AASHTO SCOTE Listserve survey results

Subject: Lane Reduction Arrows
Date of initial survey request: December 14, 2016
Date of summary: December 28, 2016
No. of states responding: 28
Original request by: Bill Lambert, New Hampshire

State	No. of arrows	Link to Standards	Comments
Alabama	3-5		Alabama's standard drawing is a duplicate of Figure 3B-14. I have searched a lot of reduction locations on conventional roads in our state but cannot find where we are using the arrows in lane reduction situations. We do have several interstate lane reductions (and a few of the infamous recovery lanes just beyond exit gores) where we are using the lane reduction arrows and most of those locations are on spacings ranging from 450'-900' with as few as 3 sets of arrows with a 'merge' legend up to as many as 5 merges/arrows.
Alaska	3	http://www.cityofsitka.com/government/departments/publicworks/documents/AKTrafficManualSupplement.pdf	Alaska has no requirement to use the arrows, but since 2005 our recommended practice (guidance statement) is based on the drawing below. While the illustration indicates three arrows, I cannot locate that number in writing. See Figure 2B-100 in attached link.
Arizona	2	http://azdot.gov/docs/default-source/businesslibraries/m-04-June-14.pdf http://azdot.gov/docs/default-source/businesslibraries/M-15d-June-14.pdf	While neither of these are exactly like the situation described, the drawings do show ADOT practice for these markings. In both cases, two arrows are generally used. I think I recall a third arrow might have been used in some lane reductions, but I'm not recalling specific locations.
Arkansas	3		Just a rule of thumb for me Bill, but I usually space them out at about a 300' interval, so in a 990' lane I'd use 3.
California			
Colorado			

Connecticut	2-3	CTDOT TR-1201_01 CTDOT Proposed Lane Reduction Detail CTDOT Proposed Freeway Lane Reduction Detail	At this time CTDOT only installs lane reduction arrows on divided highways. Department installs 3 arrows spaced 300' apart starting 900' in advance of the end of the lane. Detail "H" on the attached Standard Sheet TR-1210_01 shows arrows spacing and placement. Our office has proposed a new detail for installation of lane reduction arrows on non-freeways. The detail will require placing two arrows spaced based on MUTCD Table 2C-4. The arrows will be required for roads with posted speeds of 45 mph or greater and will be optional for lower speed roads. Proposed non-freeway arrow spacing and placement is shown on attached "Proposed Lane Reduction Detail". In addition, Department is proposing to revise existing details and add new details for lane reduction on divided highways. The details will continue to include placing 3 lane reduction arrow 300' apart, but first arrow placement will based on MUTCD Table 2C-4. Proposed details are also attached in "Proposed Freeway Lane Reduction Detail" file.
Delaware	2-4	http://www.deldot.gov/information/pubs_forms/manuals/de_mutcd/pdf/Part3-Markings-December-2012-FINAL.pdf	See link for specific criteria
Florida	2	See below:	FDOT uses the same design as the MUTCD for the lane reduction for taper lengths and a slightly modified approach to the signing and pavement markings.
Georgia			
Hawaii			
Idaho			
Illinois			
Indiana	n/a		INDOT's Design Manual refers back to the MUTCD section you cite. Since we have no construction standards it is up to our designers or the district traffic office to determine the number and spacing within the parameters set by the MUTCD. The recommended spacing does seem overly busy to us as well; we think it's worth looking into.
Iowa	2		We have installed the merge arrow pavement marking in a few

