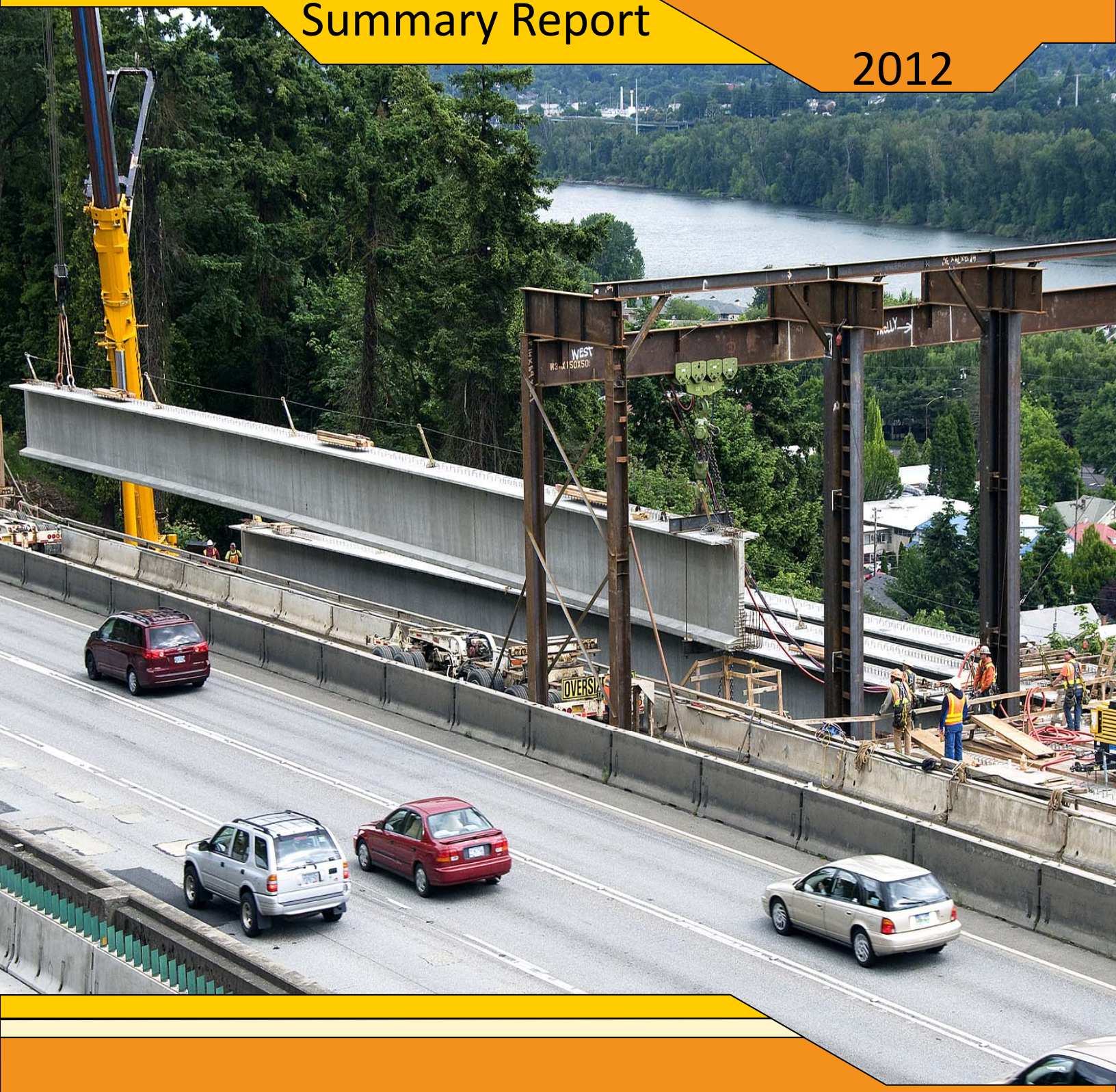
Oregon Work Zone Safety Audit

Summary Report

2012



Oregon Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

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Cover Photo: Beam Lift at I-5 Iowa St. Viaduct, Portland

Introduction

As part of ODOT's statewide work zone safety and temporary traffic control program, jointly with the FHWA, the Traffic Control Plans (TCP) Unit travels around the State conducting several, multi-day construction Work Zone Safety Audits. The 2012 Work Zone Safety Audits visited and reviewed 29 different highway construction work zones.

The 2012 construction season provided a wide variety of work zones to review. Project locations ranged from the Oregon Coast to the Blue Mountains of Eastern Oregon. Several projects completely closed the road to public travel, while others worked alongside high-speed, live traffic.

In conducting the Safety Audits, a number of Reviewers are invited to participate. Reviewers represent a broad cross-section within the temporary traffic control discipline – FHWA, ODOT Region TCP Design and Region Safety personnel. Audit participants are asked to score the work zones on a wide array of performance measures. Scores and comments are used to focus and heighten awareness of the many standards, practices, procedures and devices used in the design and implementation of ODOT's Traffic Control Plans. This report provides important feedback for statewide TCP Designers, ODOT engineering consultants and Region Construction Project Management staff. ODOT benefits from the Safety Audits by realizing measurable improvements in the quality and safety of the temporary traffic control plans used on its highway construction projects.

Objective

The purpose of the Work Zone Safety Audits is to:

- Confirm ODOT Temporary Traffic Control Design Standards and Practices are being implemented in the field consistently and uniformly.
- Confirm that the latest Standards and Practices are effective at providing a satisfactory level of safety for the traveling public and construction workers.
- Reveal additional techniques or technologies needed to improve overall safety, traffic flow and construction efficiency.
- Strengthen communication and working relationships between ODOT design and construction staff, consultants, and contractor employees.
- Identify current standard practices that need to be updated based on observations and feedback.

Methods

Since 2002, ODOT has been conducting detailed work zone reviews in an effort to strengthen the quality, efficiency and safety of its highway construction work zones. The Work Zone Safety Audits serve as a key element within the Agency's quality control and quality assurance programs. The Audits allow designers, Safety staff, Project Coordinators and Construction personnel the opportunity to observe strengths and weaknesses within this unique and dynamic discipline.

Each Reviewer was asked to evaluate the condition and effectiveness of a variety of devices used within the work zone. Over 30 different "measures" are scored for each project visited. Scores are based on a scale of 1 (low) to 10 (high). A score of 4 or less warrants immediate contact with the ODOT Project Manager's office or an on-site agency representative to discuss the issue and possible mitigation strategies.

The Work Zone Safety Audit Evaluation Form (Figure 1) is used by Reviewers to record scores, notes and comments for each project visited.

This year's audits were conducted over four separate trips in July and August:

- Regions 1 and 2 (north)
- Region 1 (Night projects)
- Regions 2 (south) and 3
- Regions 4 and 5

Evaluation Forms were collected from 29 different construction projects, visited by 12 Reviewers, resulting in over 170 pages of scores and comments.

