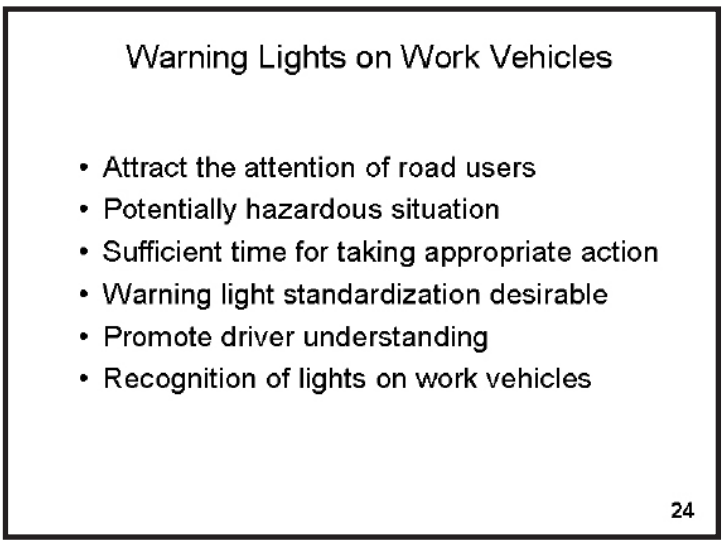
As per the MUTCD, a barricade is a portable or fixed device having one to three specially marked rails used to control users or delineate the travel path. There are three different types of barricades. Type I, Type II and Type III. Barricades are recommended in a few of the TTC plans for utility work zones, such as work in the center of an intersection and for pedestrian provisions.

According to the MUTCD, "a barricade is a portable or fixed device having from one to three rails with appropriate markings and is used to control road users by closing, restricting, or delineating all or a portion of the right-of-way."

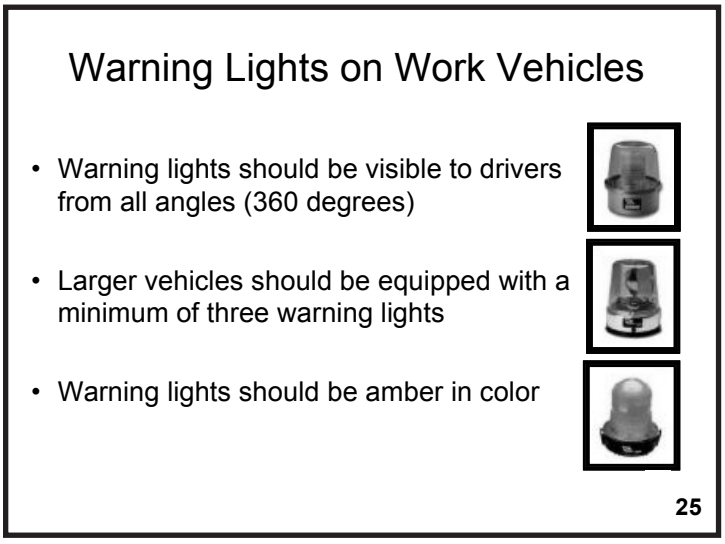
Type I barricades contain one marked rail, are typically a warning light, are three feet high by two feet wide, and are the smallest of the three types of barricades. They are typically used on low speed roads as they provide the least protection of the three barricade types. They are used in situations where flow is maintained through the work zone, typically on urban streets

Type II barricades are similar to Type I barricades. Both types of barricades are three feet by two feet, though the Type II barricades are more conspicuous as they have two orange and white striped planks in comparison to the one that is present on Type I barricades. Type II barricades are appropriate for higher speed roadways, including freeways and expressways.

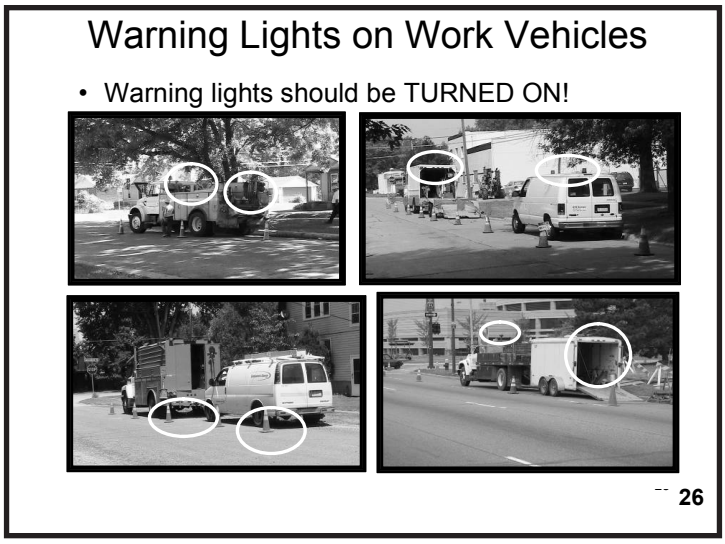
The largest of the group is the Type III barricade, which is nearly twice the size measuring five feet high by four feet wide. These barriers have three orange and white planks and are used for situations which require a full or partial road closure.



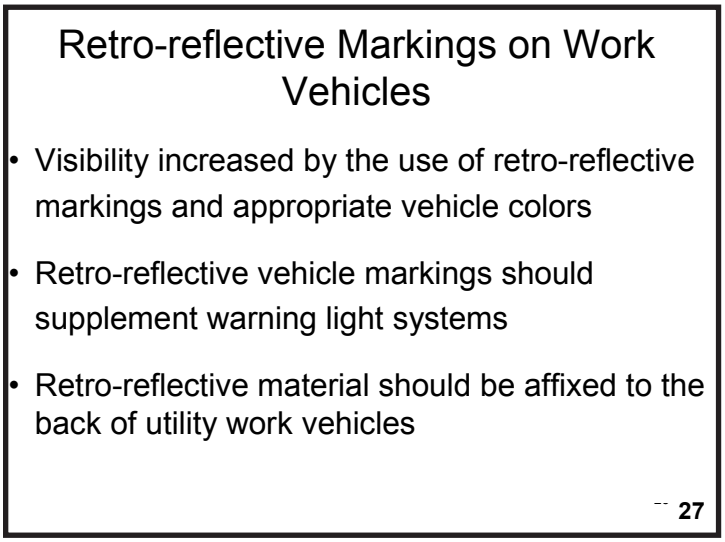
In many instances, the work vehicle is an important element for providing information to motorists of ongoing work activities. To enhance the conspicuity of work vehicles, warning lights are essential for utility applications. Warning lights are able to attract the attention of oncoming drivers and alert them to a potentially hazardous situation. By standardizing the warning lights on work vehicles, driver understanding can be improved and there will be more time available for motorists to take appropriate actions.



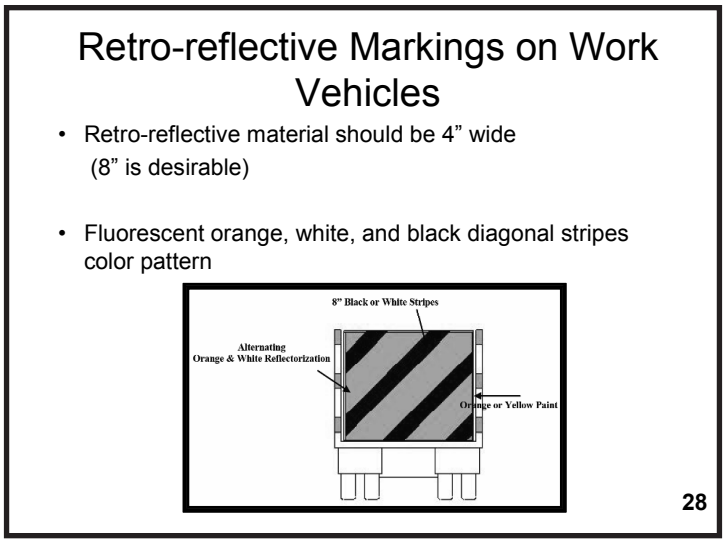
Warning lights should be visible to drivers from all angles and should be amber in color. To enhance visibility, larger work vehicles and equipment should be equipped with a minimum of three warning lights while two lights would be sufficient for smaller sized vehicles (panel vans). As a result of past studies on human visual perception and detection with respect to warning lights, it is recommended that two rotating beacons and one incandescent flashing light be used. Additionally, the four-way flashers should also be used and remain in operations while the work is being conducted.



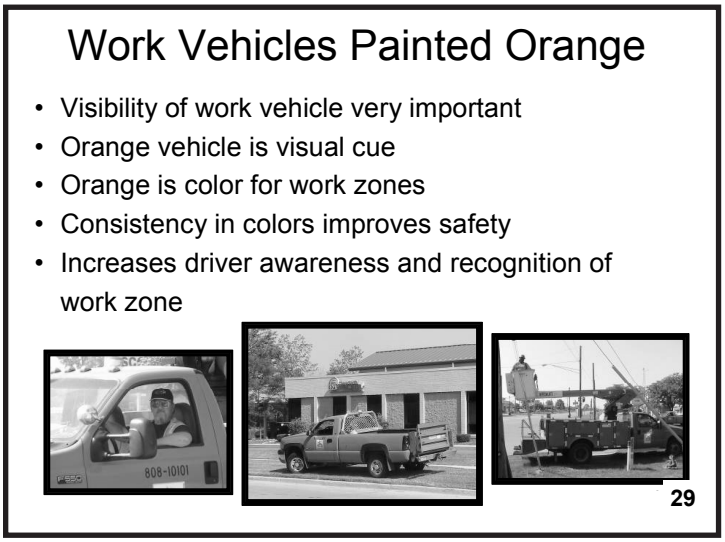
In order for warning lights on work vehicles to be effective for traffic control, they should be turned on. This slide illustrates a number of utility jobs where the work vehicles were equipped with warning lights that were not turned on. Warning lights do not demand a great deal of power to function and are highly visible when turned on. It is recommended that warning lights always be turned on when a vehicle is present in a utility work zone.



In addition to warning lights, the visibility of vehicles can be further enhanced through the use of retro-reflective markings and by painting work vehicles an appropriate color. Retroreflective blocks ideally should be visible on all sides of the vehicle to make its perimeter visible in darkness. In terms of an appropriate color of work vehicles, orange is recommended as it is easily discernable in most work environments. Retro-reflective markings can be placed on the rear of utility vehicles to increase visibility.

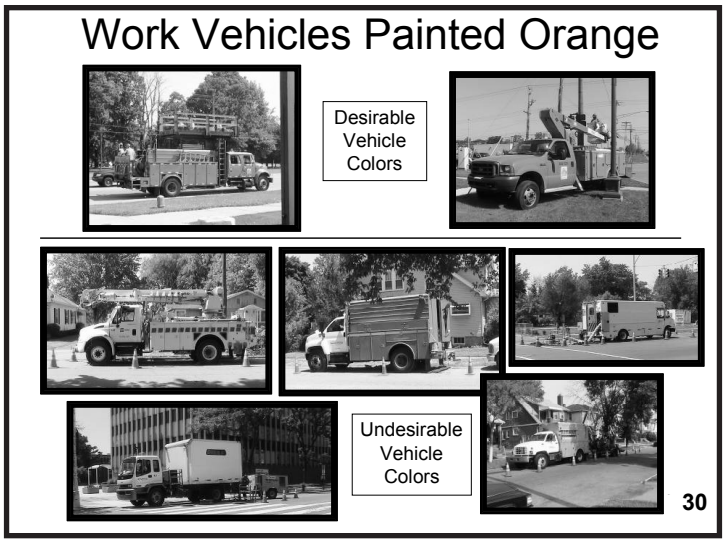


Here is a picture of a sample design of a utility work vehicle. Retro-reflective material is provided in 8-inch wide stripes painted diagonally across the back of the orange vehicle. The stripes should alternate between fluorescent orange and either white or black. This combination has found to be effective for both daytime and nighttime use.

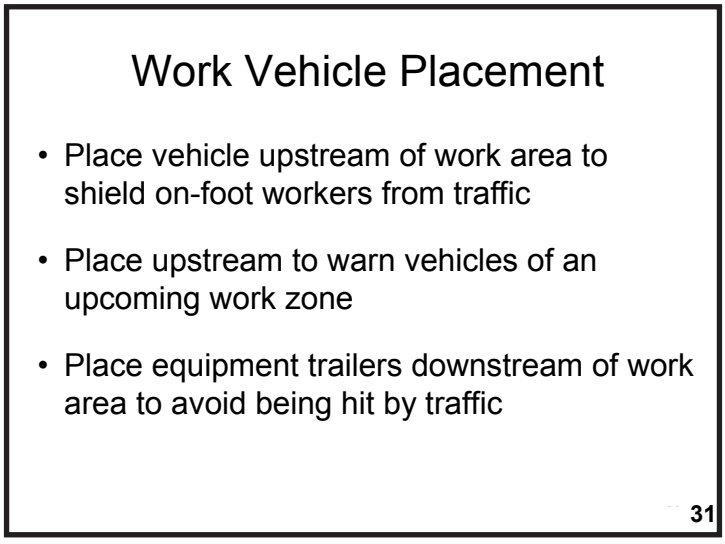


For many years, construction work zones have been easily identifiable to motorists due to the prevalence of orange colored vehicles, equipment, and traffic control devices. However, the utility industry has generally not followed these same standards. Many utility work vehicles are white and are only recognizable as utility vehicles through the presence of a flashing light or a company logo. Painting these work vehicles orange will help to improve driver expectancy of utility work, increasing awareness and recognition of work activities.

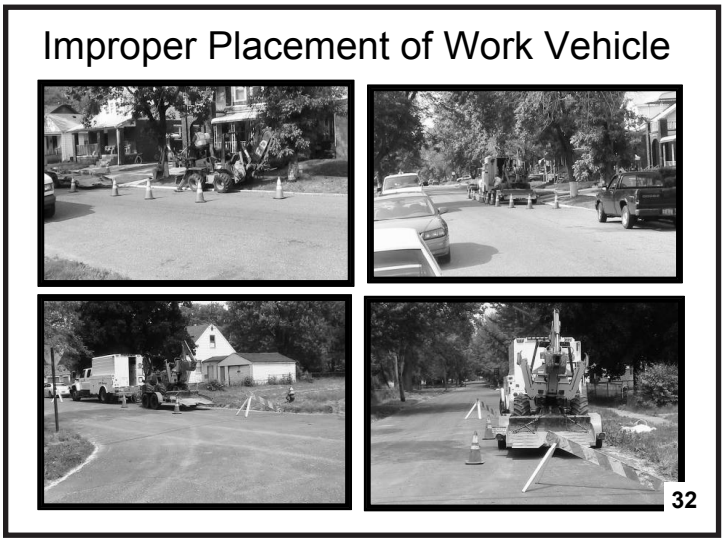
Again orange, is the color of work zones. Many times, utility work zones are small and possess relatively few orange TCDs, thus using the color orange for utility vehicles will help motorists identify a utility work zone. The truck itself acts as one large dominant TCD.



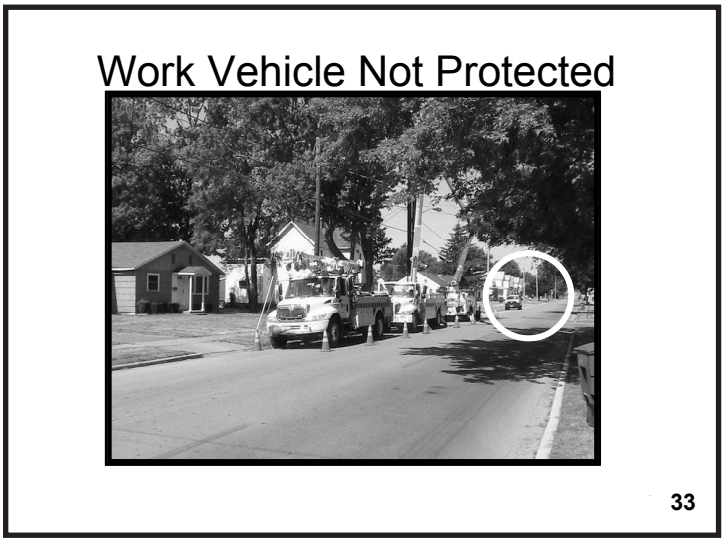
As these photos illustrate, work vehicles that are painted orange are more easily distinguished than other vehicles. The white vehicles tend to blend in with their background environment while the orange vehicles stand out from their surroundings.



Work vehicles, in addition to providing a visual cue to motorists, are able to provide protection to utility workers if placed at an appropriate location within the work zone. The work vehicles should be placed upstream (before) the work area in order to shield workers from adjacent traffic. Additional vehicles may be placed in advance of the work zone to provide a warning of upcoming work activities. Equipment trailers, which are larger, should be placed downstream (after) work area to avoid being hit by traffic.



(Ask the participants to identify the problems with each of these work vehicle placements). The trailers shown in the above photos are placed upstream of the work vehicles, presenting a hazard to approaching motorists. The trailer should be placed on the opposite side of the work area.



In this photo, the work vehicle upstream of the work area is not protected and is at high risk. The other company vehicles are all marked off using cones.

Set-up and Removal of Devices

- Spend least amount of time necessary to set-up and remove devices
- Perform work as expeditiously as possible to reduce exposure
- Decreasing exposure time increases safety
- Use devices that are easily transported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When setting up and removing temporary traffic control devices, the risk of crashes is reduced if the exposure time of the involved workers is minimized.

Set-up of Traffic Control Devices

- Identify traffic control plan ahead of time
- Plan and discuss traffic control off roadway
- Park work vehicles and equipment to maximize safety
- Place traffic control devices as per selected plan starting at beginning of work zone

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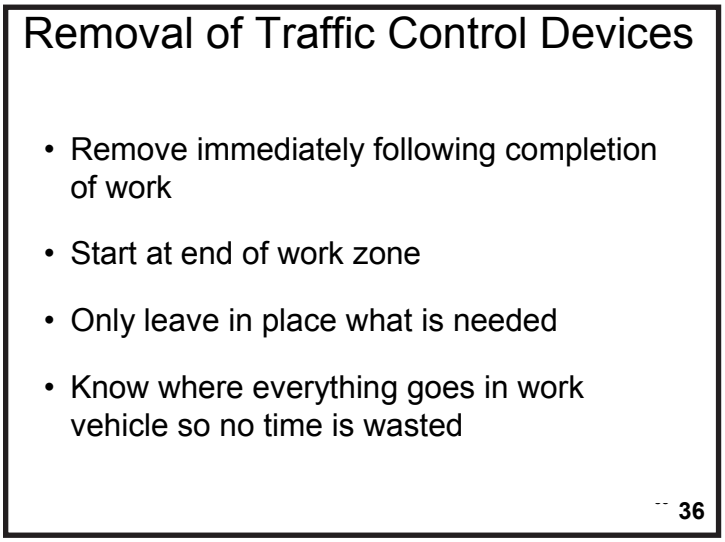
There are several steps which can reduce the required set-up time for traffic control devices at a given work site. Based on the roadway characteristics where the work will be occurring, agencies should be able to identify appropriate traffic control devices ahead of time. Work vehicles and equipment should be parked in a manner such that it maximizes safety at the work site by shielding workers from adjacent traffic. The traffic control devices should be set up starting at the beginning of the work zone and going toward the end of the work zone.