			locations on a permanent basis. We only use two arrows
Kansas			
Kentucky	3		In Kentucky, lane reduction arrows are optional. We would primarily utilize this option on high-speed facilities. If lane reduction arrows are used, our policy manual suggests using three (see below drawing). We are currently in the process of updating this drawing as it was developed before the arrows were shown on the MUTCD drawing. Our new drawing will still show 3 arrows but will not include an arrow at the RIGHT LANE ENDS sign. We will continue to use the two arrows at the location of the W4-2 sign and the end of the lane lines. However, the location of the 3rd arrow on our new drawing will be a distance of ¼d downstream of the end of the lane lines. This will keep the spacing between our markings consistent (¼d), plus include an arrow in the area with no lane lines (as is currently shown in the MUTCD Figure).
Louisiana	2	http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Standard_Plans/Standard%20Plans/Signing%20and%20Pavement%20Markers/PM-06.pdf	
Maine	2		Bill we use 3B-14 to lay out our lane reduction arrows. We only use 2 and we adjust locations using engineering judgement on shorter truck lanes as some of the prescribed distances put the arrows at the beginning of the truck lane. We find that to be counter-productive to what we are trying to achieve with the lane. We have also had several complaints regarding them being wasted money and why are we doing it. I wouldn't recommend doing more than two, it will be very busy looking if you do.
Maryland			
Massachusetts	2, sometimes 3		Here is our opinion, regarding Bill's question on the number of arrows needed, is that Figure 3B-14 does not specify where the lane-reduction arrows are to be placed. The dimension lines for 'd' show the placement of the warning sign relative to the start of the taper. The longitudinal positioning of the arrows does not appear to be

			addressed anywhere in the text of the MUTCD, and the figure itself is titled "Example". District 6 has been installing the arrows in numerous locations, both in projects under design and with maintenance contracts. We have experimented with various patterns, using anywhere from 2 to 4 arrows, and with spacing of either 80 or 120 feet (for ease of layout). Based on subjective opinions from driving past installed locations, it seems the optimal layouts are: • Mainlines - Three arrows, with the middle arrow in-line with the next-to-last BWL segment. • Ramps with lane reductions - Two arrows, with the upstream arrow in-line with the next-to-last BWL segment. • Long acceleration lanes on mainlines, where installing the arrows could be useful to drivers - Either 2 or 3 arrows, depending on the length of the acceleration lane. The last arrow is typically placed just before the taper begins. For high-speed applications (45mph+), the arrows are spaced at 120'. For lower speeds (Examples: AETS Demolition projects (607582 Weston, 608509 Allston, 608510 Ted Williams); Route 2 at Route 3/16 in Cambridge; I-95 NB at Route 30 in Weston; I-93 to Route 3 at Braintree Split.
Michigan	2		In Michigan we install two lane-reduction arrows at such sites, with one located at the end of the lane line markings and the other just before the start of the physical taper as shown in the MUTCD drawings. Per Section 3B.09 (10) the pavement markings are supplemental to the signs at lane-reduction transitions, and since the lane-reduction arrows are supplementing a single sign (W4-2) we feel two arrows add sufficient emphasis. While the resulting spacing does

