TECHNICAL MEMORANDUM

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DIAGNOSTIC STUDIES OF HIGHWAY VISUAL COMMUNICATION SYSTEMS

HPR-2(108)

PILOT SITE NUMBER 1

STATE HIGHWAY 10 LITTLE ROCK, ARKANSAS

TM2(108)-1

INTRODUCTION

The "Diagnostic Studies of Highway Visual Communications System" research project has been designed to: (1) review the current practices in visual communications with the automobile driver using a multidiscipline team approach; (2) identify the deficiencies in these practices and (3) recommend changes in the existing standards. Pilot studies were conducted in three states (Arkansas, California, and Maryland) in order to develop the diagnostic study techniques and to acquaint the members of the Project Policy Committee with these procedures. This memorandum is a detailed report on the results of the diagnostic team review of sites within these states. The opinions expressed are those of the diagnostic team and not the recommendations of the research staff. The results of pilot studies and the improvements recommended by the staff will be combined as an interim report to be published in the near future.

DESCRIPTION OF STUDY PROCEDURES

The diagnostic evaluation of the study site was conducted using both the driver interview and open-end questionnaire techniques. Each member is asked to drive a route following the instructions of the interviewer. The route included short sections on adjacent facilities as illustrated in Figure 1. The driver was asked to comment on the roadway section as he drove and these comments were recorded. The interviewer asked questions only as necessary to keep the converstation productive. At the conclusion of each driving phase (night and day), the subject was asked to complete a questionnaire. The interviews and the comments on the questionnaire are the basis of the material presented in this memorandum.

STUDY SITE CHARACTERISTICS

Pilot Site Number 1 is located on Arkansas State Highway 10 approximately fifteen miles West of the City of Little Rock, Arkansas. The study section begins at a point approximately five and one-quarter miles West of the intersection with Arkansas State Highway 300 and continues to a point one-half mile West of the intersection of Arkansas State Highway 113. The study section is rural in nature throughout its length of approximately six and one-half miles with no development along the roadway proper. The study site runs along the South edge of Lake Maumelle and entrances to two marinas are within the site limits. Along with these two marina entrances, the study section is also intersected by Arkansas State Highway 113.

Arkansas State Highway 10 along this section is a thirty foot basic roadbed consisting of two eleven foot through lanes and unpaved grass covered stabilized aggregate shoulders varying in width from two feet to eight feet. A substantial proportion of the roadway section has effective shoulders of four feet or less. The three major intersections along the study section are Jim's Landing, Maumelle Harbor and Arkansas State Highway 113. The intersection with Jim's Landing is channelized and the State Highway 113 intersection is of the old Y-type design. In addition to these intersections, there are approximately three other intersections along the study section.

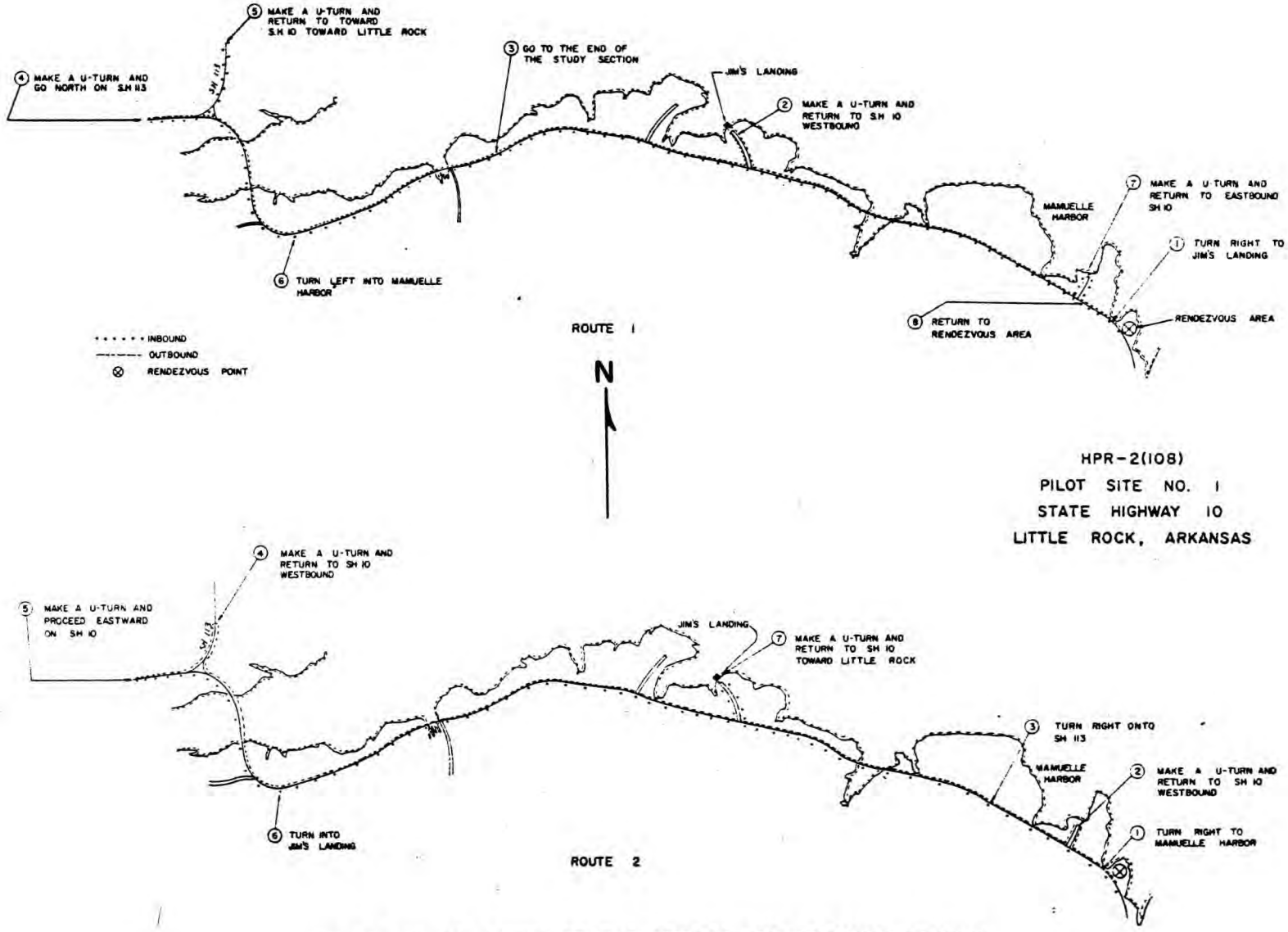
The pavement markings consist of a center line and edge lines that are located approximately one foot from the pavement edge. Spot delineation is provided at a few points primarily by wooden guide posts with reflective sheeting.