Traffic control devices should be removed immediately at the completion of the utility work. Removal should begin at the downstream end of the work zone and working back toward the start of the work zone in each direction. Workers should be knowledgeable of how equipment and traffic control devices are placed in the work vehicles in order to minimize the time required for loading and unloading.

In addition to making the work zone and equipment visible to motorists, it is imperative that workers present in the work area are also highly visible. High-visibility safety apparel must be worn at all times. Fluorescent orange, yellow, or yellow-green is recommended due to the high conspicuity of such colors. In addition, retroreflective markings must be included on all work clothing as specified in the MUTCD.

Worker Safety Apparel

- Proposed Amendment to MUTCD Section 6D.03 requires "American National Standard For High-Visibility Safety Apparel and Headwear"
- ANSI (American National Standards Institute) / ISEA (International Safety Equipment Association) 107-2004
- Class 2 and 3 garments based on worker activities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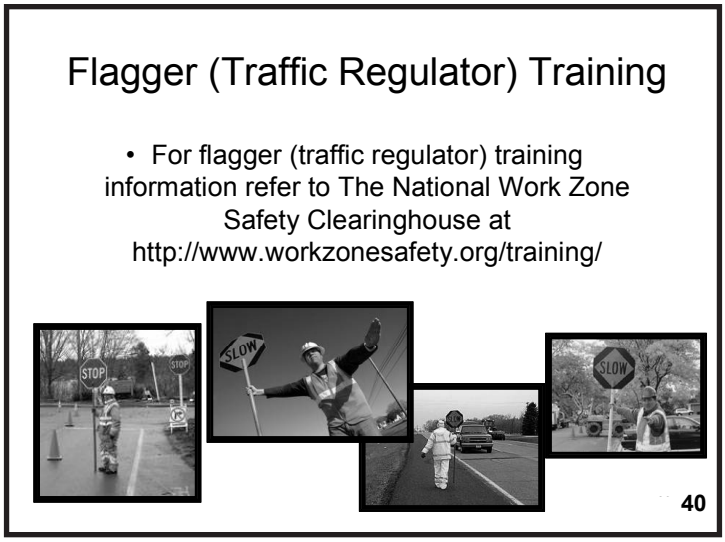
The MUTCD follows the American National Standard for High-Visibility Safety Apparel. There are three ANSI conspicuity classes based on the type of work activities at a given work site.

Class 1 garments are not recommended for use in utility work zones. Class 2 or 3 garments are recommended as described below.

When workers are charged with tasks which divert their attention from approaching traffic, class 2 garments should be utilized. They should be used when traffic speeds are greater than 25 mph, but less than 50 mph and when the work activities take place close to the road. Class 2 garments are also appropriate in instances of inclement weather where greater visibility is necessary and when there are complicated backgrounds in the work site.

Class 3 garments are the most conspicuous of the three classes and should be worn by workers who face serious hazards where either weather, work activities, or some other factors impair visibility to oncoming motorists. Class 3 garments should be worn whenever adjacent traffic speeds are greater than 50 miles per hour. Class 3 garments are recommended for all utility workers as such personnel are frequently focused on activities unrelated to traffic and are in positions where they may be less visible to approaching drivers.

In addition to visible work clothing protective equipment should be utilized, including hard hats, steel toe boots, and protective eyewear.

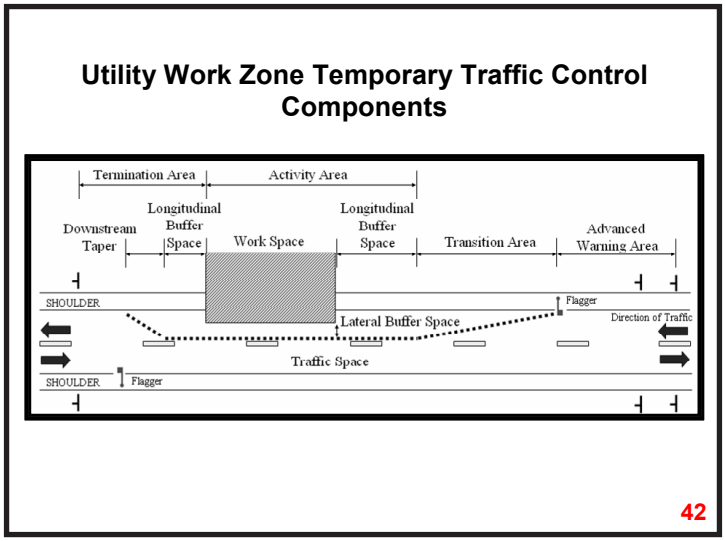


Workers with very specialized tasks often require specialized training. A common example in a work zone environment is the flagger. Flaggers training information is available through the National Work Zone Safety Clearinghouse. The Clearinghouse also provides additional information on all aspects of work zone safety, including links to material associated with utility work zones.

Lesson 3: Suggested Traffic Control Plans / Pedestrian Issues

Lesson Number:	3
Lesson Title:	Suggested Traffic Control Plans / Pedestrian Issues
Performance-Based Learning Outcomes:	To understand the components of a traffic control plan. To learn about the utility work zone traffic control plans recommended in the *Guidelines*. To understand the importance of considering pedestrians in work zone traffic control. To learn what type of traffic control is needed to guide pedestrians through utility work zones.
Instructional Method:	The instructor will describe the components of the traffic control plan. The instructor will then explain each utility work zone traffic control plan recommended in the *Guidelines*. The instructor will then stress the importance of pedestrian safety and describe how it can be achieved through the use of proper traffic control.
Time Allocation:	30 minutes

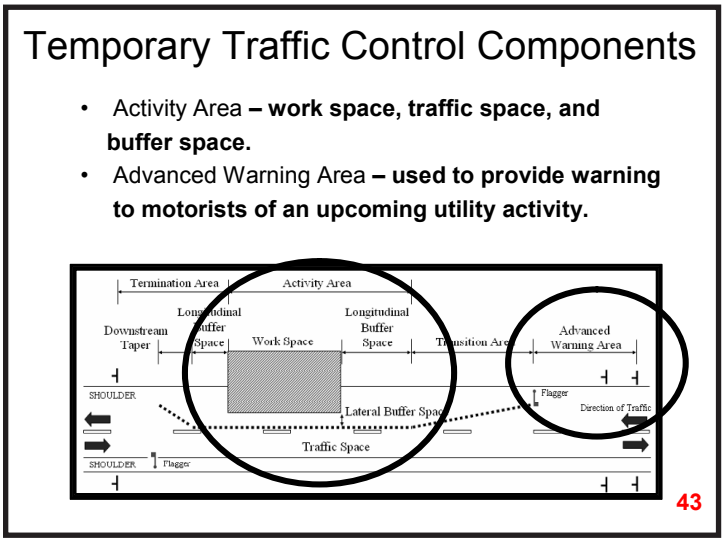
The suggested elements to be included in a temporary traffic control plan for utility work zones will be covered in this lesson, as well as the traffic control plans for utility work zone applications recommended in the *Guidelines*. Traffic control plans and elements are recommended for routine utility projects that can be completed during the day, on or near streets and roads (not expressways or freeways). The number and types of traffic control devices included in these plans vary based on the associated risk for a particular situation.



This figure shows a typical temporary traffic control plan. Each of the components are labeled. (At this point, ask the participants if they know what each of these components are.)

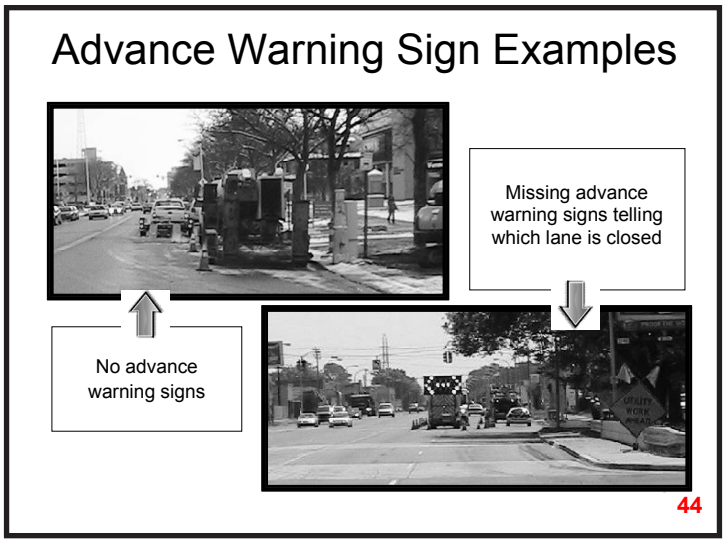
The basic safety principles governing the design of permanent roadways and roadsides should also govern the design of TTC zones. The goal should be to route road users through such zones using roadway geometrics, roadside features, and TTC devices as nearly as possible, compared to those for normal highway situations.

A TTC plan, should reflect the complexity of the work project, and be prepared and understood by all responsible parties before the site is occupied. Any changes in the TTC plan should be approved by an official, who is knowledgeable (trained and/or certified) in proper TTC and work zone practices.



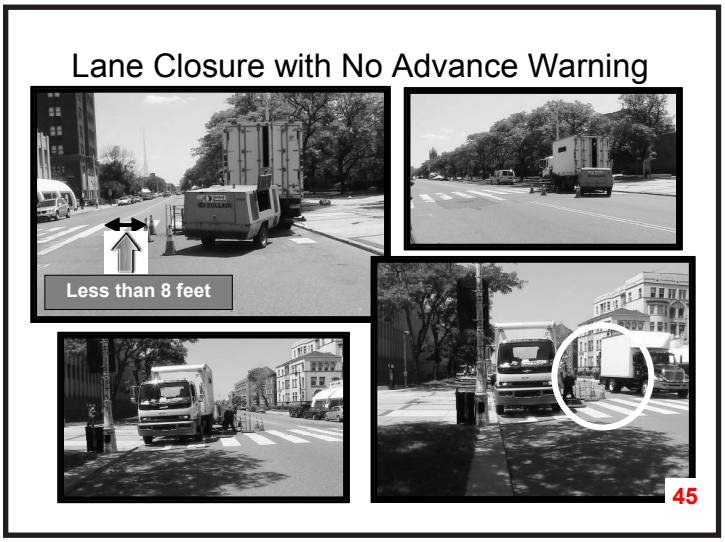
The "activity area" is an area on or near the roadway where the work activity takes place. It is composed of the work space and the traffic space, and may contain one or more buffer spaces. The "work space" is where the work is actually taking place and includes workers, equipment, and material. The traffic space is the portion of roadway through which road users are routed through the work area.

The "advanced warning area" is the section of roadway where road users are informed about the upcoming work zone. This area may vary from a single sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to a series of signs and channelizing devices in advance of the temporary traffic control zone transition area.



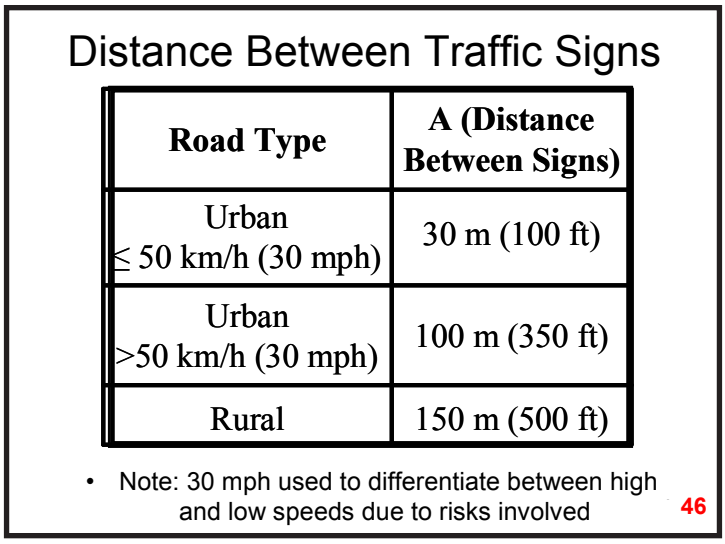
When an advance warning sign is not provided, drivers do not have as much time to react to an upcoming work zone. The first photo shows an example of a utility work zone without advance warning signs. The second photo shows a utility work zone which requires a lane closure. However, no information is provided to approaching road users as to this upcoming closure. It is imperative that appropriate signage be provided to inform road users of any unusual activities that will be required of them when moving along the roadway environment.

The advance warning area is very important as it informs road users what to expect upon reaching the work zone. Driver mistakes are the key contributing factor to crashes and are often caused by insufficient, poorly delivered, or untimely visual cues.

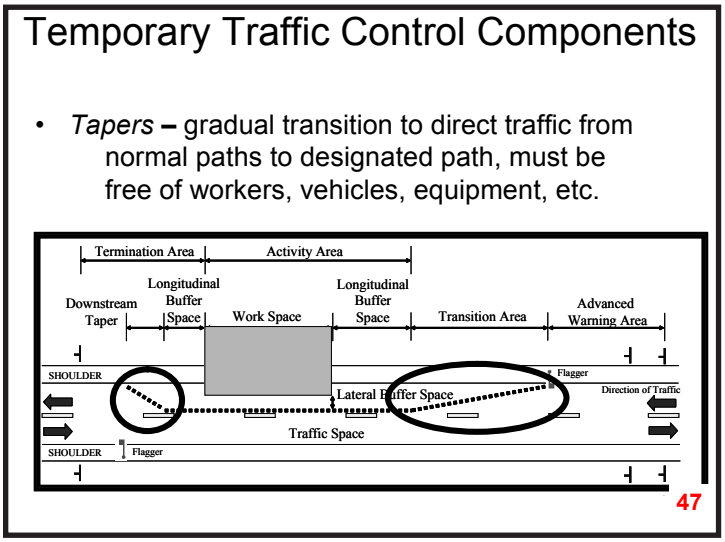


Frequently, utility work zones do not provide sufficient advance warning. In this example, the only warning provided was through the orange cones surrounding the work vehicle.

Clearly, if advance warning is not provided, a hazardous situation results for both workers and motorists. In most cases, signage, warning lights or other types of advanced warning is necessary. The question is, how many and what types of signs and traffic control devices are necessary, and how far should they be spaced apart? (Pose question to audience.)

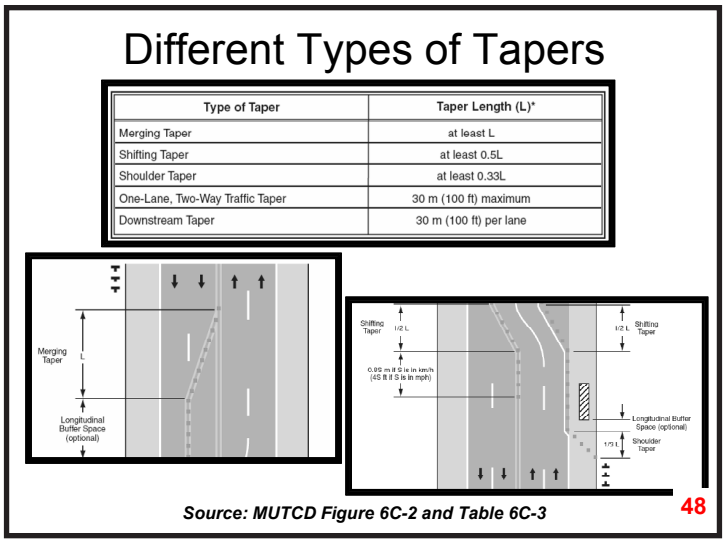


In environments where low travel speeds are expected, such as residential streets, drivers do not need as much perception-reation time. Consequently, signs can be spaced at 100-ft intervals along roads with speed limits of less than 30 mph. For urban roads with speed limits of over 30 mph, signs should be spaced at 350-ft intervals due to the increase in speed and decrease in perception reaction time. In rural locations, signs should be spaced at 500-ft intervals as higher speed roads are common in rural areas. Two or more advanced warning signs are generally recommended in work zones in rural areas.



"Tapers" are created, using a series of channelizing devices or pavement markings placed, to move traffic out of or into its normal path. Tapers may be used in both the transition and termination areas of work zones.

Longer tapers are not necessarily better. Extended tapers encourage sluggish driving, and delay lane changes. Taper lengths should be examined in the field to determine the appropriateness of their lengths.



There are several different types of tapers. A merging taper is used to transition, when closing one or more lanes of traffic. A shifting taper is used to maintain normal traffic lanes, which shift in order to accommodate work that is occurring in the area previously occupied by traffic. A shoulder taper gradually closes off access to the shoulder (similar to how a merging taper closes a traffic lane). Shoulder tapers should be used when the shoulders are a part of the activity area, are closed to traffic, or may be mistaken as a driving lane.

The maximum distance between channelizing devices in a taper should not exceed the speed limit in feet.

Formulas for Calculating Taper Lengths

Speed Limit (S)	Taper Length (L) Meters
60 km/h or less	$L = \frac{WS^2}{155}$
70 km/h or more	$L = \frac{WS}{1.6}$

Speed Limit (S)	Taper Length (L) Feet
40 mph or less	$L = \frac{WS^2}{60}$
45 mph or more	L = WS

Where: L = taper length in meters (feet)
W = width of offset in meters (feet)
S = posted speed limit, or off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in km/h (mph)

Source: MUTCD Table 6C-4

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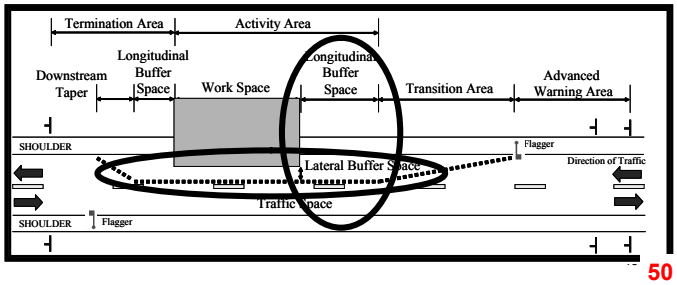
Minimum taper lengths can be determined based upon the speed of traffic and the width of the offset to be closed. Formulas are provided above for calculating the taper length based on these characteristics.

Temporary Traffic Control Components

- *Buffer Space* (Optional) – lateral and/or longitudinal area that separates traffic from work space, must be free of workers, vehicles, equipment, etc.



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The "Buffer Space" is an optional feature in the activity area that separates traffic flow from the work activity or a potentially hazardous area, and provides recovery space for an errant vehicle. Neither work activity nor storage of equipment, vehicles, or material should occur in this space. Buffer spaces may be positioned longitudinally and laterally, with respect to the direction of traffic flow.

Why Use a Buffer Space?

- Easy to accommodate into plan
- Inexpensive
- Improves worker safety
- Provides additional space between work zone and motorists

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A buffer space should be utilized if there is space available; as it can easily be accommodated into the temporary traffic control plan. Buffer spaces are an inexpensive way to improve worker safety by creating additional space between the work zone and oncoming motorists.