The large amount of data and comments collected allows us to generate a wide array of reports. Please contact the Traffic Control Plans Unit in Salem for additional information regarding reporting options and availability.

This year:

- 29 projects were evaluated spanning all five Regions.
- 12 different Reviewers participated, including representatives from:
  - ODOT Construction Project Management and Inspection
  - ODOT Traffic-Roadway Section
  - Designers from ODOT Region Tech Centers
  - ODOT Transportation Safety Division Safety Coordinators
  - Federal Highway Administration (FHWA)

Measures were scored as applicable for each project. If a device or condition was not present on a project at the time of the visit, a score was not given. For example, temporary concrete barrier may have been included in a particular contract, but if not in use on the project site at the time of the visit, "Temporary Concrete Barrier" (and likely, "Temporary Impact Attenuators") would not have been scored for that project.

Each of the following Measures were evaluated for each project visited:

Temporary Signing – Overall Quality (design, condition), Placement and Spacing (visibility and legibility).

Channelization Devices – Overall Quality, Condition, Placement and Effectiveness for Tubular Markers/ Cones, Drums, and Barricades.

Pavement Markings & Markers – Overall Quality (condition and visibility), Placement and removal of temporary and permanent markings, where applicable.

Temporary Concrete Barrier – Alignment, Crashworthy installations, and Quality of the barrier.

Reflective Barrier Panels – Condition (cleanliness and installation), Effectiveness, and Placement.

Temporary Impact Attenuators – Proper application and Quality (maintenance and placement).

Portable Changeable Message Signs (PCMS) – Effective placement, Condition, and Message quality.

Sequential Arrow Panels – Proper application, Placement, and Quality of the device.

Temporary Traffic Signals – Proper installation (design and layout), Operation, and Maintenance.

Bike/Ped/ADA Facilities – ADA Compliance, Adequate signing and devices; and, Continuity through the project site (detours, diversions).

Flaggers – Proper placement, Effective devices and equipment; and, Performance.

Pilot Cars – Appropriate application and Performance.

Mobility – Effect of construction activities on traffic. Not exceeding specified delay limits.

Worker Garments & Equipment – Standard application of safety measures for workers and equipment on the jobsite.

Figure 1—Work Zone Safety Audit Evaluation Form

PROJECT NAME:				DATE:
HIGHWAY:	MILEPOST:	REGION:		REVIEWED BY:
PROJECT MANAGER:	OTHER CONTACTS:			
GENERAL NOTES	CONTRACTOR:			TCS

Only score Devices you witnessed on the Project. If a certain device was not present, do not score it.

S C O R I N G

Notify PM or Field Project Representive!				BELOW AVG.	AVERAGE	ABOVE AVG.	GOOD	VERY GOOD	EXCELLENT
1	2	3	4	5	6	7	8	9	10

CATEGORIES		SCORE	NOTES
TEMPORARY SIGNING (Signs, Flags, Supports)	QUALITY		
	PLACEMENT		
	SPACING		
CHANNELIZATION DEVICES (Tubular Markers, Cones, Drums, Barricades)	Tubes/Cones		
	DRUMS		
	BARRICADES		
PAVEMENT MARKINGS (Paint, Tape, Reflective & Flexible Markers)	CONDITION		
	PLACEMENT		
CONCRETE BARRIER	CONDITION		
	PLACEMENT		
Reflective Barrier Panels? Y or N	CONDITION		
IMPACT ATTENUATORS (Drum Arrays, Narrow-Site & TMA)	CONDITION		
	PLACEMENT		
PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)	MESSAGE		Capture message, if possible
	PLACEMENT		
	CONDITION		
SEQUENTIAL ARROW PANEL (Arrow Board)	PLACEMENT		
	CONDITION		
TEMP. TRAFFIC SIGNALS	SET-UP		
	CONDITION		
BICYCLE, PEDESTRIAN & ADA FACILITIES (Score if existing facilities affected by construction)	SIGNING		
	Continuous Route?		
	ADA Compliance		
FLAGGERS	VISIBILITY		
	Performance		
PILOT CARS	Equipment		
	Performance		
MOBILITY	Overall Flow		
Time Stopped At Flagger or Signal (If applicable)		min	
Approx. Travel Speed thru the work zone?		mph	
WORKER GARMENTS & EQUIPMENT	GARMENTS		
	EQUIPMENT		
SITE HOUSEKEEPING	CLEAN, ORDERLY		
POLICE ENFORCEMENT	ON-SITE?	Y or N	
	PAYING OT?	Y or N	
DRIVER-FRIENDLY WORK ZONE	Ease of Navigation		This category for information only. Do not include in Page Total.
	Consistency		

	=		N *		FINAL SCORE
GRAND TOTAL =		÷		=	

* N = The Number of Scored Categories

Results

In the statistics that follow, approximately 3,000 scores from the 12 different Reviewers were tabulated for the 29 projects. Project scores were combined and averaged based on the number of participants submitting an Evaluation Form. Overall average project scores were calculated for each Region and are compared to scores collected since 2002 (Figures 3 through 7). Average scores for individual projects were ranked in order of highest to lowest (see Pages 10 through 14).

Measure Scoring Summary

Figure 2 shows the statewide average score for each work zone Measure. Figure 2 can be used to identify measures (devices, practices) needing additional attention at the design and/or implementation phase of the project. It also identifies measures that are meeting or exceeding road users' expectations.

Of the 31 measures, all but three received an average score above 6.50. Fifteen of the measures received average scores above 7.00.

Measures that consistently received the highest average scores for 2012 were:

- Impact Attenuators – Condition, 7.73
- Concrete Barrier - Condition, 7.55
- Temp. Traffic Signals – Condition, 7.54
- Temporary Signs – Quality, 7.49
- Refl. Barrier Panels – Condition, 7.47
- Mobility – Overall Flow, 7.47

Measures that consistently received the lowest average scores for 2012 were:

- Bicycle, Pedestrian & ADA Facilities – ADA Compliance, 5.99
- Portable Changeable Message Signs – Message, 6.30
- Bicycle, Pedestrian & ADA Facilities – Continuous Route, 6.41