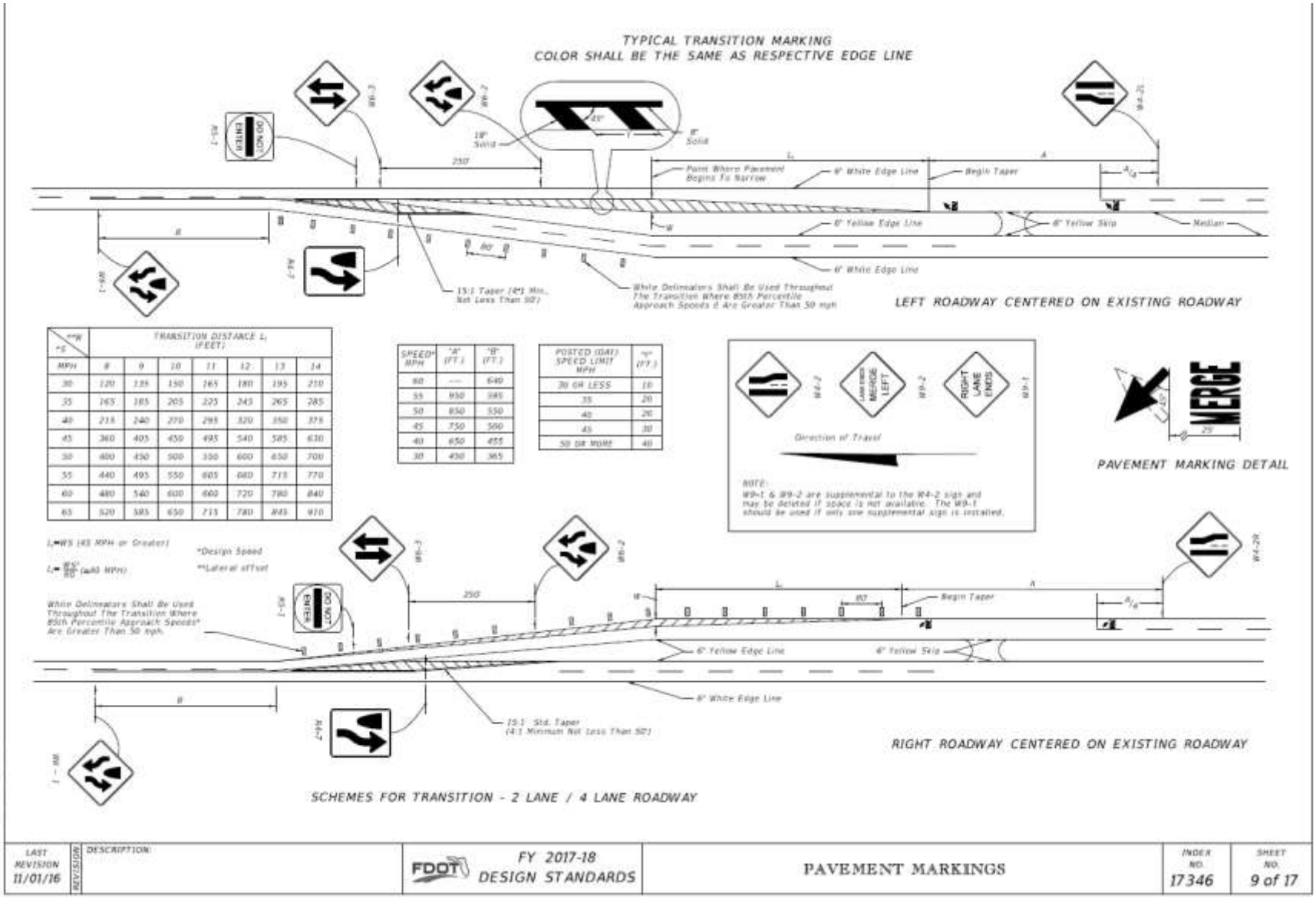
			not meet the "Guidance" language of Section 3B.20 (08), all "Standard" language regarding the markings is still satisfied.
Minnesota	2		In Minnesota we use two arrows. In low speed urban roadways, the marking are optional (engineering judgement).
Mississippi	2		For a lane reduction Mississippi would typically use two arrows. I agree that 5 or 6 would be excessive but could be a factor of roadway characteristics & volume.
Missouri	2, no more than 3		We do not have any standards of our own at this time, but typical installations are a minimum of two and normally no more than three depending on the length of the lane. For the most part we are only using them on entrance ramps where we have lane drop on the ramp before entering the mainline roadway, I don't think we have used any on climbing lanes / passing lanes at this time. And the applications we do use them on are unusual cases where it may not be clear the lane drops due to a horizontal curve (first image) or a shorter than expected lane that has limited merging distance (second image), locations where the standard lane ends warning sign series needs some enhancements to work more smoothly. As you pointed out, not popular as a commonly used marking due to maintenance reasons of wear and difficult lane drops in these locations to place and refresh the markings. Essentially, we do not use these in standard applications, but as a special need application.
Montana			
Nebraska	2		We don't use them as a standard, but when we have typically we'll start with just the two as shown in the MUTCD. We do have one location on the interstate with 5.
Nevada			
New Hampshire			
New Jersey	2		Lane reduction arrows aren't widely found in NJ but their use is on the upswing. We typically follow Figure 3B-14 and use 2 arrows but we have used a 3rd under extended lane length scenarios.
New Mexico	1-3	NMDOT – Gore Striping and Geometric Details for Entrance and Exit Ramps	