Buffer Space Issues

Did not use buffer space

Used buffer space but no taper

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These photographs demonstrate a utility work zone with and without a buffer space. Notice that the work zone utilizing a buffer space did not provide an appropriate taper.

Buffer Space Issues

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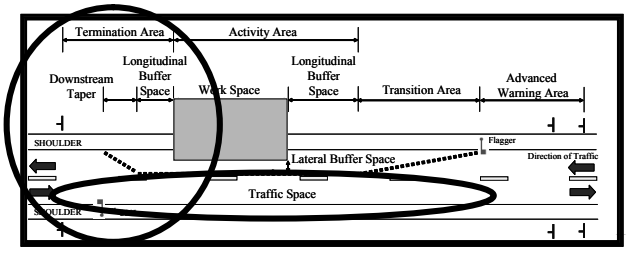
In some instances, it is not possible to include a buffer space due to a lack of available space as illustrated in the photograph above.

Temporary Traffic Control Components

- *Termination Area* – area used to return to normal path
- *Traffic Space* – portion of highway in which road users are routed through the activity area



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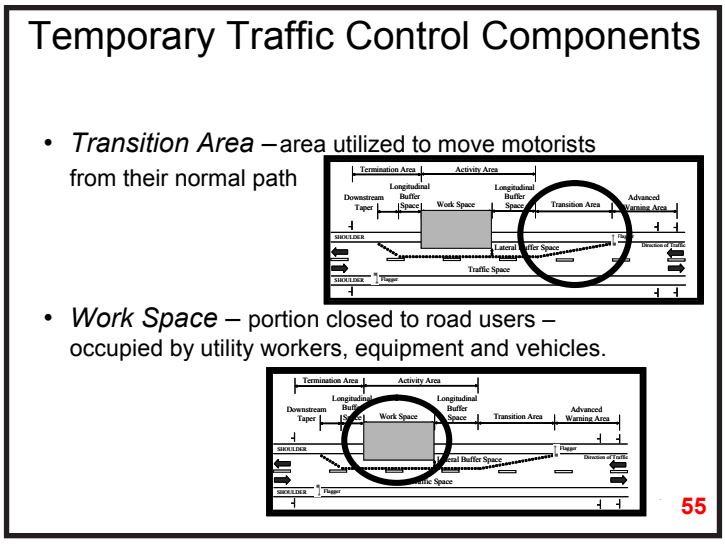
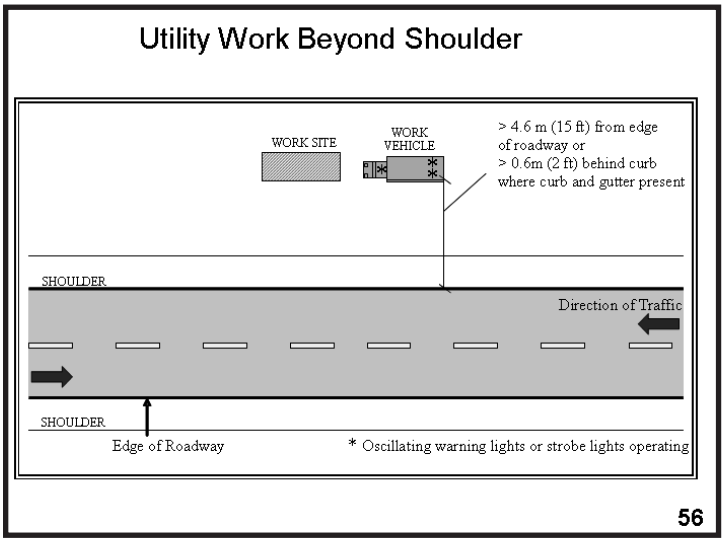
The "Termination Area" is used to return traffic to the normal traffic path through the use of channelizing devices. The "Traffic Space" is the portion of the roadway in which traffic is routed through the activity area.



The "Transition Area" is intended to redirect drivers from the normal path to a new path. In mobile operations, the transition area moves with the work space.

The "Work Space" is the portion of the roadway closed to traffic and is set aside for workers, equipment, and material. The work space may be fixed or may move as work progresses, and is usually delineated by channelizing devices or, to exclude vehicles and pedestrians, by temporary barriers.

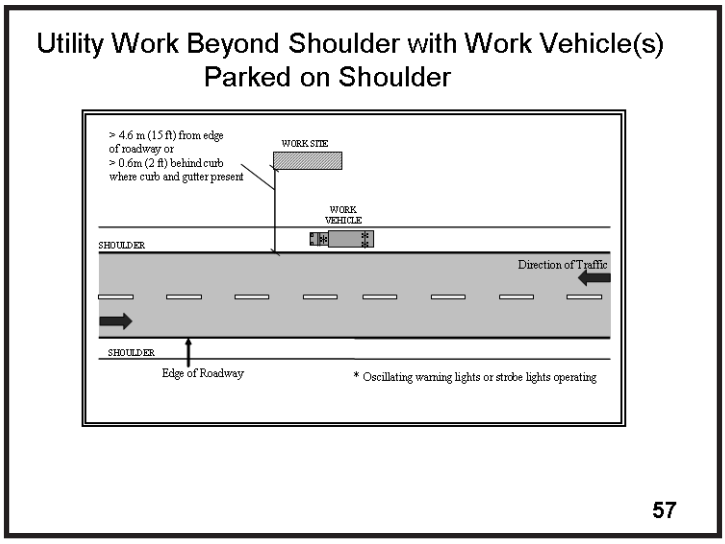


Traffic Control Plan A

Applicable for:

- Utility work 4.6 m (15 ft) BEYOND the edge of the roadway or 0.6 m (2 ft) BEYOND the curb where curb and gutter present
- Cases where a work vehicle is NOT parked on the shoulder

This situation presents the lowest risk scenario of the typical traffic control plans presented in the training program. The work is being conducted away from the roadway and the work vehicle is also parked a sufficient distance from the road. The advance warning area may consist of warning lights in operation on the work vehicle for such situations where the activity area is sufficiently far from the road user's path so it does not interfere with normal flow.

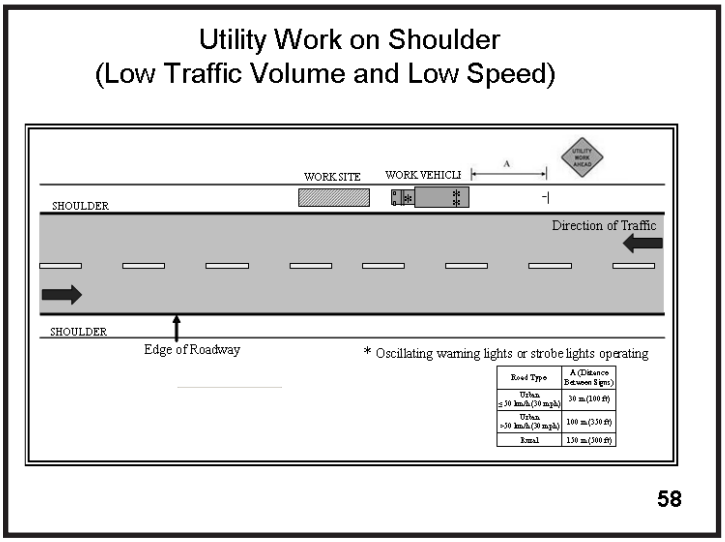


Traffic Control Plan B

Applicable for:

- Utility work 4.6 m (15 ft) BEYOND the edge of the roadway or 0.6 m (2 ft) BEYOND the curb where curb and gutter present
- Cases where a work vehicle IS parked on the shoulder

Traffic Control Plan B presents a low risk scenario where the work is being conducted away from the roadway. Though the work vehicle is parked on the shoulder, the activity area is sufficiently removed so that the advance warning area may comprise of warning lights in operation on the work vehicle.

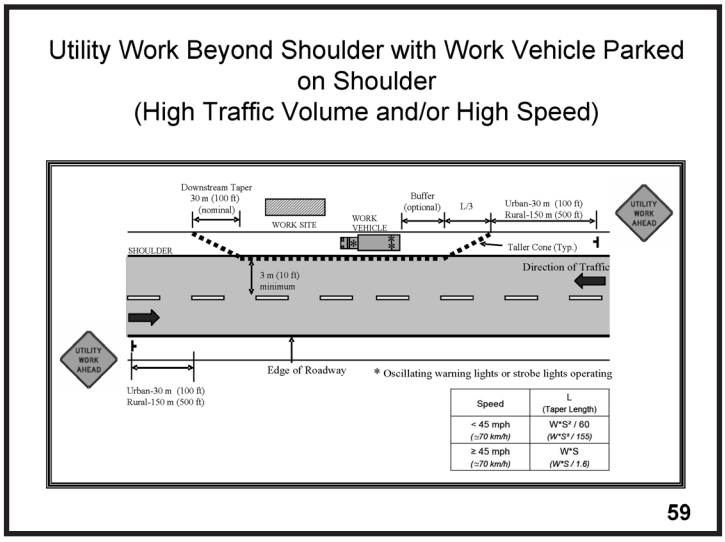


Traffic Control Plan C

Applicable for:

- Utility work ON the SHOULDER
- Cases where there is NO minor encroachment
- Cases where the adjacent road is LOW traffic volume and LOW speed

Traffic Control Plan C is similar to Plan B except, in this case, the work area is located on the shoulder of the roadway. The close proximity of workers and equipment to the adjacent traffic space creates a higher level of risk than in the previous two scenarios. Due to this heightened risk, a minimum of one advance warning sign denoting the upcoming utility work should be provided in addition to the warning lights in operation on the work vehicle.



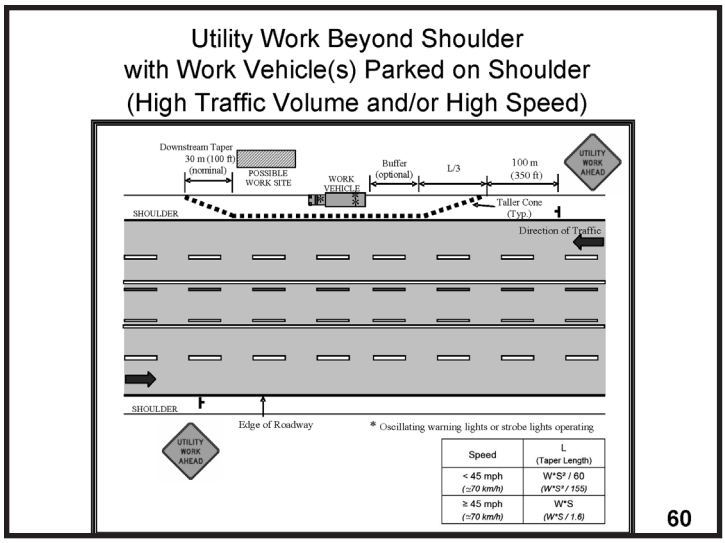
Traffic Control Plan D1

Applicable for:

- Utility work ON the SHOULDER on a two-lane road
- Cases where there is a work vehicle parked on the shoulder
- Cases where the adjacent road is HIGH traffic volume and/or HIGH speed

Traffic Control Plan D1 has similarities to each of the previous scenarios, though this particular layout applies to situations where the adjacent roadway is either high speed (greater than 30 mph posted speed limit) or high volume.

Delineation, typically in the form of cones, is necessary when high speeds are present, either work is occurring on the roadway or shoulder, or a vehicle is parked on the roadway or shoulder.

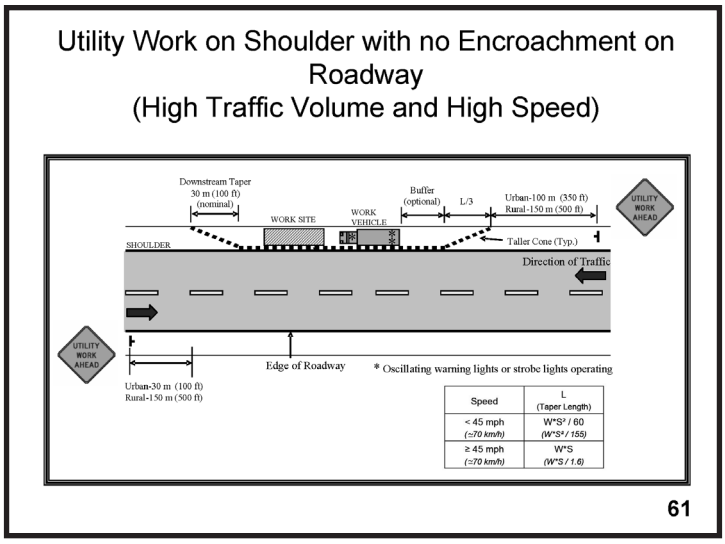


Traffic Control Plan D2

Applicable for:

- Utility work BEYOND the SHOULDER on a multilane raod
- Cases where there is a work vehicle parked on the shoulder
- Cases where the adjacent road is HIGH traffic volume and/or HIGH speed

Traffic Control Plan D2 is analogous to Traffic Control Plan D1 as applied to a multilane road. A UTILITY WORK AHEAD sign should be placed upstream of the work zone in both directions and, as the speed limit exceeds 30mph, channelizing devices are recommended to protect workers on the shoulder. Ten feet must be available in the lane adjacent to the work site or else a lane closure is required.

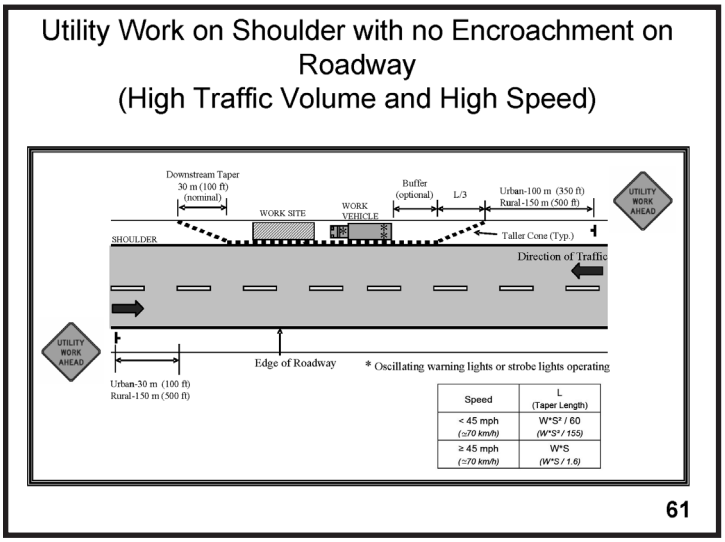


Traffic Control Plan D3

Applicable for:

- Utility work ON the SHOULDER on a two-lane road
- Cases where there is NO minor encroachment
- Cases where the adjacent road is HIGH traffic volume and/or HIGH speed

When utility work is conducted on the shoulder and the adjacent road is either high speed or high volume, channelization is required due to the heightened level of risk experienced by workers. A UTILITY WORK AHEAD sign should be placed upstream of the work zone in each direction.

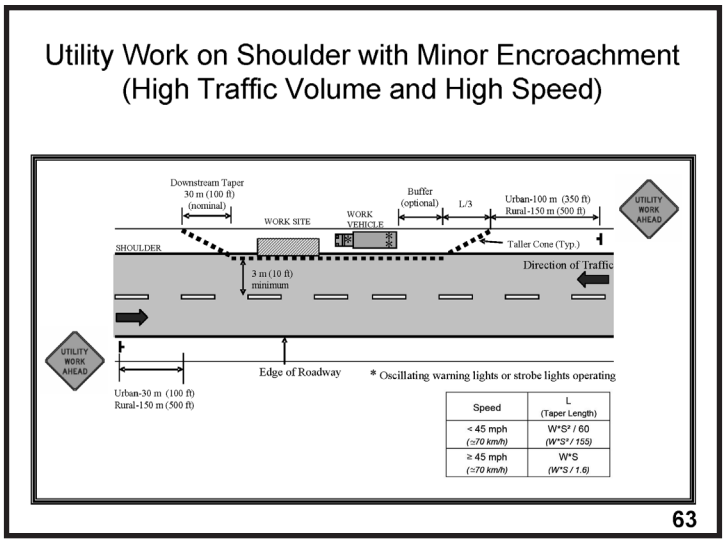


Traffic Control Plan D4

Applicable for:

- Utility work ON shoulder on a multilane road
- Cases where there is NO encroachment
- Cases where the adjacent road is HIGH traffic volume and/or HIGH speed

Traffic Control Plan D4 is analogous to Traffic Control Plan D3 as applied to a multilane road. When utility work is conducted on the shoulder and the adjacent road is either high speed or high volume, channelization is required due to the heightened level of risk experienced by workers. A UTILITY WORK AHEAD sign should be placed upstream of the work zone in each direction.

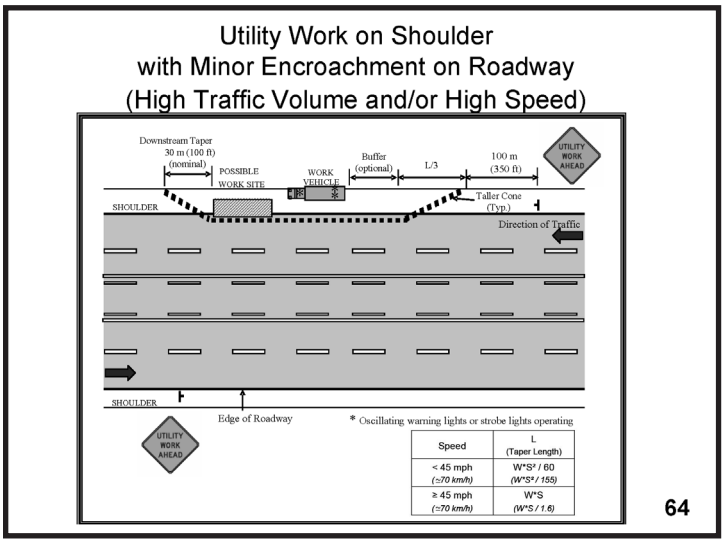


Traffic Control Plan D5

Applicable for:

- Utility work ON the SHOULDER on a single lane road
- Cases where there IS minor encroachment
- Cases where the adjacent road is HIGH traffic volume and/or HIGH speed

Traffic Control Plan D5 is appropriate when utility work occurring on the shoulder encroaches upon the outside travel lane. A minimum of 10 feet must be available in each lane or else a closure would be required. A UTILITY WORK AHEAD sign should be provided upstream of the work zone in each direction. Due to the high speed or high volume of the adjacent roadway, channelization should be provided as extra protection for the workers on or near the roadway.