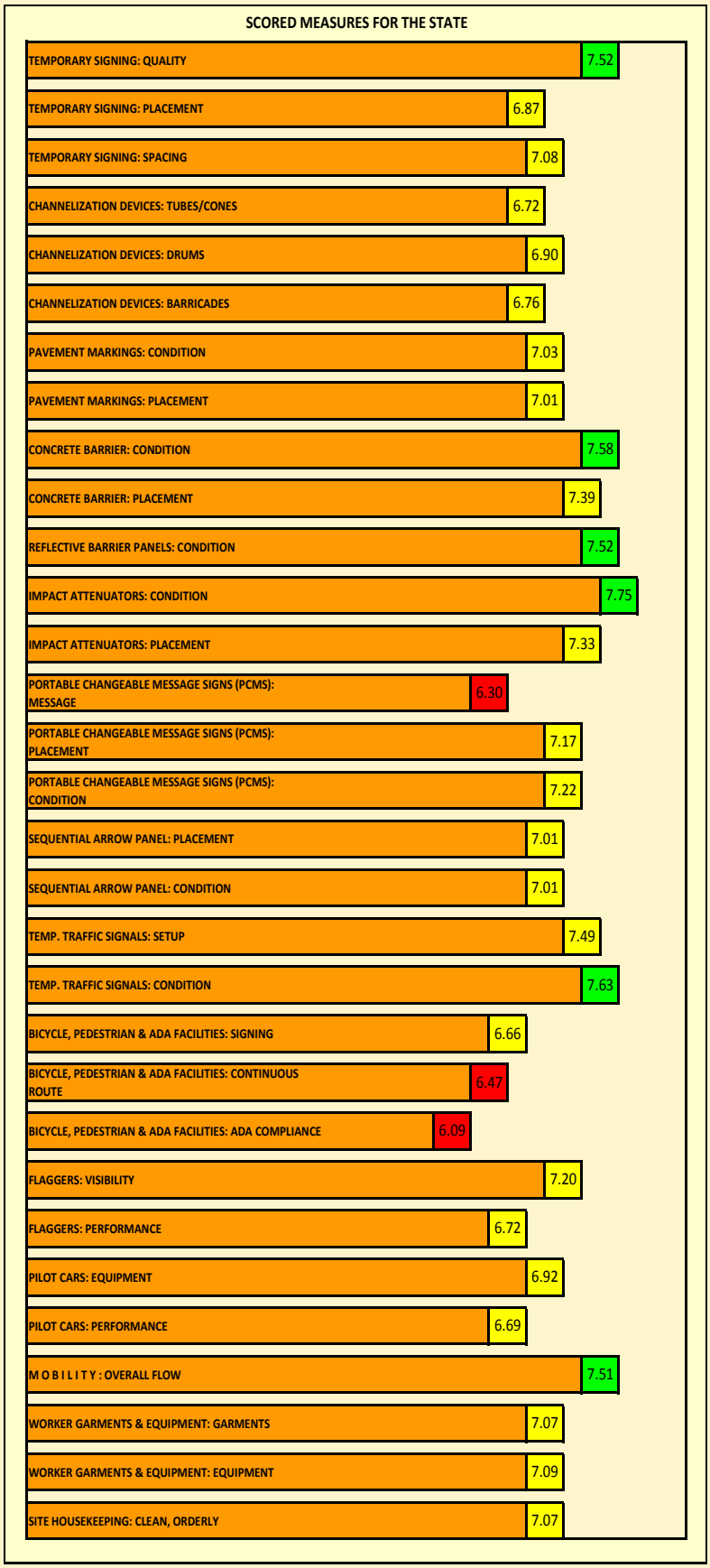


Figure 2—Average Measure Scores

Statewide Scoring Summary

The 2012 Work Zone Safety Audits reviewed 29 projects - the least amount of projects reviewed since 2003. The statewide average project score increased from 2011 to 2012; but, is consistent with scores from past audits.

The statewide average project score of 71* equates to a rating of, "Above Average" based on the current scoring system. The above average rating confirms that the TCP Standards and Practices are mostly effective and being implemented a majority of the time.

** Raw scores ("out of 10") are converted to scores based on 100 for annual comparison purposes.*

During the Audits, a few isolated projects needed immediate attention to the traffic control plan. On-site Region Project Management staff was prompt and cooperative in responding to questions or suggested improvements.

The Measures scored during the Audits were averaged and ranked – both statewide and for each Region (See Figures 3 through 6).

Figure 3—Annual Scores

2012 WORK ZONE SAFETY AUDIT SUMMARY REPORT - SCORING STATISTICS by YEAR

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TOTAL PROJECTS REVIEWED	22	29	46	54	43	38	43	60	42	43	29
HIGH SCORE	89	82	87	82	81	81	94	88	74	75	80
AVERAGE SCORE	72	73	73	71	71	75	77	76	67	69	71
LOW SCORE	54	63	53	51	59	63	68	62	53	57	57

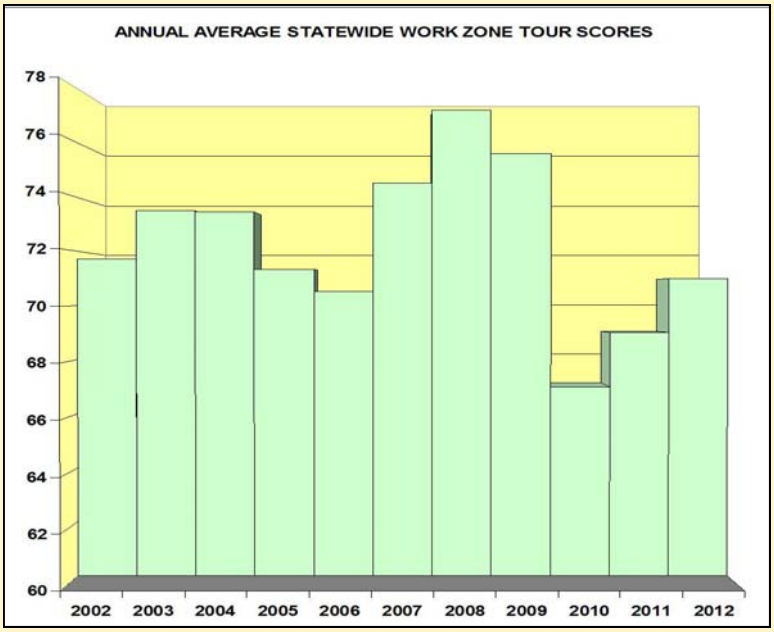


Figure 4—Annual Scores graph

Region Scoring Summary

All five of the ODOT Regions increased their scores compared to 2011*. Overall , Region average scores remained consistent with historical scores dating back to 2002.

* *Only one project reviewed in Region 4.*

Due to the completion of the OTIA III program and overall decreased statewide project funding, the number of projects available for review has been declining since 2009. Nonetheless, enough data is still available to aid the TCP Unit in improving the statewide work zone safety and traffic control plans program.

On the pages that follow, are graphical Region maps showing individual Project scores and overall average Measure scores for that Region. Projects and measures highlighted in green are the highest scores, highlighted in yellow the middle scores, and highlighted in red the lowest scores.