New York	n/a		The two arrows in Figure 3B-14 are not the definitive number and are only there as an illustration. The actual number of arrows will depend upon Section 3B.20 (08) and "d". The number of arrows will be minimized if you use a spacing of ten times the height of the marking (i.e. bigger spacing) and the advance warning distance "d" is lower (i.e. less distance to cover). If a lane reduction arrow is 18 ft in length, d= 990 ft and we use the 10 times the height rule, then the spacing would be 180 ft. That would result in at least 5 arrows. If we used the minimum 4 times the height of an arrow, then the spacing would be 72 feet and you would have about 13 arrows. Still think 5 or 6 are a lot. The formula is a sliding scale in some ways depending upon what you pick for an arrow spacing and what the advance sight distance that is needed.
North Carolina			
North Dakota			
Ohio	2		In Ohio, the typical practice is to use two arrows, as shown in MUTCD Figure 3B-14.
Oklahoma			
Oregon	2-3		Oregon DOT's current policy (available here) is two lane reduction arrows should be used similar to MUTCD Figure 3B-14 where the posted speed limit is 45 mph or more. We include a third optional lane reduction arrow half-way between the arrows at the beginning and end of the lane reduction area. We've found the optional middle arrow can be good where the lane reduction transition is at a crest vertical curve and on freeway-speed lane reductions with long transition areas (good interstate examples here and here; another example where the designer only used two where three might have been nice is here). Given the size and maintenance needs of these arrows, 3 seems like a good maximum. 5-6 arrows would be too much of a good thing. Because Figure 3B-14 shows this specific scenario with two arrows that are clearly more than 10x the arrow height apart, we think recommending 2 arrows to our designers meets the recommendation in MUTCD 3B.20 paragraph

			34. Our crews maintain these more often in snowplow areas, especially in our Cascade mountains and other high-elevation passes (examples here, here, here, here, here, and here), just like any other arrow hit with plows, studs, and gravel. We've been talking about recessing these below the pavement surface similar to our longitudinal lines but have yet to do an installation. In particularly bad winter damage areas, we've omitted the arrows on a case-by-case basis.
Pennsylvania			
Rhode Island			
South Carolina	2		In South Carolina we traditionally use 2 lane reduction arrows in a lane drop situation. On non-interstate routes, we typically place the arrows about 200 feet apart with the first arrow being approximately 300 feet (last arrow 100 feet) before the beginning of the taper for the reduction. On interstate routes, we still only use two arrows. The arrows are typically spaced 300 feet apart with the first arrow approximately 600 feet (last arrow 300 feet) before the beginning of the taper for the reduction.
South Dakota			
Tennessee			
Texas	2		
Utah			
Vermont	3		
Virginia	2		We do not have any official policies beyond what is in the MUTCD regarding lane reductions, except that Section 3B.09 of the Virginia Supplement of the MUTCD states that Lane Reduction Arrows (LRAs) shall be used in lane reductions on roads with speed limit ≥ 45 mph. Most Virginia lane reductions generally have 2 LRAs, consistent with what is depicted in Figure 3B-14, though the specifics may of course vary based on site-specific conditions. Spacing LRAs every 170~180

			feet apart, as suggested by Section 3B.20 para 08, would appear to be excessive on 55+ mph lane reduction with no glaring sight distance or crash history issues. Hope this helps
Washington			
West Virginia			
Wisconsin	3		
Wyoming			
Other:			
Jim Powell		Lane Transition Possibilities 20Jn2014v2	

Florida:



*S / **W	TRANSITION DISTANCE L (FEET)						
MPH	8	9	10	11	12	13	14
30	120	135	150	165	180	195	210
35	165	185	205	225	245	265	285
40	215	240	270	295	320	350	375
45	360	405	450	495	540	585	630
50	600	450	500	550	600	650	700
55	440	495	550	605	660	715	770
60	480	540	600	660	720	780	840
65	520	585	650	715	780	845	910

SPEED* MPH	"A" (FT.)	"B" (FT.)
60	---	640
55	950	385
50	850	550
45	750	500
40	650	455
30	450	365

POSTED (OAT) SPEED LIMIT MPH	"Y" (FT.)
30 OR LESS	10
35	20
40	26
45	30
50 OR MORE	40

LAST REVISION	REVISION	DESCRIPTION:	FDOT		INDEX NO.	SHEET NO.
11/01/16			FY 2017-18 DESIGN STANDARDS	PAVEMENT MARKINGS	17346	9 of 17