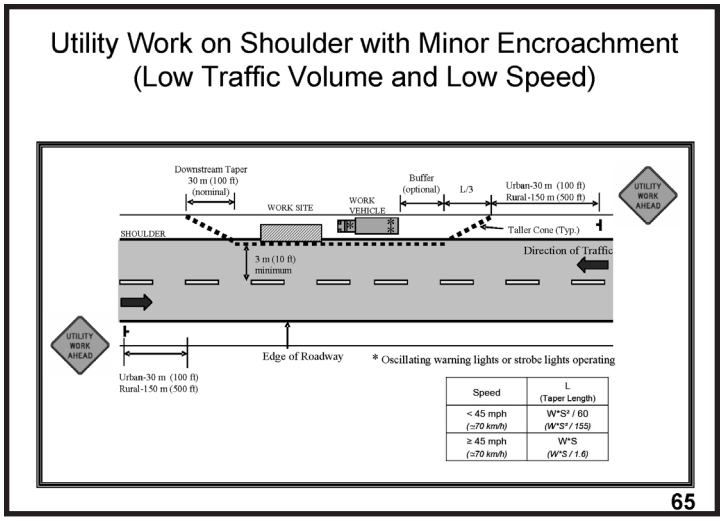


Traffic Control Plan D6

Applicable for:

- Utility work ON the SHOULDER on a multilane road
- Cases where there IS minor encroachment
- Cases where the adjacent road is HIGH traffic volume and/or HIGH speed

Traffic Control Plan D6 is analogous to Traffic Control Plan D5 as applied to a multilane road. Traffic Control Plan D5 is appropriate when utility work occurring on the shoulder encroaches upon the outside travel lane. A minimum of 10 feet must be available in each lane or else a closure would be required. A UTILITY WORK AHEAD sign should be provided upstream of the work zone in each direction. Due to the high speed or high volume of the adjacent roadway, channelization should be provided as extra protection for the workers on or near the roadway.

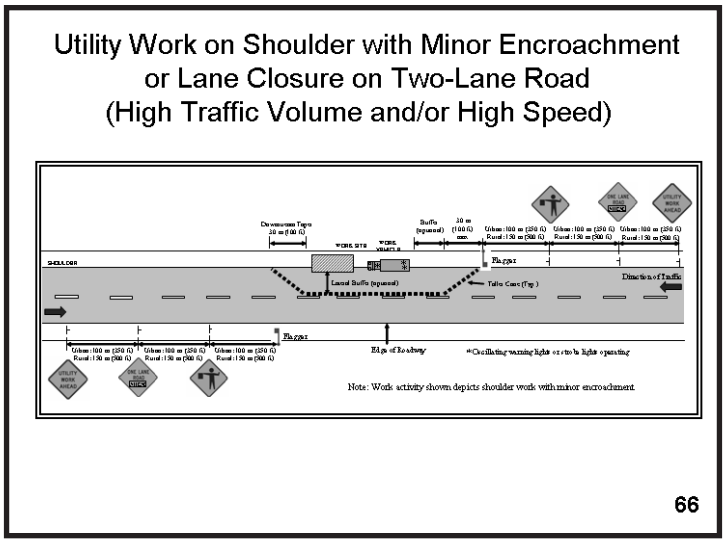


Traffic Control Plan E

Applicable for:

- Utility work ON the SHOULDER
- Cases where there IS minor encroachment
- Cases where the adjacent road is LOW traffic volume and LOW speed

In some situations, the utility work area may encroach onto the roadway facility without requiring a lane closure. Such situations require the use of delineation due to the additional risk posed by the encroachment onto the traveled way. The adjacent traffic lane can remain open, provided that a lane width of at least 10 feet is available and the adjacent traffic is both low volume and low speed. If the lane width is reduced to less than 10 feet or the adjacent facility is high volume or high speed, a closure may be appropriate.

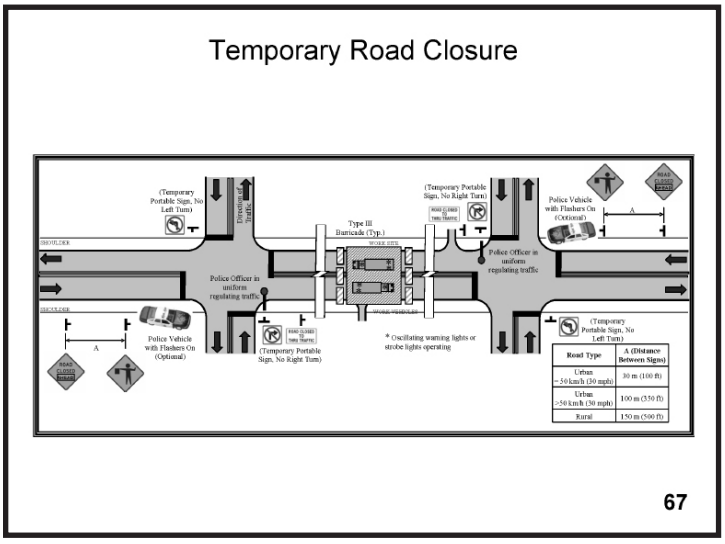


Traffic Control Plan F

Applicable for:

- Utility work ON the SHOULDER
- Cases where there IS minor encroachment
- Cases where the adjacent road is HIGH traffic volume and/or HIGH speed

In situations where the work area encroaches such that the available lane width is less than 10 feet or where the adjacent road is high volume or high speed, Traffic Control Plan F is appropriate. In situations where an entire lane of traffic is closed, a minimum of two signs is recommended. In the situation illustrated in Plan F, a flagger on both approaches of the work zone would require the usage of an additional sign alerting oncoming traffic of the presence of the flagger. This sequence of signs should be arranged such that the most general sign appears first (e.g., utility work ahead) and subsequent signs provide more specific information.

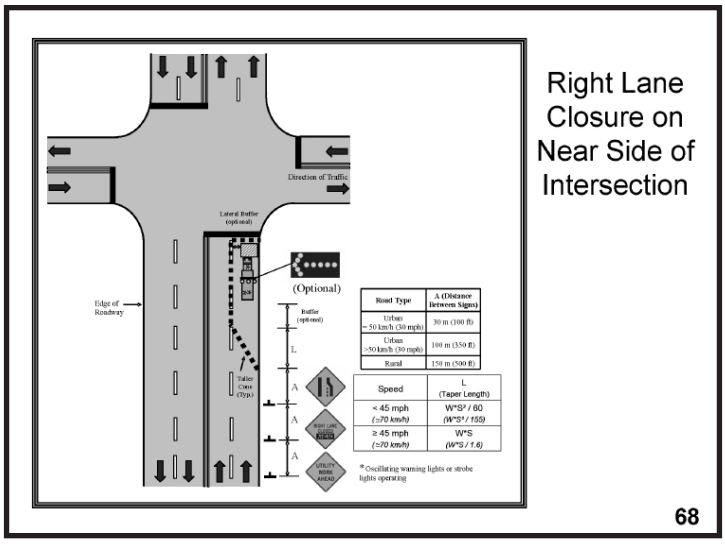


Traffic Control Plan G

Applicable for:

- Utility work ON the ROADWAY
- Cases where the ENTIRE ROAD is temporarily CLOSED

In cases where an entire road closure is necessary, a UTILITY WORK AHEAD sign is necessary, with additional signage alerting traffic of the upcoming road closure, as well as the presence of a flagger if applicable. The presence of police officers and vehicles are recommended, where possible, to help direct traffic in instances where a full closure is necessary.

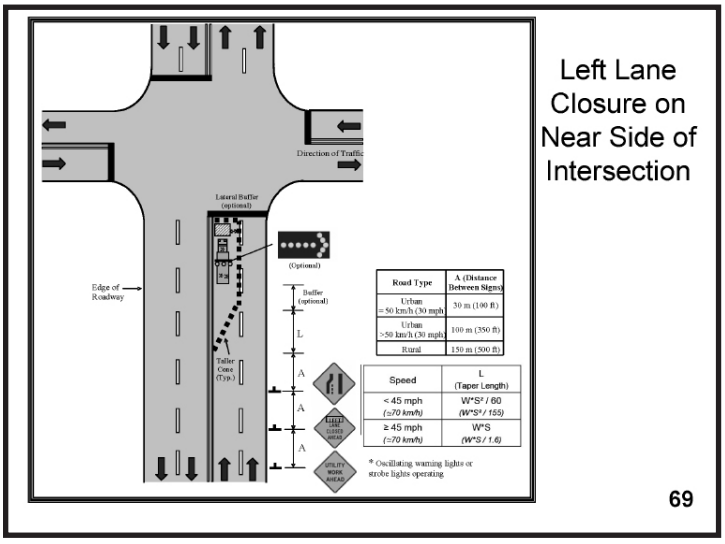


Traffic Control Plan H

Applicable for:

- Utility work ON the ROADWAY
- Cases where the work is NEAR an INTERSECTION
- Cases where there IS A LANE CLOSURE
- When the closure is in the RIGHT LANE on the NEAR SIDE of the intersection

Work near intersections requires additional signage if portions of the traveled way require closure. A series of three signs is recommended for cases where a lane is closed upstream of the intersection. It is recommended that an arrow board be provided at the start of the activity area to direct merging traffic. This arrow board may be mounted on the vehicle or placed as far upstream as possible within the taper without encroaching onto the traffic space.

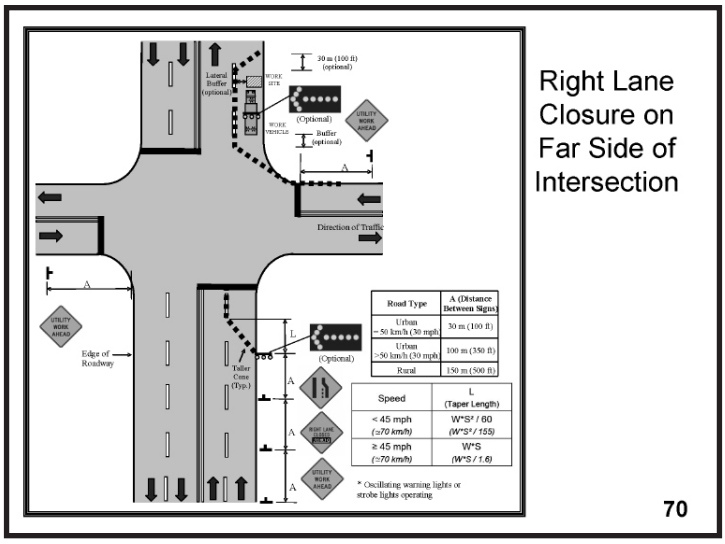


Traffic Control Plan I

Applicable for:

- Utility work ON the ROADWAY
- Cases where the work is NEAR an INTERSECTION
- Cases where there IS A LANE CLOSURE
- When the closure is in the LEFT LANE on the NEAR SIDE of the intersection

For right or left lane closures in traffic upstream of the intersection the same series of traffic control devices is recommended. A three-sign sequence and an optional arrow board are recommended in such situations.

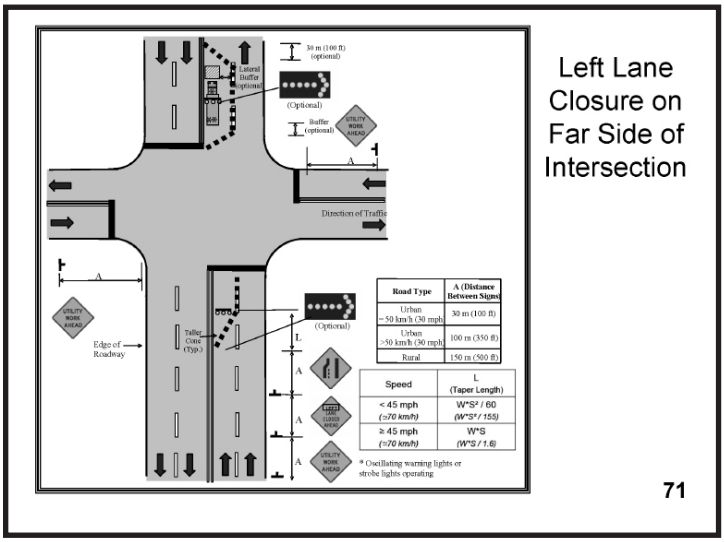


Traffic Control Plan J

Applicable for:

- Utility work ON the ROADWAY
- Cases where the work is NEAR an INTERSECTION
- Cases where there IS A LANE CLOSURE
- When the closure is in the RIGHT LANE on the FAR SIDE of the intersection

When a closure is required downstream of the intersection, further traffic control is required because these closures affect traffic on all four approaches. The same three-sign and arrow board sequence should be utilized on the approach directly upstream of the closure, while a UTILITY WORK AHEAD sign should be provided on each of the cross-street approaches. The side of the cross-street that is connected to the closure should include channelization directing turning vehicles from that approach around the closure. An additional arrow board should be provided on the far side of the intersection on the approach where the work is being conducted.

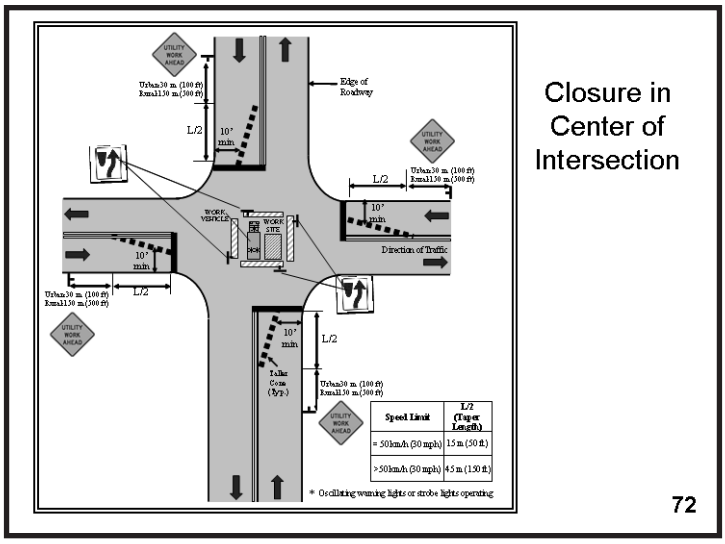


Traffic Control Plan K

Applicable for:

- Utility work ON the ROADWAY
- Cases where the work is NEAR an INTERSECTION
- Cases where there IS A LANE CLOSURE
- When the closure is in the LEFT LANE on the FAR SIDE of the intersection

Similar traffic control is required for closures of the far side left lane as for the far side right lane. The three-sign and arrow board sequence should be utilized on the approach directly upstream of the closure while a UTILITY WORK AHEAD sign should be provided on each of the cross-street approaches. An additional arrow board should be provided downstream of the intersection on the approach where the work is occurring.

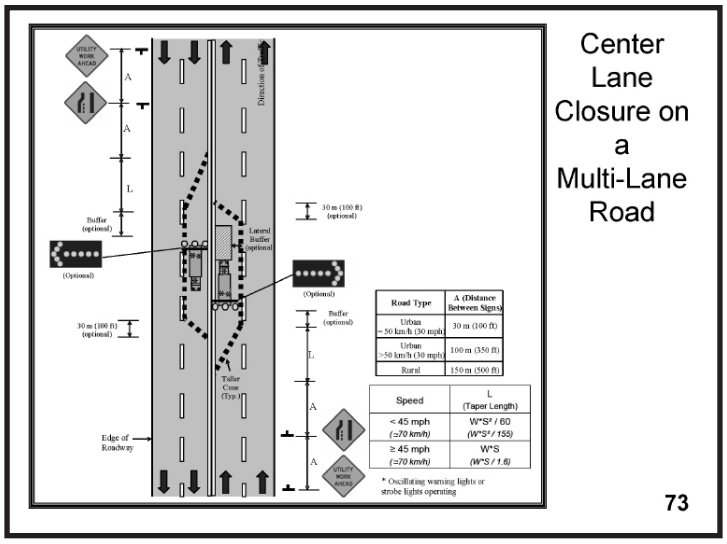


Traffic Control Plan L

Applicable for:

- Utility work ON the ROADWAY
- Cases where the work is AT an INTERSECTION
- Cases where there IS A LANE CLOSURE
- Where the closure is in CENTER of intersection

If the center of the intersection has to be closed, such as for traffic signal maintenance, a UTILITY WORK AHEAD sign should be provided on each approach and traffic should be directed around the closure using channelization on each approach. Type III Barriers should be placed around the work space, supplemented by a sign indicating a shift in traffic around the work space.

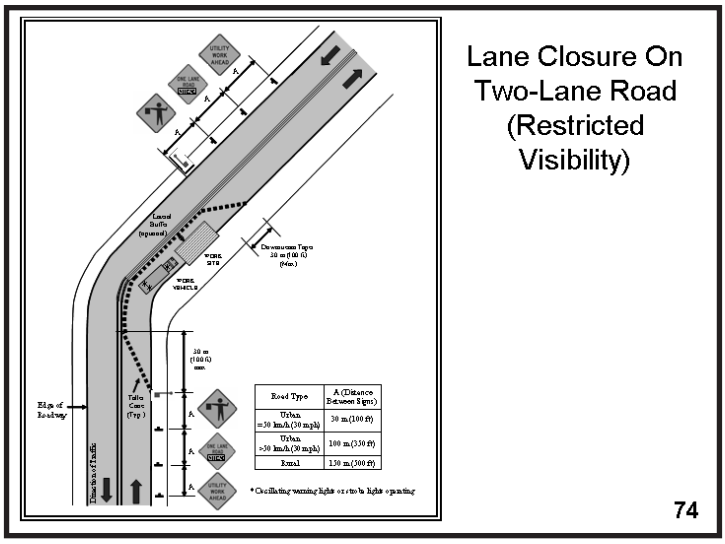


Traffic Control Plan M

Applicable for:

- Utility work ON the ROADWAY
- Cases where the work is in the MIDDLE OF THE ROAD
- Cases where the adjacent road is HIGH traffic volume

When utility work is conducted in the middle of a multi-lane roadway and a closure is required, Traffic Control Plan M is appropriate. This plan requires channelization upstream and downstream of the work area and it is recommended that a minimum of two signs be utilized on each approach. The first sign should alert motorists of the upcoming work area via a UTILITY WORK AHEAD sign and the second should provide information on the lane closure. An arrow board is recommended on both approaches to the work zone.

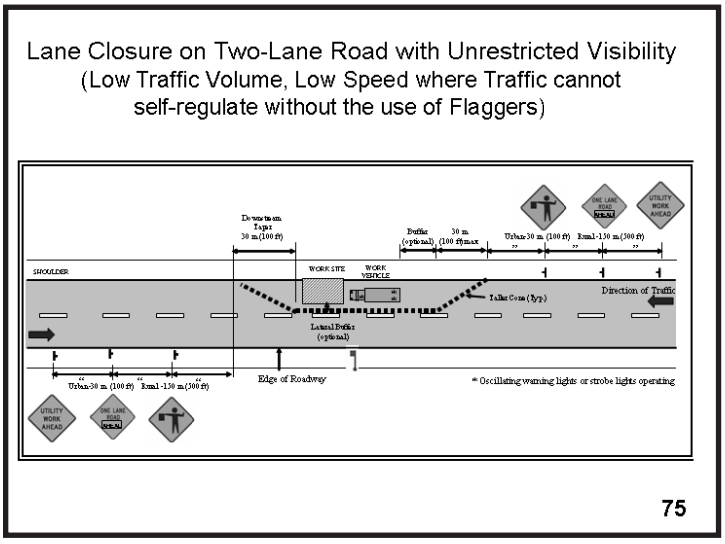


Traffic Control Plan N

Applicable for:

- Utility work ON the ROADWAY
- The roadway is TWO LANES
- Cases where there IS A LANE CLOSURE
- Cases where there is RESTRICTED VISIBILITY near the closure

When a lane closure is necessary on a two lane road where visibility is restricted, channelization should be provided upstream and downstream of the work area along with a series of three signs. The first two signs should alert motorists to the upcoming work area and lane closure, respectively, while the third sign is to inform motorists of the presence of flaggers at the start of the transition area. Due to the restricted visibility, two flaggers should be utilized, one on each approach to the work zone.