Figure 5—Region Scoring Statistics

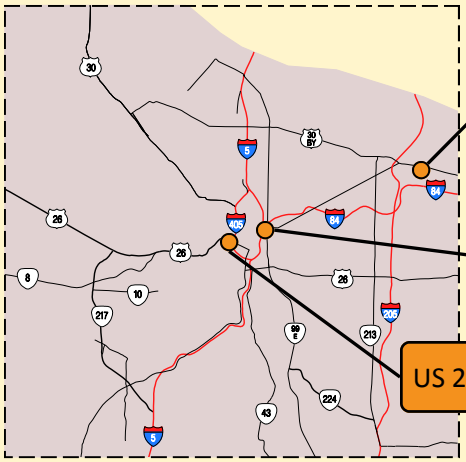
2012 WORK ZONE SAFETY AUDIT SUMMARY REPORT - SCORING STATISTICS by REGION

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	AVERAGE
REGION 1	69.3	77.7	72.8	73.9	75.6	76.7	82.0	74.3	68.1	68.0	68.6	73.4
REGION 2	61.3	72.5	72.0	70.9	68.1	74.8	74.0	78.4	67.2	70.2	70.8	70.9
REGION 3	75.5	72.8	72.3	70.0	70.3	72.8	75.0	75.7	66.1	70.2	71.2	72.0
REGION 4	76.3	74.0	74.5	69.9	66.7	74.8	78.0	73.8	68.4	68.1	78.2	73.0
REGION 5	76.2	70.4	75.7	72.0	71.9	73.5	77.0	73.6	64.6	68.0	71.0	72.2

Figure 6 - # of Projects

PROJECTS SCORED per REGION	
Region 1	6
Region 2	5
Region 3	7
Region 4	1
Region 5	10

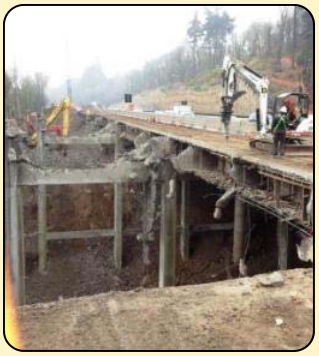
Region 1

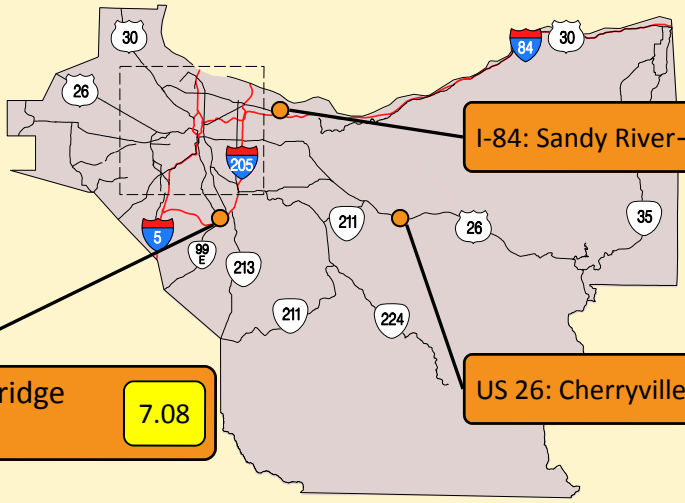


US 30: NE 22nd—MP 13.54 Section 6.53

I5: Holladay—Marquam & I-405: Fremont Bridge 6.95

US 26: I-405 to Sylvan 6.71





I-84: Sandy River—Jordan Rd. 6.91

OR 43: Willamette River Bridge (Oregon City Arch Bridge) 7.08

US 26: Cherryville Dr.—Salmon River 7.00

Region 1 Measure

Strengths:

- Flaggers
- Pilot Cars.

Weaknesses:

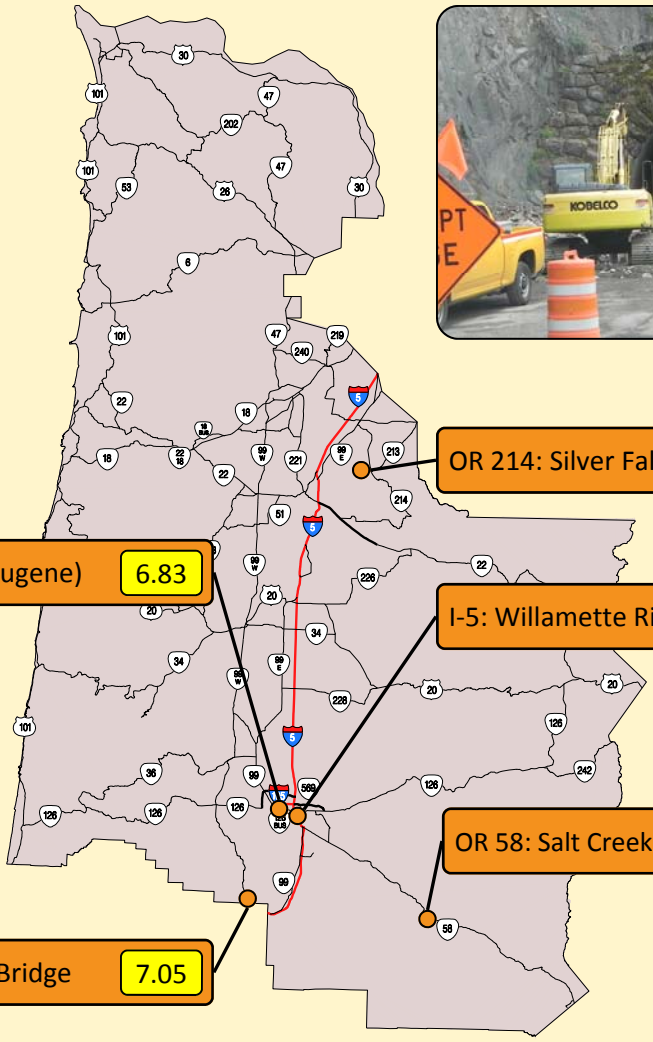
- Channelization Devices
- PCMS
- Sequential Arrow Panel

Measure Scores

Temporary Signing	6.70	Temporary Traffic Signal	6.69
Channelization Devices	6.62	Bicycle/Ped/ADA	6.83
Pavement Markings	6.84	Flaggers	7.33
Concrete Barrier	6.78	Pilot Cars	7.38
Impact Attenuators	6.78	Mobility	6.88
PCMS	6.55	Worker Garments	6.74
Sequential Arrow Panel	6.60	Site Housekeeping	6.77

Region 2

Project Scores



OR 214: Silver Falls Highway Preserv. 6.96

OR 99: Roosevelt—Garfield (Eugene) 6.83

I-5: Willamette River Bridge 7.14

OR 58: Salt Creek Tunnel & Half Viaducts 7.43

OR 200: S. Fork Siuslaw River Bridge 7.05

Region 2 Measure

Strengths:

- Temporary Signing
- Bicycle/Ped/ADA
- Impact Attenuators

Weaknesses:

- Mobility
- Worker Garments
- Site Housekeeping

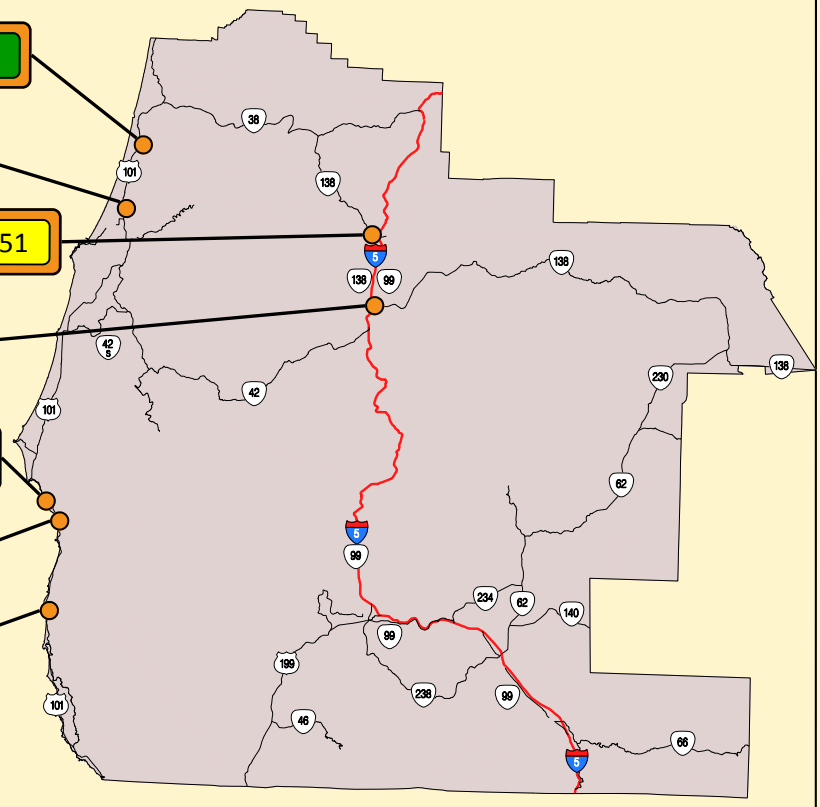
Measure Scores

Temporary Signing	7.23
Channelization Devices	6.96
Pavement Markings	6.95
Concrete Barrier	7.07
Impact Attenuators	7.12
PCMS	7.09
Sequential Arrow Panel	7.09
Temporary Traffic Signal	7.07
Bicycle/Ped/ADA	7.14
Flaggers	7.09
Pilot Cars	6.75
Mobility	6.50
Worker Garments	6.38
Site Housekeeping	6.64

Region 3

Project Scores

US 101: Tugman State Park—Spinreel Rd.	7.98
US 101: McCollough Bridge Rehab	7.42
OR 138W: Dodge Cr. & Calapooia Cr. Bridges	7.51
I-5: Del Rio Road Interchange	6.97
US 101: Kobernick Slide Repair (Unit II)	7.52
US 101: Slide Creek Realignment	6.73
US 101: Gold Beach Signals	5.70



Region 3 Measure

Strengths:

- Impact Attenuators
- Mobility
- Concrete Barrier
- Site Housekeeping

Weaknesses:

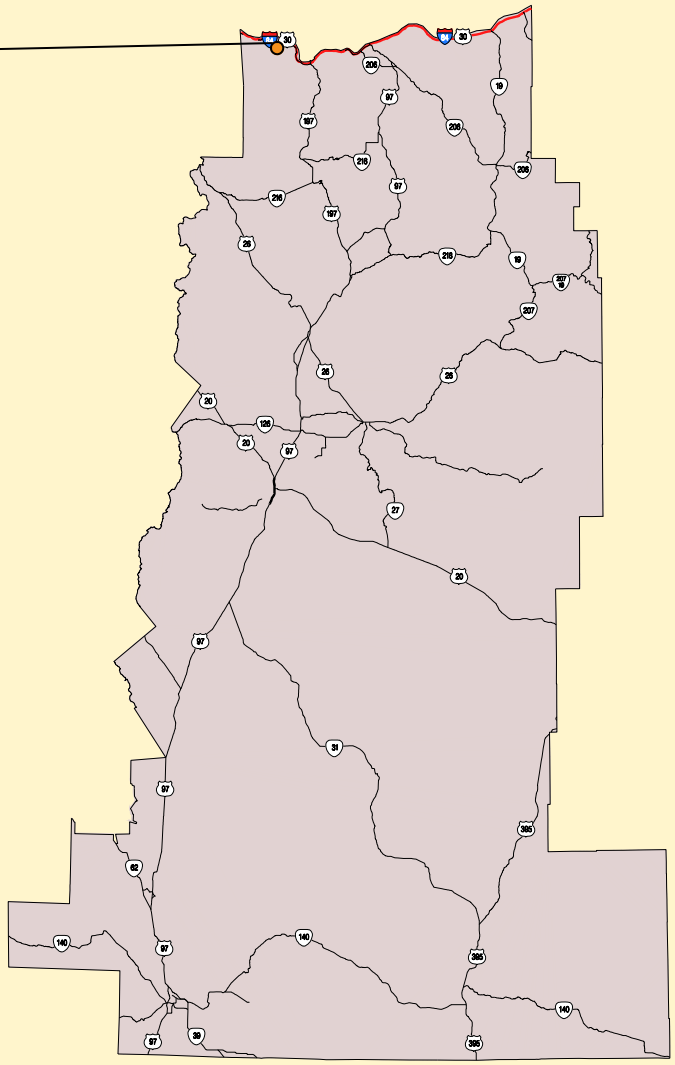
- Bicycle/Ped/ADA
- Sequential Arrows

Measure Scores

Temporary Signing	7.25	Temporary Traffic Signal	7.33
Channelization Devices	7.03	Bicycle/Ped/ADA	6.24
Pavement Markings	6.86	Flaggers	6.74
Concrete Barrier	7.42	Pilot Cars	—
Impact Attenuators	7.72	Mobility	7.72
PCMS	7.30	Worker Garments	7.10
Sequential Arrow Panel	6.50	Site Housekeeping	7.41

Region 4

I-84: Rowena Bluff Rockfall 7.82



Measure Scores

Temporary Signing	7.61	Temporary Traffic Signal	—
Channelization Devices	7.42	Bicycle/Ped/ADA	—
Pavement Markings	7.50	Flaggers	—
Concrete Barrier	8.38	Pilot Cars	—
Impact Attenuators	8.13	Mobility	8.33
PCMS	—	Worker Garments	7.58
Sequential Arrow Panel	7.67	Site Housekeeping	7.67

Region 4 Measure

(Representative on one project)