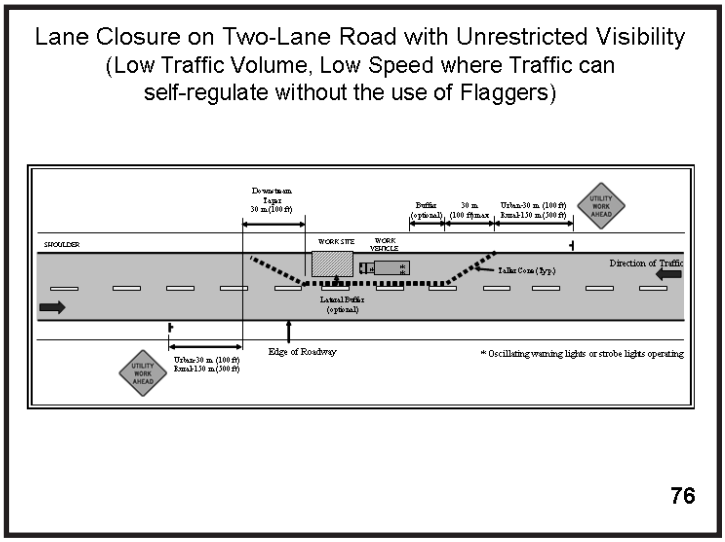


Traffic Control Plan O

Applicable for:

- Utility work ON the ROADWAY
- The roadway is TWO LANES
- Cases where there IS A LANE CLOSURE
- Cases where the adjacent road is LOW speed and LOW traffic volume
- Cases where a FLAGGER is USED

When a lane closure is necessary on a two lane road where traffic presents a relatively low risk environment (low speed, low volume, unrestricted visibility), channelization should be provided upstream and downstream of the work area along with a series of three signs. The first two signs should alert motorists of the upcoming work area and lane closure, respectively, while the third sign informs motorists of the presence of a flagger. Due to the relatively low risk presented by the low speed, low volume, and unrestricted visibility, only one flagger located in the middle of the work zone may be necessary in this situation.

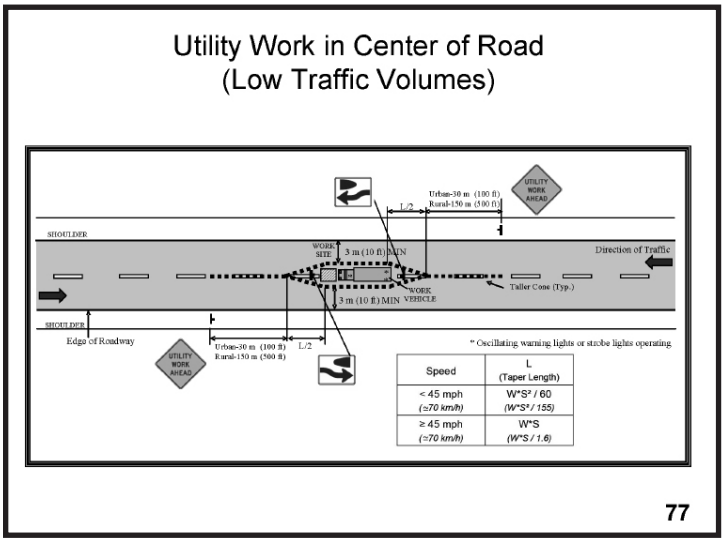


Traffic Control Plan P

Applicable for:

- Utility work ON the ROADWAY
- The roadway is TWO LANES
- Cases where there IS A LANE CLOSURE
- Cases where the adjacent road is LOW speed and LOW traffic volume
- Cases where a FLAGGER is NOT USED

When a lane closure is required on a two lane road with low speed, low volume, and unrestricted visibility, channelization should be provided to protect those workers on the roadway. If conditions allow for traffic to be self-regulated, only a single UTILITY WORK AHEAD sign is needed in addition to the channelization.

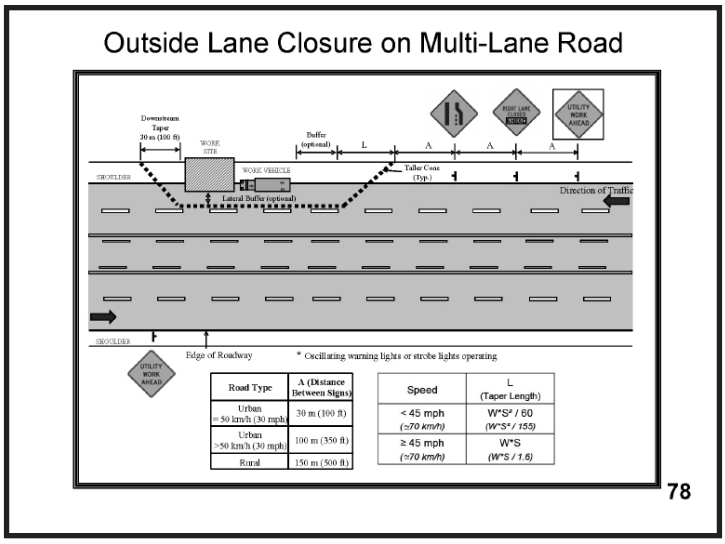


Traffic Control Plan Q

Applicable for:

- Utility work ON the ROADWAY
- Cases where the work is in the MIDDLE OF THE ROAD
- Cases where the adjacent road is LOW traffic volume

If utility work is required in the middle of a low volume road, channelization upstream and downstream of the work area may be provided without necessitating a lane closure provided that at least ten feet of lane width are available on each side of the work area. Supplementing the channelization, a UTILITY WORK AHEAD sign should be provided in addition to a sign indicating the shift in traffic necessary upon entering the work zone.

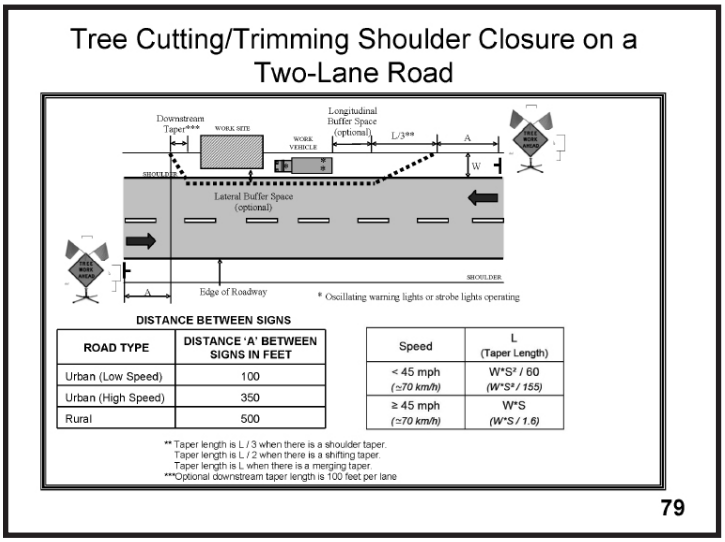


Traffic Control Plan R

Applicable for:

- Utility work ON the ROADWAY
- The roadway is MULTI-LANE
- Cases where there IS A LANE CLOSURE
- When the closure is in the OUTSIDE lane

When a lane closure is required on a multi-lane road, a three sign sequence should be utilized in combination with channelization. The sign-sequence should include a UTILITY WORK AHEAD sign, as well as two signs denoting the upcoming lane closure. The first sign should display the lane closure message in text while the second sign should present this information symbolically.

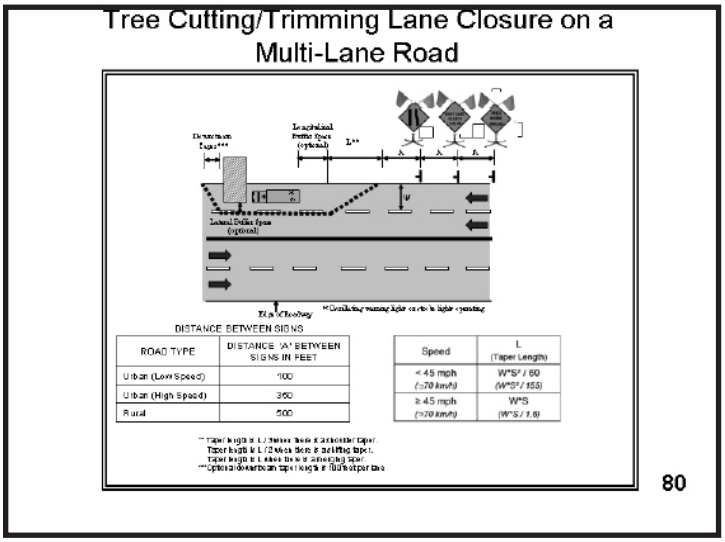


Traffic Control Plan S

Applicable for:

- Tree cutting/trimming work
- Road is TWO LANES
- When there is a SHOULDER CLOSURE

Tree cutting and trimming operations frequently require the closure of a shoulder along a two lane road. In such situations, a TREE WORK AHEAD sign is recommended in addition to channelization. The signage may be supplemented by flags to provide enhanced visibility to oncoming traffic.

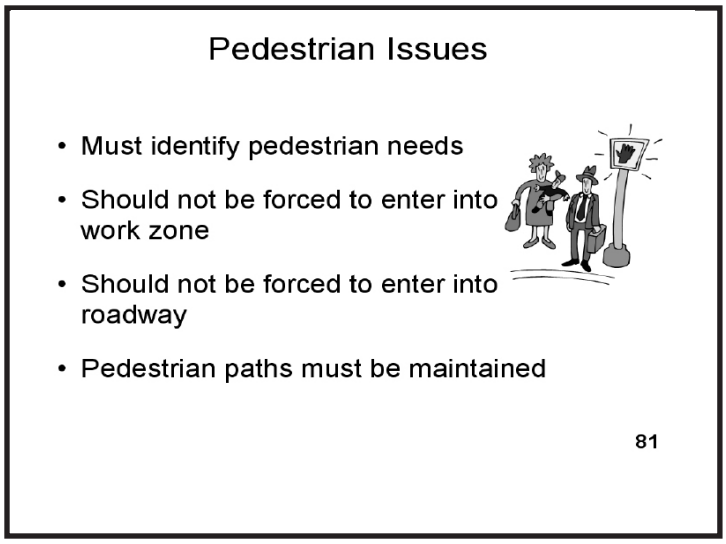


Traffic Control Plan T

Applicable for:

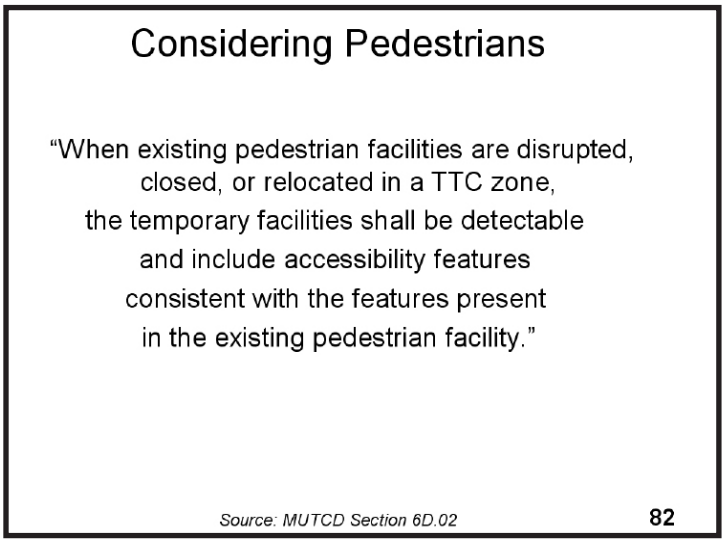
- Tree cutting/trimming work
- Road is MULTI-LANE
- Cases where there is a LANE CLOSURE
- When the lane closure is in the OUTSIDE lane

When tree cutting or trimming operations on a multi-lane road require a closure of the outside lane, a three sign sequence should be utilized in combination with channelization. The sign-sequence should include a TREE WORK AHEAD sign, as well as two signs denoting the upcoming lane closure. The first sign should display the lane closure message in text while the second sign should present this information symbolically. Each of these signs may be supplemented with orange flags to enhance work zone conspicuity.

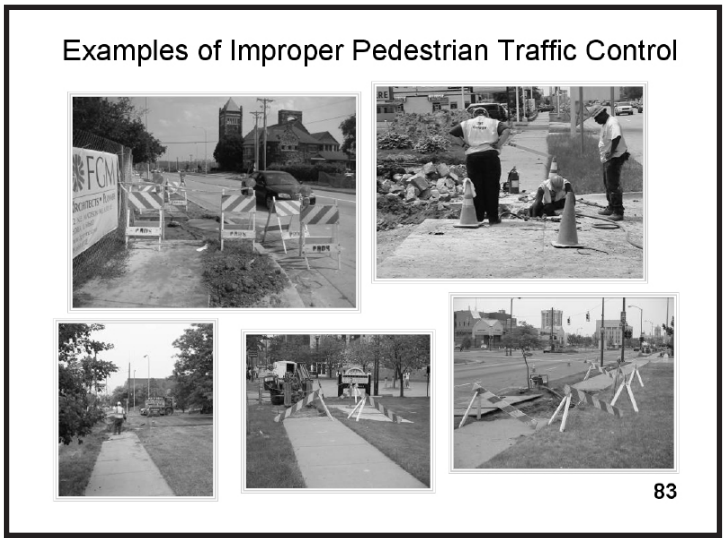


Often pedestrians are not considered explicitly in the development of temporary traffic control plans for utility work zones. However, due to their vulnerability, areas where substantial pedestrian volumes are anticipated should accommodate their safe passage through the work zone.

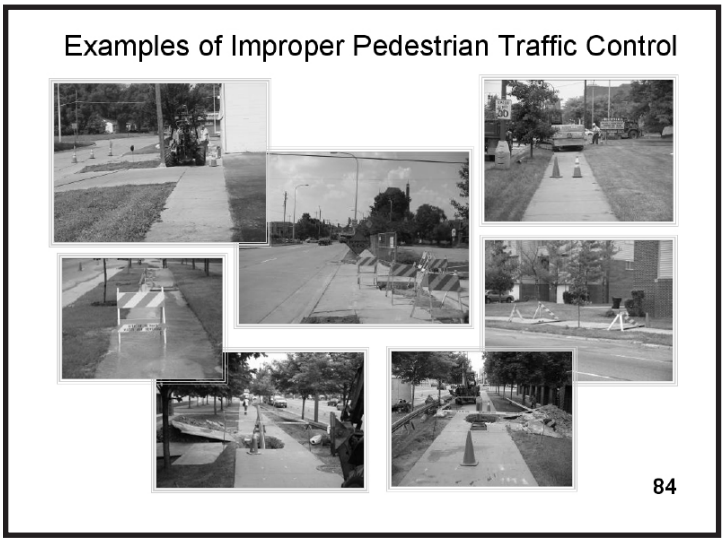
Pedestrians should not be forced to enter either the work zone or the roadway. If sidewalks are interrupted by the work area, temporary walks should be provided or detour routes posted to allow safe pedestrian walkways.



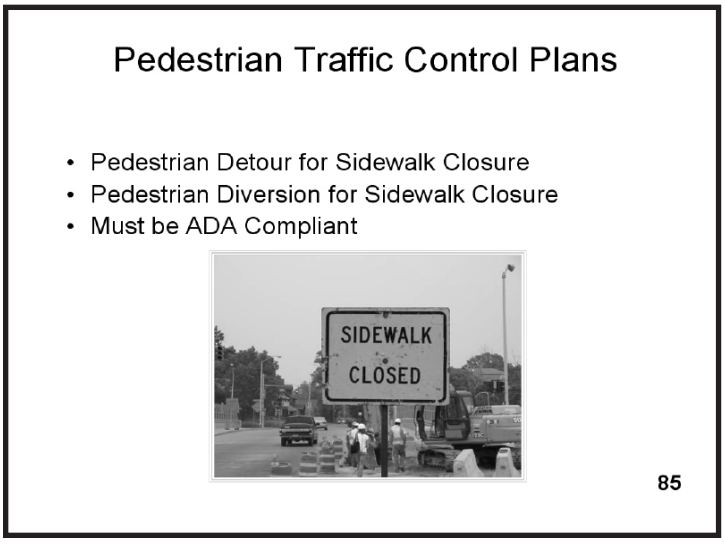
The MUTCD also emphasizes the issue of pedestrian safety. According to the MUTCD, when pedestrian facilities are disturbed, they must be accounted for and be consistent with the pedestrian facilities that currently exist.



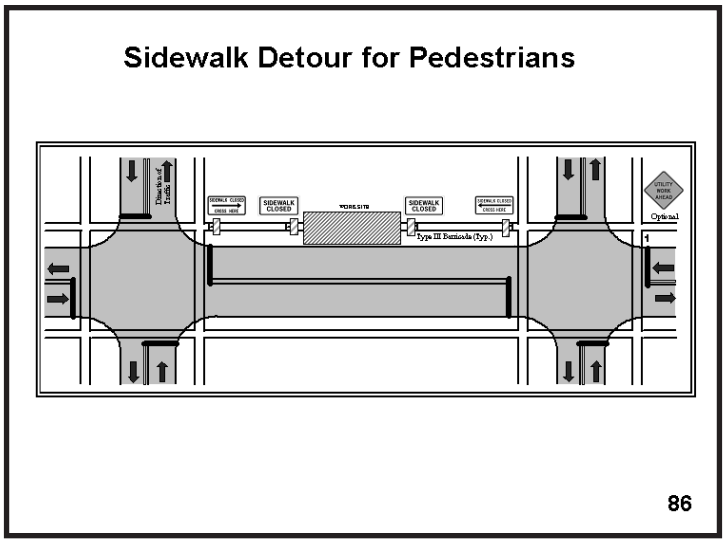
Here are a few examples of temporary traffic control that interferes with safe pedestrian passage through the work zone.



Here are some more examples of improper pedestrian traffic control in work zones.



If a section of sidewalk must be closed for utility work, either a pedestrian detour or pedestrian diversion should be provided to accommodate pedestrian flow through the facility. "Pedestrians should be separated from the worksite by appropriate devices that maintain the accessibility and detectability for pedestrians with disabilities. Bicyclists and pedestrians should not be exposed to unprotected excavations, open utility access, overhanging equipment, or other such conditions". (MUTCD, Section 6G.05).

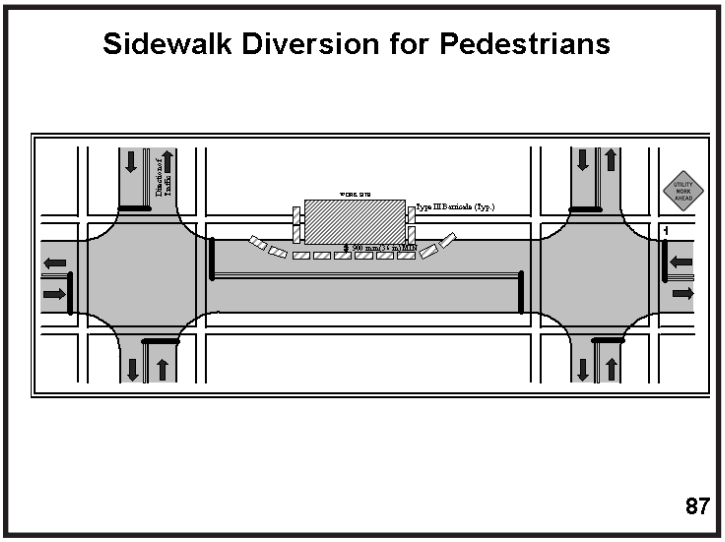


Pedestrian Control Plan U

Applicable for:

- Pedestrian safety and mobility considerations
- Cases when the sidewalk is CLOSED
- When the sidewalk closure results in a pedestrian sidewalk DETOUR

A sidewalk detour should be accessible in situations where space is not available to create a temporary sidewalk. Signage should be provided to inform pedestrians that the walk will be closed and advise them of an appropriate alternate path.

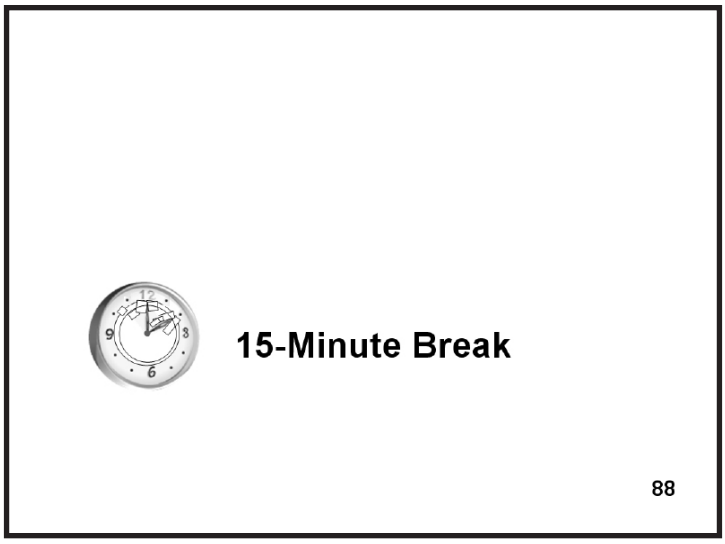


Pedestrian Control Plan V

Applicable for:

- Pedestrian safety and mobility considerations
- Cases when the sidewalk is CLOSED
- When the sidewalk closure results in a pedestrian sidewalk DIVERSION

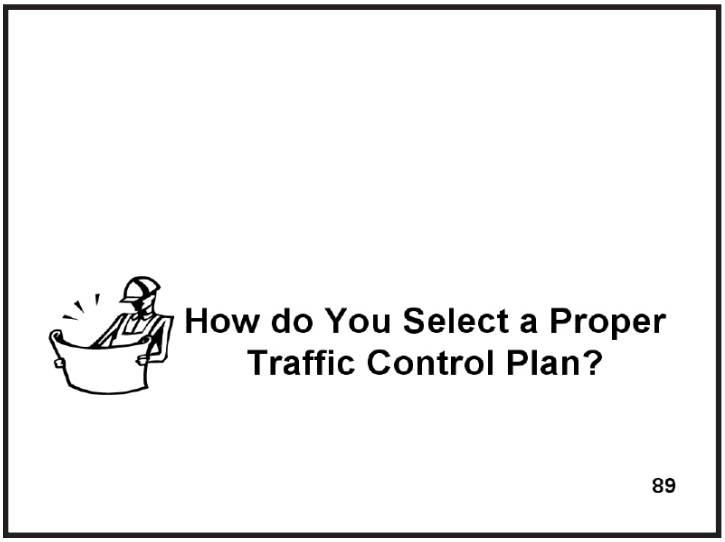
In cases where sufficient right-of-way is available, a sidewalk diversion may be constructed to allow pedestrians to walk around the work site while separated from the traffic stream by appropriately placed barriers.



At this point the instructor should provide a 15 minute break for the participants.

Lesson 4: How Do You Select a Proper Traffic Control Plan?

Lesson Number:	4
Lesson Title:	How do You Select a Proper Traffic Control Plan?
Performance-Based Learning Outcomes:	To understand how a proper utility work zone traffic control plan is selected.
Instructional Method:	The instructor will describe how the proper utility work zone traffic control plan is selected based on characteristics of the work zone and roadway, as well as an assessment of risk.
Time Allocation:	15 minutes



There are a number of factors that must be considered when selecting an appropriate temporary traffic control plan for a utility work zone application. The *Guidelines* present several typical temporary traffic control plans, although site-specific conditions may require modifications to these 'typical' plans.

Traffic Control Plan Selection

- Location of utility work
- Traffic volume of adjacent road
- Travel speed of vehicles on adjacent road
- Location of lane closure
- Roadway type

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There are five characteristics which should be considered when determining an appropriate temporary traffic control plan for a utility job: (1) the location, relative to the roadway, where the utility work will be conducted, (2) the traffic volume of the adjacent road where the work is being conducted, (3) the travel speed or posted speed limit for vehicles on the adjacent road, (4) whether or not a lane closure is required and, if so, the location of the required closure, and (5) the type, or class, of roadway where the work is being conducted.

Location of Utility Work

- Beyond the shoulder - > 4.6 m (15 ft) from edge of roadway OR > 0.6 m (2 ft) beyond curb
- On the shoulder
- On the roadway

Utility Work Beyond Shoulder

Utility Work on Shoulder

Utility Work on Roadway

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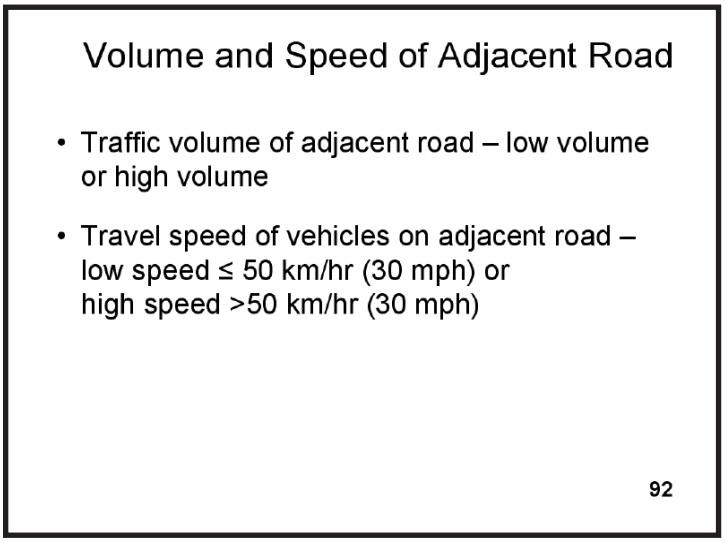
Utility work can be conducted in one of three general locations: (1) beyond the shoulder or curb (where provided) of the roadway, (2) on the shoulder, or (3) on the roadway.



Varying levels of temporary traffic control devices are necessary depending upon the speed and volume of traffic on the adjacent road. For utility work zones, the threshold for high and low speed was determined to be 30 mph. This is intentionally different than the definition for high and low speed contained in the MUTCD, which is 45 mph. The rationale for the definition of high and low speed for utility applications is as follows:

- The range of speeds on roads where routine utility work takes place is different and lower than that for highway construction projects.
- The ability to have higher sensitivity to residential applications was needed as utility work commonly takes place in residential areas, which commonly are low risk situations and have substantially less temporary traffic control needs.

Location of Lane Closure

- Mid-Block
- Intersection – right lane on near side, left lane on near side, right lane on far side, left lane on far side, center of intersection

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The location of the lane closure results in a different traffic control plan. Additional information must be provided to the road user when the lane closure is near an intersection. Such closures could include right or left lane closures at the near or far side of the intersection or a lane closure in the center of the intersection.

Roadway Type

- Rural vs. Urban
- Two-Lane vs. Multi-Lane

Lane Closure on Urban Multi-Lane Road

Lane Closure on Rural Two-Lane Road

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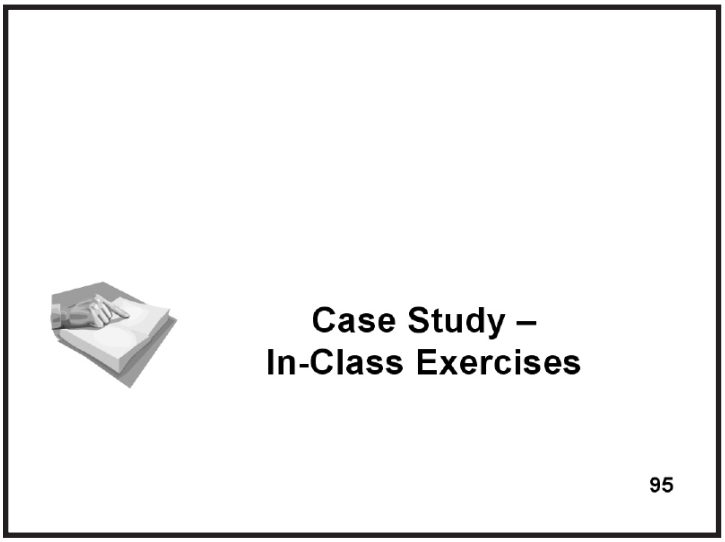
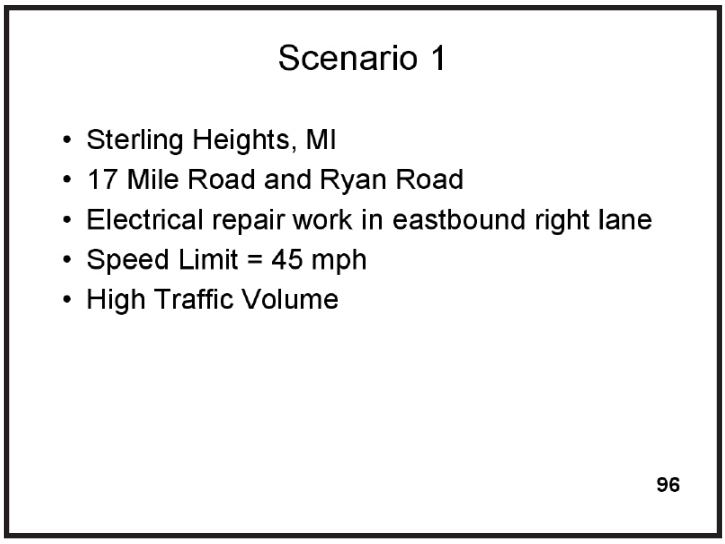
The roadway type also plays a role in the selection of the utility work zone traffic control plan. Whether the area is rural or urban and whether it is a two-lane road or a multi-lane road, helps to determine the proper traffic control plan that should be used.

Lesson 5: Case Study – In-Class Exercises

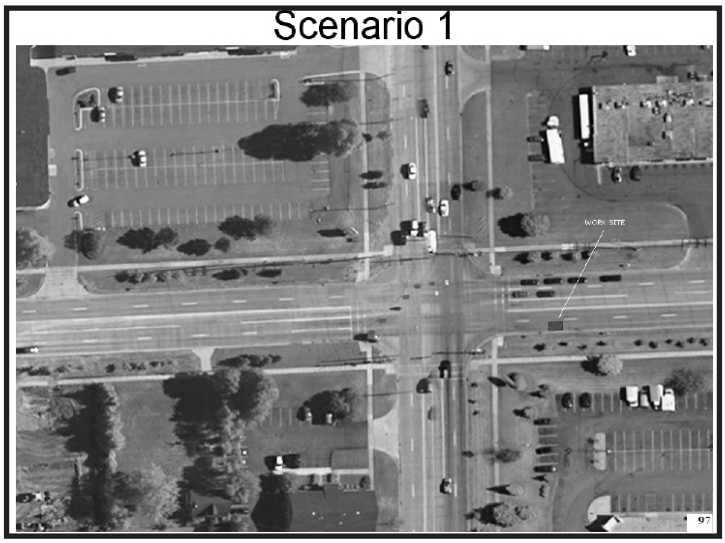
Lesson Number:	5
Lesson Title:	Case Study – In-Class Exercises
Performance-Based Learning Outcomes:	To be able to apply what was taught throughout the day to a real life scenario.
Instructional Method:	The instructor will give each participant a copy of the in-class exercises on a CD that contains the Drag and Drop Application, as well as handouts containing instructions and other information. Participants that have a computer should be paired up with those that do not. The instructor will explain how to complete the exercises and then provide time for the participants to complete them. The instructor will then go through the solutions to the exercises.
Time Allocation:	30 minutes



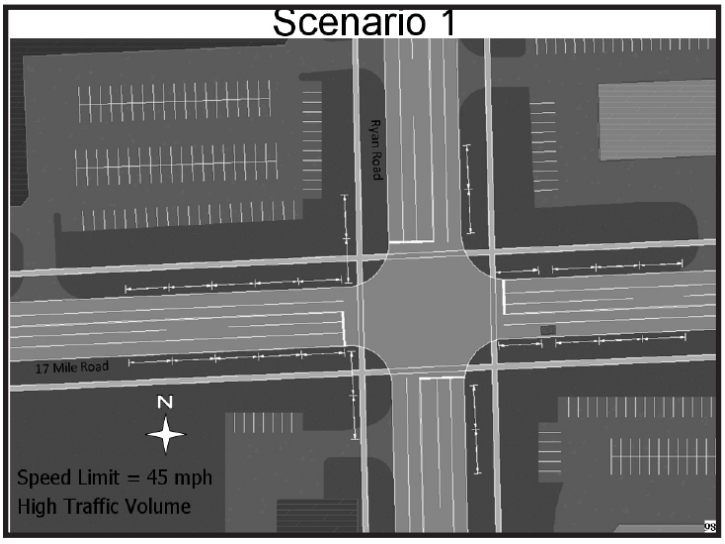
This lesson includes the case studies and in-class exercises. The instructor should distribute a CD, which contains the Drag and Drop Application to everyone so that they can participate in the exercises. The instructor should group the participants into groups so that at least one person in each group has access to a computer. The instructor should then pass out the instruction sheet that contains information about each scenario, useful equations for taper lengths and sign spacing, and directions for completing the exercises. The handouts are contained in Appendix I.



The first in-class exercise involves electrical repair work in the eastbound right lane on 17 Mile Road east of Ryan Road in Sterling Heights, MI. This intersection is subject to high traffic volumes and has a posted speed limit of 45 mph. The participants are asked to develop an appropriate temporary traffic control plan for this utility work zone application.



This slide shows an aerial photograph of the location for scenario 1 to give the participants a better understanding of the site (i.e. rural or urban).



This slide shows the intersection characteristics and the location of the work area denoted by the green square. This is what should appear on the screen for the participants, with the exception of the traffic control devices. In the Drag and Drop Application, warning signs, channelizing devices and symbols denoting other traffic control are contained in the upper left hand corner. The participants should be instructed to develop the utility work zone by using the mouse to drag and drop each traffic control device into the proper location on the figure for scenario 1 figure. The instructor should display and discuss the solution once the participants have completed their designs.

Scenario 2

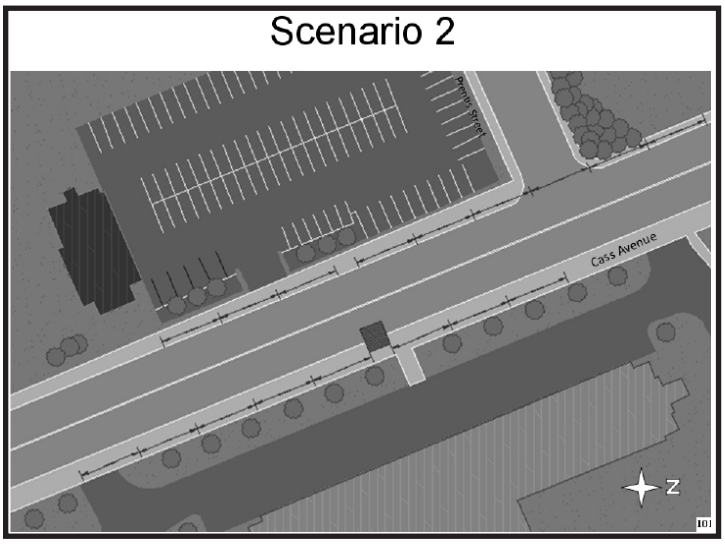
- Detroit, MI
- Cass Avenue north of Canfield Street
- Electrical repair work on northbound shoulder
- Speed Limit = 35 mph
- Low Traffic Volume

99

The second in-class exercise involves electrical repair work on the northbound shoulder of Cass Avenue north of Canfield Street in Detroit, MI. This intersection is subject to low traffic volumes and has a posted speed limit of 35 mph. The participants are asked to develop an appropriate temporary traffic control plan for this utility job.

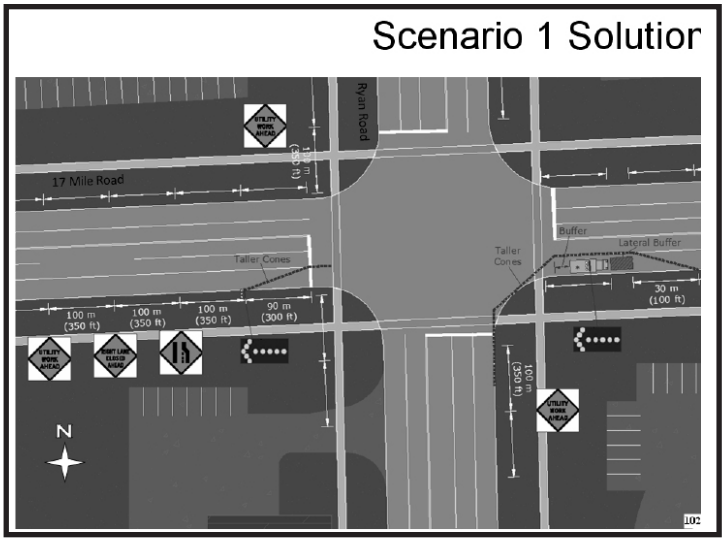
Scenario 2

This slide shows an aerial photograph of the location for scenario 2 to give the participants a better understanding of the site.