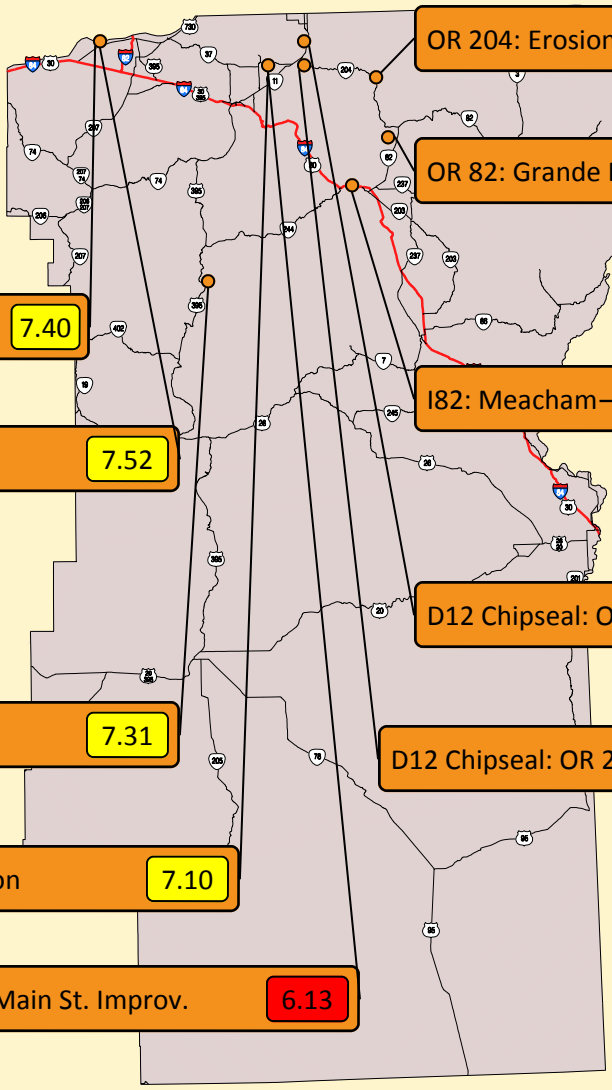
Strengths:

- Mobility
- Concrete Barrier

Weaknesses:

- Channelization Devices
- Pavement Markings

Region 5



OR 204: Erosion Control 7.49

OR 82: Grande Ronde R. & INPRR Br. 7.59

US 730: Irrigon—Diagonal Road 7.40

I82: Meacham—Glover Section 7.81

US 730: Umatilla River Bridge 7.52

D12 Chipseal: OR 11 Section 6.47

US 395: Freight Improvements 7.31

D12 Chipseal: OR 204 Section 6.17

D12 Chipseal: OR 334 Section 7.10

OR 334: Athena Main St. Improv. 6.13

Measure Scores

Temporary Signing	7.28	Temporary Traffic Signal	8.00
Channelization Devices	6.42	Bicycle/Ped/ADA	6.66
Pavement Markings	7.41	Flaggers	7.02
Concrete Barrier	7.74	Pilot Cars	6.97
Impact Attenuators	7.74	Mobility	7.32
PCMS	6.81	Worker Garments	7.07
Sequential Arrow Panel	6.71	Site Housekeeping	6.83

Region 5 Measure

Strengths:

- Temp. Traffic Signals
- Concrete Barrier
- Impact Attenuators
- Pavement Markings

Weaknesses:

- Channelization Devices
- Bicycle/Ped/ADA

RECOMMENDATIONS

The annual Work Zone Safety Audits revealed a number of consistencies, improvements and positive comments. However, substandard quality control issues were also witnessed – some new, some recurring. Work Zone Safety Audit comments, Measure scores and comparative 2012 rankings of the Measures were used to identify this year's TCP Strengths and Weaknesses.

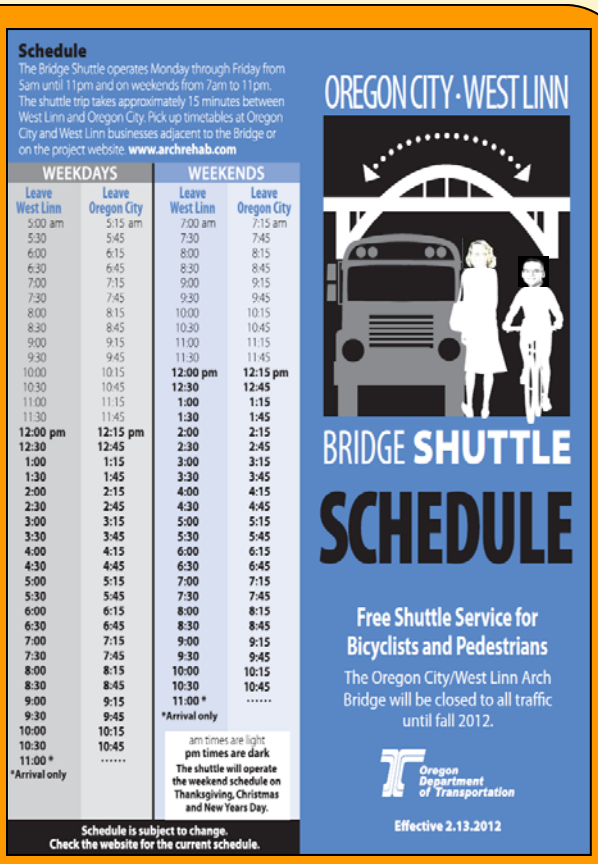
TCP Strengths included Impact Attenuators, Concrete Barrier, Mobility, Temporary Traffic Signals, and Temporary Signing. Weaknesses included Bicycle/ Pedestrian/ADA accommodation, Channelization Devices, Pavement Markings, Flaggers, and PCMS.

Several extraordinary examples of temporary traffic control measures were encountered during the safety audit, as shown below.

MEASURE	Statewide Ranking		+/-
	2011	2012	
TEMP. TRAFFIC SIGNALS	1	1	
IMPACT ATTENUATORS	5	2	+
M O B I L I T Y	3	3	
CONCRETE BARRIER	4	4	
TEMPORARY SIGNING	9	5	+
APPAREL	12	6	+
SITE HOUSEKEEPING	11	7	+
PAVEMENT MARKINGS	8	8	+
SEQUENTIAL ARROW PANEL	2	9	-
FLAGGERS	7	10	-
PCMS	6	11	-
PILOT CARS	NA	12	-
CHANNELIZATION DEVICES	10	13	-
BICYCLE/PED/ADA	13	14	-

Region 3, Kobernik Slide Project. Dedicated bike lane used during construction.

Region 2, Salt Creek Tunnel Project. Using permanent VMS on I5 to warn of closures on OR58.



Region 1, Oregon City Arch Bridge Project. Dedicated shuttle used during construction.

Work Zone Traffic Control Safety Audit "Strengths"

1. *Temporary Traffic Signals*

Temporary traffic signals can be used to temporarily replace a permanent signal, or to control alternating two-way traffic on a one-lane road.

The temporary traffic signals encountered this year appeared to function well and were very responsive to traffic - many using video detection technology to minimize delays for motorists.

A major emphasis today, and a struggling measure of past audits, is for adequate accommodation for bicycles and pedestrians in the work zone. Projects using temporary traffic signals did a very good job of moving motor vehicles, but were less effective in moving non-motorized traffic through the activity area.

TCP Action

Review current temporary traffic signal guidance with regard to pedestrian and bicycle movements and incorporate new/ modified guidance accordingly.

2. *Impact Attenuators*

The purpose of Impact attenuators is to protect vehicles from striking blunt objects (e.g. barrier ends) present in the work zone.

During this year's audit, all blunt objects were protected using attenuators, with the exception of one case. The presence of proper attenuators, in good condition and properly placed, was a significant improvement over past years. All concrete barrier ends in the work zone should be protected with a Temporary Impact Attenuator, unless other mitigation measures are employed. Existing impact attenuators should be maintained as well.

Where an Impact Attenuator can be a traffic hazard itself (i.e. traffic traveling in the opposite direction is exposed to the rear end (heaviest sand barrels) of the Impact Attenuator), the attenuator should be off-set to minimize the potential for vehicles striking the heavier barrels. Many projects utilized this measure.

TCP Action

The ODOT TCP Unit is developing a new Standard Drawing (TM833) to provide additional guidance and clarity for choosing impact attenuators and for offsetting or realigning temporary impact attenuators under various conditions and work zone configurations.

Work Zone Traffic Control Safety Audit "Strengths"

3. Mobility

ODOT places strong emphasis on Mobility through its work zones. This emphasis is most evident within the recently updated Highway Mobility Manual in the discussion of corridor delay threshold limits.

This year's Audit confirmed ODOT's emphasis on mobility as traffic flow through the majority of the work zones visited was exceptional - including work zones with reduced posted speeds, controlled by flaggers and traffic signals; and, those that included traffic detours.

Minor mobility issues included longer traffic queues without an Advance Flagger and closed roads with substandard detour signing or guidance.

TCP Action

The TCP Unit will revisit current guidance and standards for Advance Flaggers for clarity and detail. The TCP Unit will also continue to support the Highway Mobility Manual and encourage TCP Designers to incorporate the requirements and guidance into their projects.

4. Concrete Barrier

The purpose of concrete barrier is to separate public traffic from the hazards of the work area, as well as providing a safe work space for workers. Barrier is typically placed on the ground, unrestrained. In constrained locations, it can be pinned to minimize deflections. A 3-ft clearance behind unpinned barrier shall be maintained to allow for deflection.

During this year's audit, most of the barrier encountered was in good shape with ends properly protected. More than one project in eastern Oregon omitted the use of concrete barrier and mitigated the exposure of traffic to the work area using a clear zone and lane closures. Most projects maintained a clear area behind barrier, allowing the barrier to function as intended.

TCP Action

From the new Federal MAP-21 policy, "positive protection" (barrier) will be required when workers do not have an escape path (i.e. work on bridges, in tunnels). The TCP Unit will notify its constituents of the new requirements and guidance, and incorporate the information into the 2013 TCP Design Manual update.

Work Zone Traffic Control Safety Audit "Weaknesses"

1. Bike/Pedestrian/ADA

The MUTCD and ODOT TCP Design Manual include standards requiring construction projects to include pedestrian accommodation at the same (or better) level as the existing facilities, or provide appropriate alternatives.

Historically, the Work Zone Safety Audits have yielded the poorest scores for the Bicycle/ Pedestrian/ADA accommodation measures. In general, comprehensive pedestrian accommodations are not seen in the projects being reviewed. Some effort is being made, but not consistently, and not in accordance with all MUTCD and ADA requirements and intentions.

Other observations include placing bicycles in a travel lane with 55 mph traffic, gravel sidewalk ramps, and pedestrians walking or bicyclists riding through the activity area on the contractor's side of devices.

TCP Action

The TCP Unit has recently added the Pedestrian Channelization Device (PCD) into the Special Provisions, by default. The TCP Unit will monitor this action and encourage TCP Designers to provide quantities and details for the device in their projects, when applicable. The TCP Unit will comprehensively review current bicycle/pedestrian/ADA requirements, practices, and guidelines, and consider the needs of pedestrians to meet current standards.

2. Channelization Devices

Channelization Devices are used to warn and guide traffic through the work zone. Channelization devices are basic devices but can have a dramatic effect on how motorists interpret and behave in the work zone.
Reviewers observed a variety of issue s regarding channelization devices, including:

- Device spacing greater than specified.
- A lack of maintenance (alignment).
- Poor quality and condition.
- The absence of devices where a need was perceived to separate liver traffic from workers and an active work area.

Specific projects identified were those with longer active work areas where:

- Very long queues of traffic were led by pilot cars, or
- Traffic was uncontrolled between flagger stations.

In these instances, the placement of channelization devices (e.g. tubular markers) along centerline would improve guidance for drivers as they pass through the active work area.

TCP Action
The TCP Unit will begin discussions for the idea of disallowing "written" projects that only use specification language and Standard Drawings to design and describe the TCP. Standard Drawings would be used as a template for the TCP (and could be included in the contract), but plan sheets would be needed to represent traffic control measures and identify construction staging details. A long-time issue centers on the misuse, misinterpretation and misapplication of the details within the Standard Drawings. Without project-specific plan sheets, it is difficult to guarantee the appropriate detail(s) from the Standard Drawings will be consistently applied to specific work activities.

Work Zone Traffic Control Safety Audit "Weaknesses"

3. Pilot Cars

Pilot Cars (with Flaggers) are used for two-way, one-lane traffic operations where Flagger stations are placed more than ½ mile apart and where traffic speeds should be regulated through the activity area.

Problems with the pilot car operation itself were observed on a few occasions. For the most part, pilot car operators performed well and regulated the speed of the queues. However, several projects using pilot cars did not include channelization devices to separate traffic from the work zone, as would be required by current specifications or Standard Drawings. A few reviewed projects could have benefitted by using pilot cars in conjunction with flaggers.

TCP Action

The TCP Unit will provide additional guidance to its statewide design and construction audience regarding the inclusion and use of Pilot Cars within the traffic control plan.

4. PCMS

Portable Changeable Message Signs (PCMS) are used to convey work zone related messages to the travelling public.

PCMS deficiencies included confusing messages, flashing messages, messages with too much information, malfunctioning units, improper use, and poor placement of the PCMS. An improper, incomplete or ambiguous message renders the PCMS useless and can have an impact on traffic safety in the work zone.

TCP Action

The TCP Unit is currently developing a new PCMS Guidelines Handbook to determine when to use a PCMS and to develop more effective, consistent messages and maximize the value of a PCMS in a work zone. The new handbook will incorporate the latest national research to make PCMS's more effective and provide users with an easy-to-use guide.