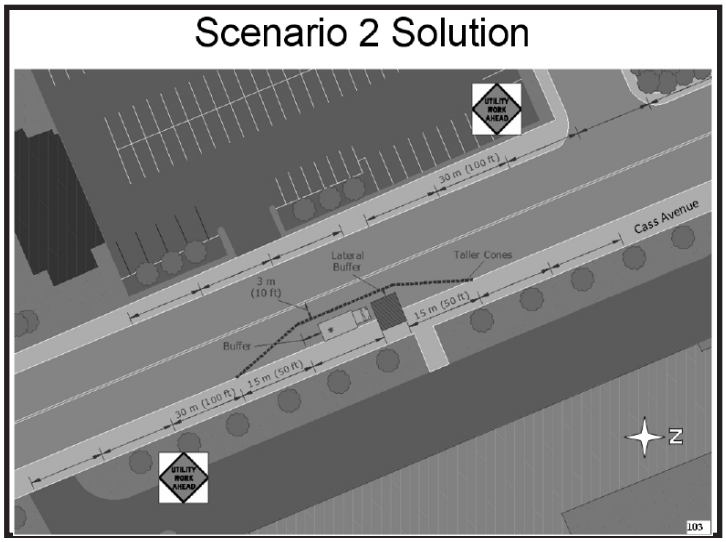


This slide shows scenario 2 as it appears on the screen for the participants.

Once the participants have been given a sufficient amount of time to complete the in-class exercises, the instructor should reveal the solutions. This is the solution for scenario 1.

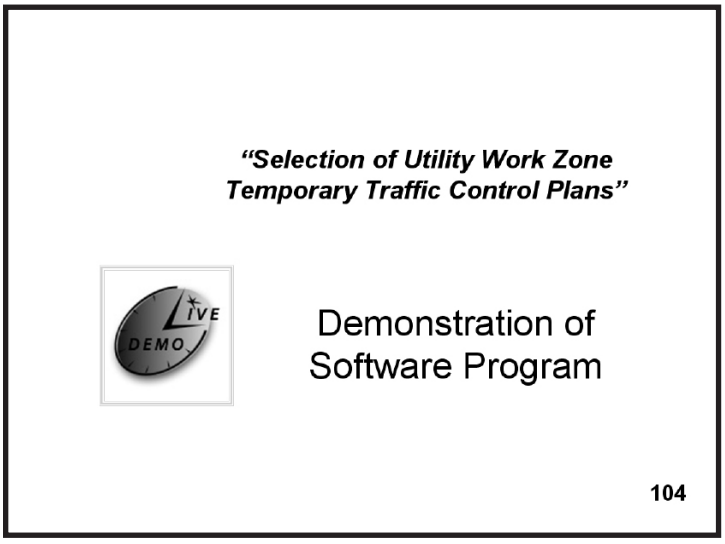


This is the solution to scenario 2, as taught in the training program.

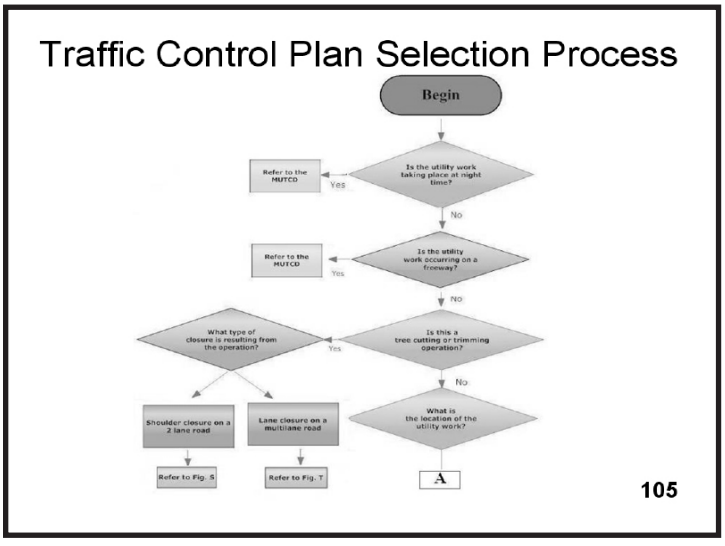


Lesson 6: Demonstration of Software Program

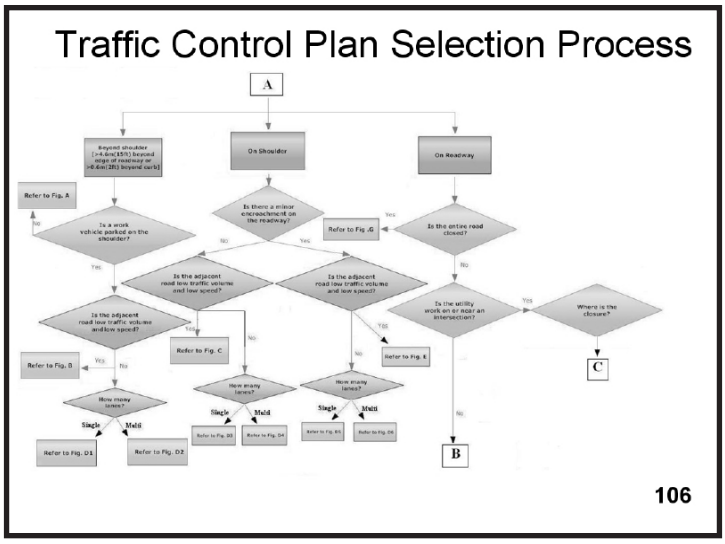
Lesson Number:	6
Lesson Title:	Demonstration of Software Program
Performance-Based Learning Outcomes:	To learn how to use the software program.
Instructional Method:	The instructor will provide a copy of the software program to all the participants. Those participants that have a laptop computer can follow along with the instructor. The instructor will conduct a demonstration of how to navigate through the software program. The instructor will demonstrate how the traffic control plan is selected through the use of this program.
Time Allocation:	15 minutes



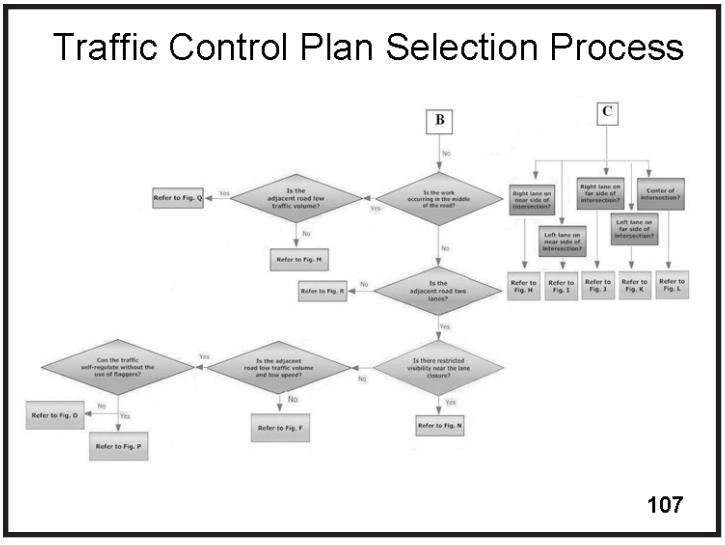
The next lesson demonstrates the "Selection of Utility Work Zone Temporary Traffic Control Plans" software program to the participants. The instructor should pass out a CD with the software program on it so the participants may follow along.



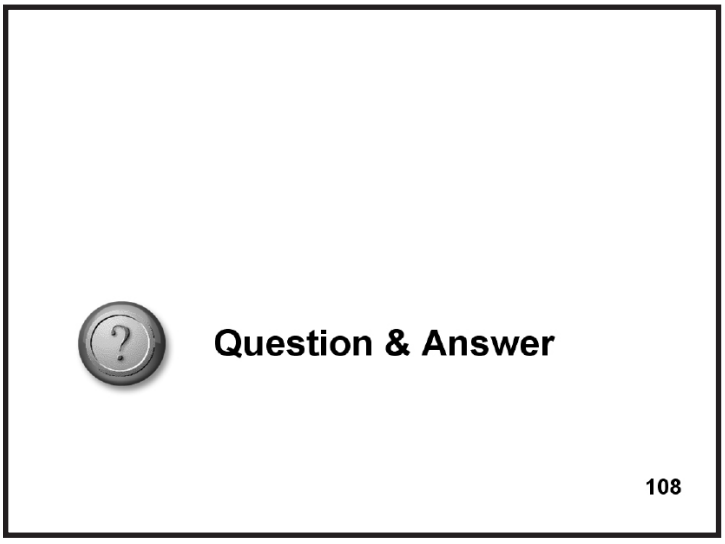
The instructor should first discuss the flow chart used to select the proper utility work zone temporary traffic control plan with the participants. The participants should understand how the proper plan is selected.



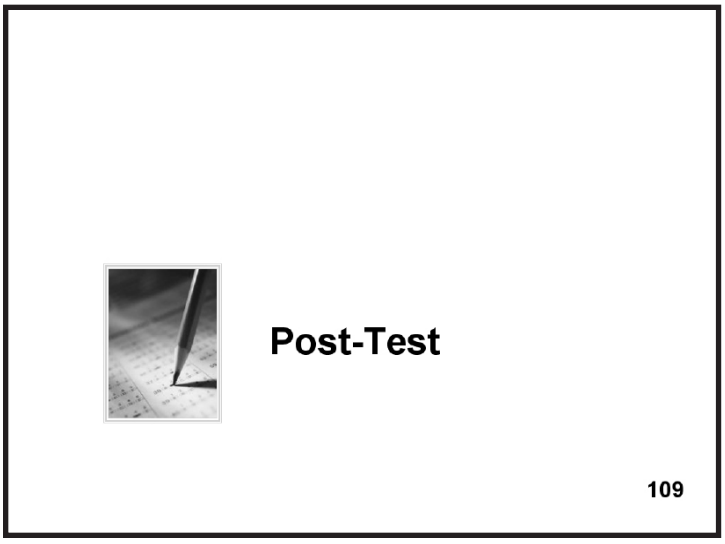
The instructor should continue through the flow chart explaining the utility work zone temporary traffic control plan selection process.



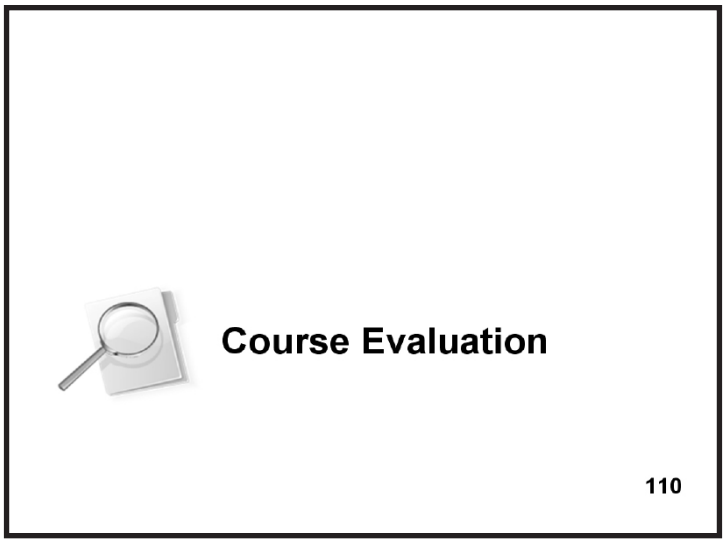
The instructor should complete the explanation of the flow chart and let the participants take time to navigate through the software program on their own.



At this point, the audience has the opportunity to ask any questions they may have about the material presented in the training program.



Participants will be given a 15-minute post-test to determine how much knowledge was gained as a result of the training program.



Each participant should still have the course evaluation form distributed at the beginning of the program. Feedback on all aspects of the training program is appreciated. The responses from the participants will help to improve the program, which will eventually be offered to utility agencies across the country. The instructor should collect the completed post-test and evaluation forms.

XII. Program Evaluation

The program evaluation is designed to allow the participants to evaluate the training program. The evaluation form should be given to each participant at the beginning of the day. The participants should be instructed to circle their evaluations at the end of each lesson. All completed evaluation forms should be collected at the end of the day before the participants leave. The evaluation form is shown on the following page.

PROGRAM EVALUATION FORM

Please circle the agency you work for: Road Agency Utility Company
Utility Contractor

Other:_____

Please provide your evaluation of the training program by circling the rank 1 (poor) to 5 (excellent) as appropriate.

Individual Sections: **Poor**
Excellent

Utility Workers, Foremen and Supervisors Module

1. Introduction to the Guidelines (Overall).....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content.....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5.....
.....
.....
.....
.....
Poor.....
Excellent
2. Recommended Traffic Control Devices and Why? (Overall) .....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content.....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5

3. Suggested Traffic Control Plans / Pedestrian Issues (Overall) .....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content .....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5
4. How do You Select a Proper Traffic Control Plan? (Overall) .....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content .....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5
5. Case Study – In-Class Exercises (Overall) .....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5
Content .....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5
6. Demonstration of Software Program (Overall) .....
1 2 3 4 5
Visual Aids .....
1 2 3 4 5
Presentation .....
1 2 3 4 5

Content.....
1 2 3 4 5
Sufficient Time/Opportunity for Discussion .....
1 2 3 4 5

Overall Training Program:

1. Program Organization.....
1 2 3 4 5
2. Program Length .....
1 2 3 4 5
3. Program Format.....
1 2 3 4 5
4. Class Size.....
1 2 3 4 5
5. Class Layout .....
1 2 3 4 5
5. Relevance and Usefulness of Topics .....
1 2 3 4 5
6. Overall Presentation .....
1 2 3 4 5

Additional Comments: _____

_____

_____

_____

_____

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XIII. Pre- and Post-Tests

The pre-test should be given at the beginning of the program and the post-test should be given at the end of the program. The pre- and post-tests contain the same questions. The pre-test should be printed on a different color paper than the post-test so they can be told apart.

These tests are designed to measure the participant's improvement of knowledge. In order to compare the pre- and post-test results by person, the instructor should have the participants write the same number in the corner of both tests such as the last four digits of their telephone number or their zip code. The participants should not be asked to write their names on the tests. Instead, the four-digit numbers can be used to match the pre-test with the post-test of the same person and measure individual improvement of knowledge due to the day long training program. A copy of the test and the answer key is shown on the following pages.

UTILITY WORK ZONE TRAFFIC CONTROL TEST

In order to evaluate the effectiveness of this training program, it is necessary to gauge the knowledge gained by the participants after completing the course. The results of this test will be used as a part of this evaluation. Consequently, your best effort on this test would be greatly appreciated and will aid in improving the training program prior to its nationwide implementation.

1. Indicate whether utility work zones or highway construction work zones best fit the given criteria. (**circle one only**)

a.	Typically have a shorter work duration:	Utility	Construction
b.	Typically have a larger crew size:	Utility	Construction
c.	Typically require more traffic control:	Utility	Construction
d.	Typically are planned in advance:	Utility	Construction

2. As per the MUTCD, for which categories of work duration may appropriately colored or marked vehicles with high-intensity rotating, flashing, oscillating, or strobe lights be used in place of signs and channelizing devices? (**circle all that apply**)

a. Long-term stationary
b. Intermediate-term stationary
c. Short-term stationary
d. Short duration
e. Mobile

3. Utility work vehicles should be parked (**circle one only**):

a. upstream of the work area
b. downstream of the work area

4. Equipment trailers should be parked (**circle one only**):

a. upstream of the work area
b. downstream of the work area

Identify whether each of the following statements is true or false. (Circle T for true and F for false)

5. The Utility Work Zone Traffic Control Guidelines supersede the MUTCD. T F

6. Utility work zones are harder for drivers to recognize as compared to highway work zones. T F

7. Class I garments are recommended for all utility workers. T F

8. Type III barricades are used in situations where a road closure is required. T F

9. Temporary traffic control signs should be mounted at least seven feet above ground. T F

10. Taller cones provide reduced visibility in comparison to standard cones. T

F

11. Lateral and longitudinal buffer spaces are required in all utility work zones. T

F

12. White utility work vehicles provide the greatest visibility to approaching motorists. T

F

13. Police vehicles with flashers activated should be utilized for temporary road closures. T

F

14. A sidewalk diversion is another name for a sidewalk detour. T

F

15. The typical traffic control plans from the Guidelines are applicable for all utility work zones. T

F

16. How much spacing should be provided between temporary traffic control signs in the following situations? (**Indicate the answer in feet**)

a. An urban area with a 25-mph posted speed limit : _____ ft

b. A rural area with a 25-mph posted speed limit : _____ ft

c. An urban area with a 55-mph posted speed limit : _____ ft

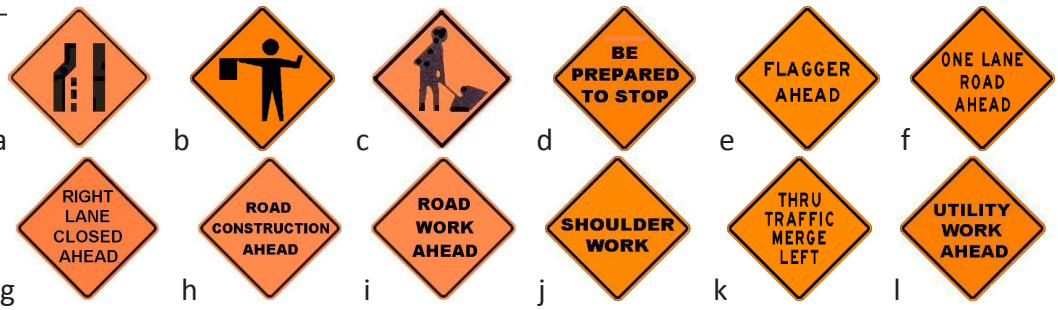
d. A rural area with a 55-mph posted speed limit : _____ ft

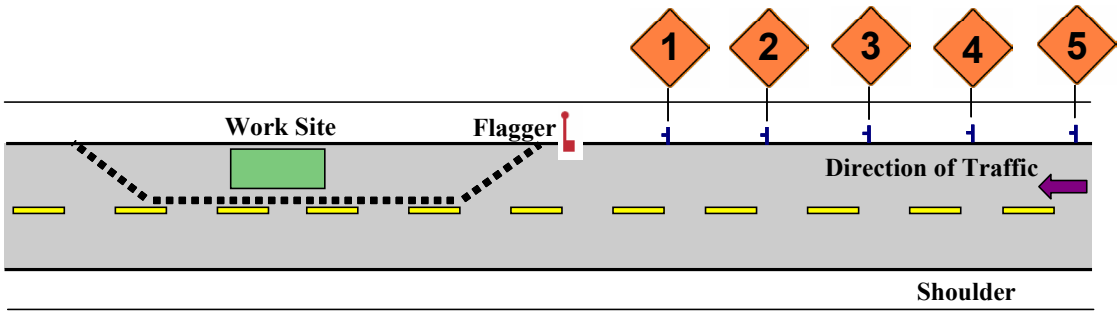
17. Indicate whether temporary traffic control signage and delineation are necessary under the following scenarios where utility work is being conducted on or beyond the shoulder.
(**Circle "Yes" or "No" in the two rightmost columns**)

Work Location	Work Vehicle Location	Volume	Speed	**Signage Necessary?**		**Delineation Necessary?**	
On Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
Beyond Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
	Beyond Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No

18. A utility project requires the use of a flagger to direct traffic at a lane closure along a section of two-lane road as illustrated in the diagram below. The following traffic control signs are available for use at the five locations indicated in the diagram. You are asked to determine how many signs are appropriate and in which sequence they should appear.
(**Write the letter corresponding to the appropriate sign at each location**)

Location 1:____ Location 2: _____ Location 3: _____ Location 4: _____ Location 5: _____





UTILITY WORK ZONE TRAFFIC CONTROL TEST (ANSWER KEY)

In order to evaluate the effectiveness of this training program, it is necessary to gauge the knowledge gained by the participants after completing the course. The results of this test will be used as a part of this evaluation. Consequently, your best effort on this test would be greatly appreciated and will aid in improving the training program prior to its nationwide implementation.

1. Indicate whether utility work zones or highway construction work zones best fit the given criteria. (**circle one only**)

a.	Typically have a shorter work duration:	Utility	Construction
b.	Typically have a larger crew size:	Utility	Construction
c.	Typically require more traffic control:	Utility	Construction
d.	Typically are planned in advance:	Utility	Construction

2. As per the MUTCD, for which categories of work duration may appropriately colored or marked vehicles with high-intensity rotating, flashing, oscillating, or strobe lights be used in place of signs and channelizing devices? (**circle all that apply**)

a. Long-term stationary
b. Intermediate-term stationary
c. Short-term stationary
d. Short duration
e. Mobile

3. Utility work vehicles should be parked (**circle one only**):

a. upstream of the work area
b. downstream of the work area

4. Equipment trailers should be parked (**circle one only**):

a. upstream of the work area
b. downstream of the work area

Identify whether each of the following statements is true or false. (Circle T for true and F for false)

5. The Utility Work Zone Traffic Control Guidelines supersede the MUTCD. T

F

6. Utility work zones are harder for drivers to recognize as compared to highway work zones. T

F

7. Class I garments are recommended for all utility workers. T

F

8. Type III barricades are used in situations where a road closure is required. T

F

9. Temporary traffic control signs should be mounted at least seven feet above ground. T

F

10. Taller cones provide reduced visibility in comparison to standard cones. T

F

11. Lateral and longitudinal buffer spaces are required in all utility work zones. T

F

12. White utility work vehicles provide the greatest visibility to approaching motorists. T

F

13. Police vehicles with flashers activated should be utilized for temporary road closures. T

F

14. A sidewalk diversion is another name for a sidewalk detour. T

F

15. The typical traffic control plans from the Guidelines are applicable for all utility work zones. T

F

16. How much spacing should be provided between temporary traffic control signs in the following situations? (**Indicate the answer in feet**)

a. An urban area with a 25-mph posted speed limit : 100 ft

b. A rural area with a 25-mph posted speed limit : 500 ft

c. An urban area with a 55-mph posted speed limit : 350 ft

d. A rural area with a 55-mph posted speed limit : 500 ft

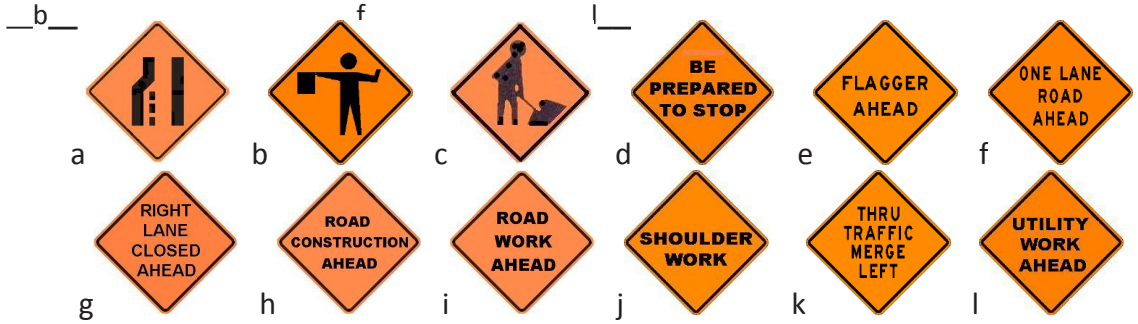
17. Indicate whether temporary traffic control signage and delineation are necessary under the following scenarios where utility work is being conducted on or beyond the shoulder.
(**Circle "Yes" or "No" in the two rightmost columns**)

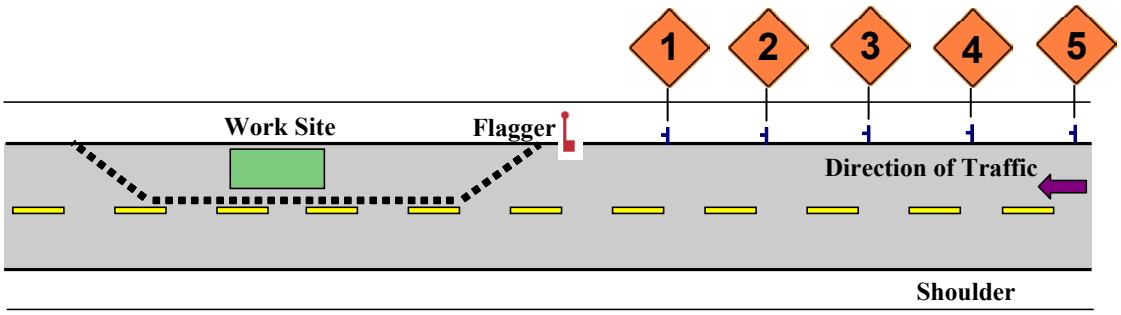
Work Location	Work Vehicle Location	Volume	Speed	**Signage Necessary?**		**Delineation Necessary?**	
On Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
Beyond Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
	Beyond Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No

18. A utility project requires the use of a flagger to direct traffic at a lane closure along a section of two-lane road as illustrated in the diagram below. The following traffic control signs are available for use at the five locations indicated in the diagram. You are asked to determine how many signs are appropriate and in which sequence they should appear.
(**Write the letter corresponding to the appropriate sign at each location**)

Location 1: Location 2: Location 3: Location 4: _____ Location 5: _____

__b__ f l__





XIV. List of Acronyms

ANSI	American National Standards Institute
ARTBA	American Road and Transportation Builders Association
ATSSA	American Traffic Safety Services Association
FHWA	Federal Highway Administration
ISEA	International Safety Equipment Association
MUTCD	Manual on Uniform Traffic Control Devices
NHI	National Highway Institute
OSHA	Occupational Safety and Health Administration
TTC	Temporary Traffic Control
TTI	Texas Transportation Institute
UWZ	Utility Work Zone

XV. List of References and Source Documents

Additional resource materials for utility work zone traffic control guidelines and training can be found at the following websites:

- American Road and Transportation Builders Association: http://www.artba.org/
- American Traffic Safety Services Association: http://www.atssa.com/
- Federal Highway Administration: http://www.fhwa.dot.gov/
- Manual on Uniform Traffic Control Devices: http://mutcd.fhwa.dot.gov/

- National Highway Institute: http://www.nhi.fhwa.dot.gov/home.aspx
- National Work Zone Safety Information Clearinghouse:
- http://www.workzonesafety.org/
- Texas Transportation Institute: http://tti.tamu.edu
- Transportation Research Board: http://www.trb.org/

Training materials and programs for traffic regulators (flaggers) can be found at the following website: http://www.workzonesafety.org/training/

A list of additional resources that may be helpful for the instructor are as follows:

Manual on Uniform Traffic Control Devices for Street and Highways. U.S. Department of Transportation, Federal Highway Administration, 2003 Edition, 2004.

1. Scriba, T., Sankar, P. and Jeannotte, K. *Implementing the Rule on Work Zone Safety and Mobility*. US Department of Transportation, Federal Highway Administration, FHWA-HOP-05-065, September 2005.

2. *Development of Standards and Procedures for Temporary Traffic Control at Utility Work Zones*. Wayne State University Transportation Research Group, August 2006.

3. Ullman B.R., M.D. Finley, and N.D. Trout. *Identification of Hazards Associated with Mobile and Short Duration Work Zones*. Texas Transportation Institute Report No. 4174-1, September 2003. http://tti.tamu.edu/documents/0-4174-1.pdf.

4. Antonucci et al., Guidelines for the Implementation of the AASHTO Strategic Highway Safety Plan Volume 17: A Guide for Reducing Work Zone Collisions, NCHRP Report 500, TRB, National Research Council, Washington D.C., 2005.

5. Chapman, P.R. and G. Underwood (1998), "Visual Search of Driving Situations: Danger and Experience", Perception, Vol. 27, pp. 951-964.

6. Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Program, http://www.cdc.gov Accessed January 9, 2007.

7. Ullman, G. L., and T. A. Scriba. Revisiting the Influence of Crash Report Forms on Work Zone Crash Data. In *Transportation Research Record 1897,* TRB, National Research Council, Washington, D.C., 2004, pp. 180-182.

8. Traffix Devices, Inc., Products, www.traffixdevices.com.

9. Shelton, L.R. (2001), Statement Before the Subcommittee on Highways and Transit, Committee on Transportation and Infrastructure, U.S. House of Representatives, May 9, 2001.

10. Kamyab, A. and T.J. McDonald (2003), "Synthesis of Best Practices for Increasing Protection and Visibility of Highway Maintenance Vehicles", Proceedings of the 2003 Mid-Continent Transportation Research Symposium, Ames, Iowa.

11. Post, D.V. (1978), "Signal Lighting System Requirements for Emergency, School Bus and Service Vehicles", DOT HS-804 095, Highway Safety Research Institute, University of Michigan, Ann Arbor, MI.

12. Federal Highway Administration (2004), Manual on Uniform Traffic Control Devices for Street and Highways, 2003 Edition, U.S. Department of Transportation, Washington, D.C.

13. Hanscom, F.R. and R.F. Pain (1990), Service Vehicle Lighting and Traffic Control Systems for Short-Term and Moving Operations, National Cooperative Highway Research Program Report No. 337, Transportation Research Board, Washington, D.C.

14. Charlton, S.G. (2006), "Conspicuity, Memorability, Comprehension, and Priming in Road Hazard Warning Signs", Accident Analysis and Prevention, Vol. 38, pp. 496-506.

15. Martens, M.H. and M. Fox (2007), "Does Road Familiarity Change Eye Fixations? A Comparison between Watching a Video and Real Driving", Transportation Research Part F: Traffic Psychology and Behavior, Vol. 10, No. 1, pp. 33-47.

16. Chapman, P.R. and G. Underwood (1998), "Visual Search of Driving Situations: Danger and Experience", Perception, Vol. 27, pp. 951-964.

17. Wayne State University Transportation Research Group (2007), Utility Work Zone Safety Guidelines and Training: Gap Study and Needs Assessment, Report to United States Department of Transportation, Federal Highway Administration.

18. Zwhalen, H.T., and T. Schnell (1997) "Visual Detection and Recognition of Fluorescent Color Targets Versus Nonfluorescent Color Targets as a Function of Peripheral Viewing Angle and Target Size", Transportation Research Record 1605, National Research Council, Washington, D.C.

19. Schnell, T., K. Bentley, E. Hayes, and M. Rick (2001), "Legibility Distances of Fluorescent Traffic Signs and Their Normal Color Counterparts", Transportation Research Record 1754, National Research Council, Washington, D.C.

20. Carlson, P.J., H.G. Hawkins, and M.D. Finley (2001), "Selection of Retroreflective Material as a Function of Sign Color and Critical Detail." Proceedings from the Transportation Research Board 80th Annual Meeting, Washington D.C., Preprint CD-ROM.

21. Ullman, G.L. (2000), "Special Flashing Warning Lights for Construction, Maintenance, and Service Vehicles: Are Amber Beacons Always Enough?" Transportation Research Record No. 1715, Washington, D.C., pp. 43-50.

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UTILITY WORK ZONE TRAFFIC CONTROL TEST

In order to evaluate the effectiveness of this training program, it is necessary to gauge the knowledge gained by the participants after completing the course. The results of this test will be used as a part of this evaluation. Consequently, your best effort on this test would be greatly appreciated and will aid in improving the training program prior to its nationwide implementation.

1. Indicate whether utility work zones or highway construction work zones best fit the given criteria. (**circle one only**)

- **a.** Typically have a shorter work duration: Utility Construction
- **b.** Typically have a larger crew size: Utility Construction
- **c.** Typically require more traffic control: Utility Construction
- **d.** Typically are planned in advance: Utility Construction

2. As per the MUTCD, for which categories of work duration may appropriately colored or marked vehicles with high-intensity rotating, flashing, oscillating, or strobe lights be used in place of signs and channelizing devices? (**circle all that apply**)

- **a.** Long-term stationary
- **b.** Intermediate-term stationary
- **c.** Short-term stationary
- **d.** Short duration
- **e.** Mobile

3. Utility work vehicles should be parked (**circle one only**):

- **a.** upstream of the work area
- **b.** downstream of the work area

4. Equipment trailers should be parked (**circle one only**):

- **a.** upstream of the work area
- **b.** downstream of the work area

Identify whether each of the following statements is true or false. (Circle T for true and F for false)

5. The Utility Work Zone Traffic Control Guidelines supersede the MUTCD. T F

6. Utility work zones are harder for drivers to recognize as compared to highway work zones. T F

7. Class I garments are recommended for all utility workers. T F

8. Type III barricades are used in situations where a road closure is required. T F

9. Temporary traffic control signs should be mounted at least seven feet above ground. T F

10. Taller cones provide reduced visibility in comparison to standard cones. T F

11. Lateral and longitudinal buffer spaces are required in all utility work zones. T F

12. White utility work vehicles provide the greatest visibility to approaching motorists. T F

13. Police vehicles with flashers activated should be utilized for temporary road closures. T F

14. A sidewalk diversion is another name for a sidewalk detour. T F

15. The typical traffic control plans from the Guidelines are applicable for all utility work zones. T F

16. How much spacing should be provided between temporary traffic control signs in the following situations? (**Indicate the answer in feet**)

a. An urban area with a 25-mph posted speed limit : _____ ft

b. A rural area with a 25-mph posted speed limit : _____ ft

c. An urban area with a 55-mph posted speed limit : _____ ft

d. A rural area with a 55-mph posted speed limit : _____ ft

17. Indicate whether temporary traffic control signage and delineation are necessary under the following scenarios where utility work is being conducted on or beyond the shoulder.

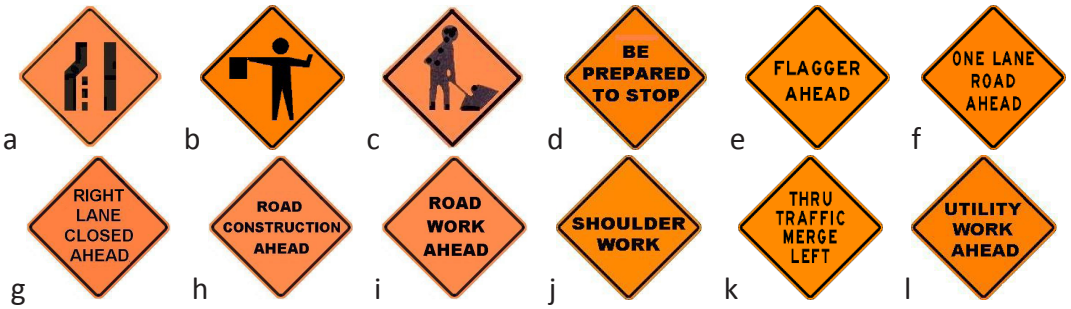
(**Circle "Yes" or "No" in the two rightmost columns**)

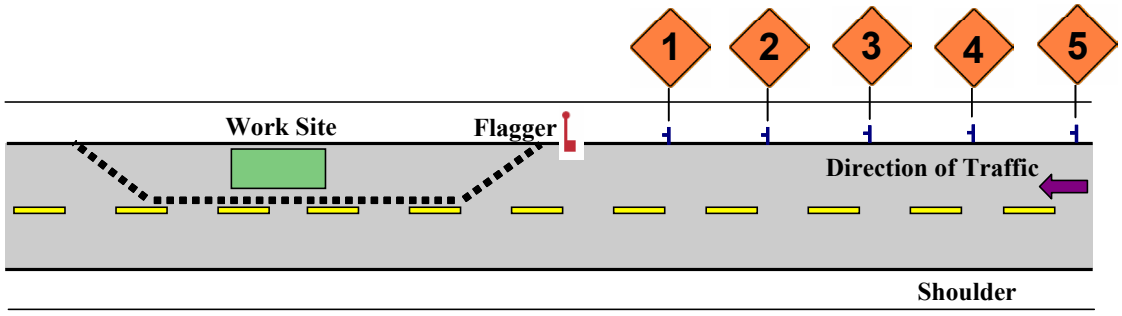
Work Location	Work Vehicle Location	Volume	Speed	**Signage Necessary?**		**Delineation Necessary?**	
On Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
Beyond Shoulder	On Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No
	Beyond Shoulder	Low	Low	Yes	No	Yes	No
		High	Low	Yes	No	Yes	No
		Low	High	Yes	No	Yes	No

18. A utility project requires the use of a flagger to direct traffic at a lane closure along a section of two-lane road as illustrated in the diagram below. The following traffic control signs are available for use at the five locations indicated in the diagram. You are asked to determine how many signs are appropriate and in which sequence they should appear.

(**Write the letter corresponding to the appropriate sign at each location**)

Location 1:_____ Location 2: _____ Location 3: _____ Location 4: _____ Location 5: _____





PROGRAM EVALUATION FORM

Please circle the agency you work for: Road Agency Utility Company
Utility Contractor Other:_____

Please provide your evaluation of the training program by circling the rank 1 (poor) to 5 (excellent) as appropriate.

Individual Sections:	**Poor**				**Excellent**
Management and Safety Officials' Module					
1. Why Follow the Guidelines? (Overall)	1	2	3	4	5
Visual Aids	1	2	3	4	5
Presentation	1	2	3	4	5
Content	1	2	3	4	5
Sufficient Time/Opportunity for Discussion	1	2	3	4	5
2. Utility Work Zone Traffic Control and Safety / Positive Guidance / Driver Expectancy (Overall)	1	2	3	4	5
Visual Aids	1	2	3	4	5
Presentation	1	2	3	4	5
Content	1	2	3	4	5
Sufficient Time/Opportunity for Discussion	1	2	3	4	5
3. Agency-wide Safety Culture – What? Why? How? (Overall)	1	2	3	4	5
Visual Aids	1	2	3	4	5
Presentation	1	2	3	4	5
Content	1	2	3	4	5
Sufficient Time/Opportunity for Discussion	1	2	3	4	5
4. Training, Knowledge Retention, and Retraining Issues (Overall)	1	2	3	4	5
Visual Aids	1	2	3	4	5
Presentation	1	2	3	4	5
Content	1	2	3	4	5
Sufficient Time/Opportunity for Discussion	1	2	3	4	5

Overall Training Program:

1. Program Organization	1	2	3	4	5
2. Program Length	1	2	3	4	5
3. Program Format	1	2	3	4	5
4. Class Size	1	2	3	4	5
5. Class Layout	1	2	3	4	5
5. Relevance and Usefulness of Topics	1	2	3	4	5
6. Overall Presentation	1	2	3	4	5

Additional Comments: _____
_____
_____
_____
_____

WAYNE STATE UNIVERSITY

U.S. Department of Transportation
Federal Highway Administration