Work Zone Traffic Control Safety Audit

Traffic Control Supervisor (TCS)

For the fourth consecutive year, measure scores were examined to determine if the average score of a given performance measure was affected by the inclusion of a TCS in the contract. Based on Figure 7, it is marginally conclusive that the inclusion of a TCS results in higher performance measure scores. Over a four-year period, from 2009 to 2012, 74 of 124 (60%) measure scores were higher when a TCS was included in the project. This data does not take into account that TCS are generally reserved for complex projects or projects with frequent changes in traffic control. Based on 2012 scores, it appears TCS were more effective this year than in previous years.

Note: For key measures involving traffic control devices, the results shown in Figure 7 were extracted from the results of the Evaluation Forms and the participants' scores.

Figure 7 -TCS

MEASURE	TCS	NO TCS
TEMPORARY SIGNING	7.21	7.14
CHANNELIZATION DEVICES	7.16	6.69
PAVEMENT MARKINGS	6.71	7.09
CONCRETE BARRIER	6.81	7.64
IMPACT ATTENUATORS	7.27	7.65
PCMS	6.77	6.97
SEQUENTIAL ARROW PANEL	6.90	7.09
TEMP. TRAFFIC SIGNALS	7.43	7.54
BICYCLE/PED/ADA	6.25	6.41
FLAGGERS	7.33	6.90
PILOT CARS	8.08	6.49
MOBILITY	7.57	7.49
WORKER GARMENTS	7.14	7.07
SITE HOUSEKEEPING	7.12	7.06

Plans vs. Standard Drawings

For 2012, measure scores were examined to determine if the average score of a particular performance measure was affected if a project included project-specific contract plan (TCP) sheets and Standard Drawings, or included only Standard Drawings. Based on Figure 8, it is marginally conclusive that the inclusion of TCP sheets resulted in higher performance measure scores. Ten of the 14 measure scores were higher when TCP were developed and included in the project. Data does not take into account that project-specific TCP sheets are generally used on projects with multiple stages, detours and/or a complex scope of work.

Note: For key measures involving traffic control devices, the results shown in Figure 8 were extracted from the results of the Evaluation Forms and the participants' scores. For concrete barrier and temp. traffic signals, plans are required to show the details as supported by the data in Figure 8.

Figure 8 - Plans

MEASURE	PLANS	NO PLANS
TEMPORARY SIGNING	7.21	7.07
CHANNELIZATION DEVICES	7.14	6.18
PAVEMENT MARKINGS	6.97	7.16
CONCRETE BARRIER	7.49	--
IMPACT ATTENUATORS	7.43	9.00
PCMS	6.81	6.66
SEQUENTIAL ARROW PANEL	6.96	7.17
TEMP. TRAFFIC SIGNALS	7.56	--
BICYCLE/PED/ADA	6.43	6.36
FLAGGERS	6.87	6.93
PILOT CARS	7.54	6.31
MOBILITY	7.54	7.36
WORKER GARMENTS	7.21	6.83
SITE HOUSEKEEPING	7.20	6.92

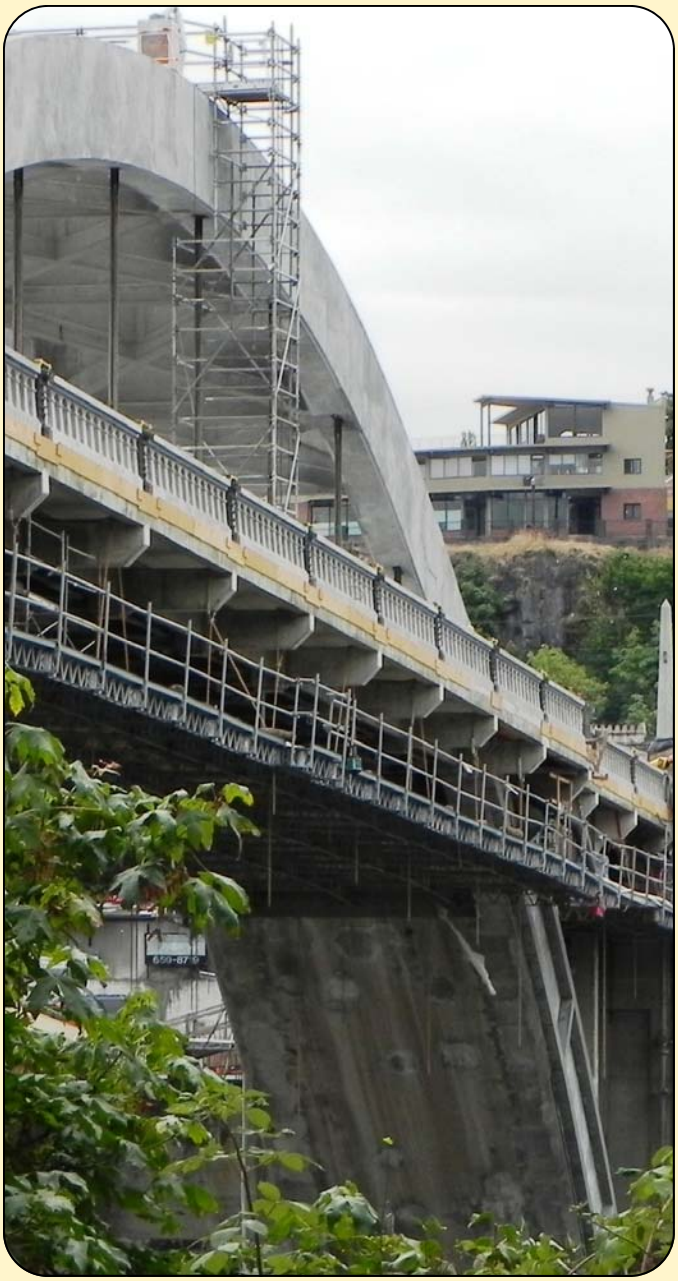
CONCLUSION

The 2012 Work Zone Safety Audits were again a success in identifying strengths and weaknesses within ODOT's TCP standards and practices and the implementation of those practices in our contracts. The Audits gave us the opportunity to review 29 different State highway construction work zones and collect over 3000 pieces of data. Overall, we witnessed a small increase in the work zone safety audit scores.

The Audits helped us meet some important goals:

- Confirmed ODOT Temporary Traffic Control Design Standards and Practices are largely being implemented in the field with consistency and uniformity.
- Confirmed the latest Standards and Practices are effective at providing a satisfactory level of safety for the traveling public and construction workers.
- Revealed additional techniques and technologies needed to improve overall safety, traffic flow, and construction efficiency.
- Strengthened communication and working relationships between ODOT design and construction staff, consultants, and contractor employees.
- Identified current standard practices that need updating based on observations and feedback.

An important additional benefit from the Work Zone Safety Audits is seeing recurring "Weaknesses." We can focus on and more closely analyze these features for solutions to improve the overall design and implementation of our work zone traffic control plans. 'Lessons learned' can be shared between all TCP designers and construction personnel in efforts to avoid seeing repeat "Weaknesses".



The Traffic Control Plan Unit would like to thank each of the Reviewers who helped with the monumental task of improving safety in Oregon work zones. Thank You.

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