All signing along the study section is on the right side of the roadway. Directional signing is used for the State Highway 113 intersection, but none existed for the two marina intersections. As Arkansas State Highway 10 has also been designated as the Ozark Trail, two separate route markers designate the route number and name.

The existing ADT is approximately 1,700 vehicles per day. The average running speed in the study section is 58 miles per hour - the posted speed limit is 60 miles per hour.

The six month accident record (Jan. - June, 1968) shows five accidents of which two resulted in personal injury. Two accidents were caused by drivers crossing the center line into the opposite lane. One accident occurred when a driver struck a bridge. Four of the five accidents occurred during daylight hours and four occurred on dry pavement. The apparent accident rate was 2.75 accidents per million vehicle miles.

A strip map of the study section is presented in Figure 1.



STRIP MAP OF STUDY SITE 1 INDICATING DRIVING ROUTES
FIGURE 1

DIAGNOSTIC TEAM REVIEW

HPR-2(108)

PILOT SITE NO. 1 - SH 10 - LITTLE ROCK, ARKANSAS

GENERAL COMMENTS

The team review of the site indicated that the design standards for the study section were not consistent with the environment. A major rural highway would be expected to have geometrics sufficient to permit safe operating speeds of 60 to 70 mph and the study section appears to have been designed on a 50 mph criteria. Also, the cross section is very narrow.

Another factor which contributes to the problems in the study section is the fact that the sections of roadway on either side of the study site appear to have been constructed to a higher standard than was the study site. The driver has no indication of a substantial change in the safe operating speed and thus could unknowingly be lured into a potential accident situation.

Improvement of these conditions would entail a considerable amount of redesign and heavy reconstruction. Such major modifications do not fall within the scope of this project and are included in this report for information purposes only.

SUGGESTED DESIGN IMPROVEMENTS

The following suggestions for design modifications are based on driver response to the existing design. In each case, several drivers reported that they were confused by the existing design or the existing configuration which resulted in a misinterpretation of the design.

Jim's Landing and Maumelle Harbor intersections are confusing, difficult to drive, and in the case of Jim's Landing, unaccessible from the West. A redesign of these intersections would be required in order to obtain reasonably smooth operation. The deceleration lane on the East approach to Jim's Landing could be extended so as to provide the driver with a clear view of the lane in sufficient time to respond. The vertical curve at that point severely restricts the driver's view of the lane.

The intersection with State Highway 113 is of the old Y-type design and results in considerable driver confusion as to proper turning maneuvers and a very flat (virtually head-on) merging situation. The right-of-way assignments are vague or non-existent and it was suggested that the intersection be redesigned as a "T" intersection.

The lack of adequate shoulders was of concern to technical and non-technical drivers alike. The existing shoulder does not appear to be stable in wet weather and a driver needing to stop would probably hesitate in pulling

off the roadway. It may, therefore, be desirable to provide paved emergency parking areas where space permits throughout the study section.

The location of the guardrail was referred to several times by the diagnostic team members. It was suggested that the existing guardrail installations be reviewed for adequacy. The first consideration should be; would the area be just as safe or possibly safer without the guardrail. Consideration should then be given to the beginning point of the rail. Several points were noted where safer operation could probably be obtained by beginning the guardrail somewhat sooner.

SUGGESTED OPERATIONAL IMPROVEMENTS

Signing - The problem of providing adequate directional signing for Jim's Landing and Maumelle Harbor (both private marinas) was discussed in some detail. The concensus seemed to be that some type of signing should be provided and the sign "MARINA" seemed to be favored for both situations, although it was recognized that it would not provide the motorist with adequate information. An alternative suggestion was made to simply add an informational plate to the intersection warning sign installations indicated "JIM'S LANDING RD." and "MAUMELLE HARBOR RD." respectively.

Another area of concern, particularly to the non-technical subjects, was the lack of cardinal direction plates on route markers and at intersections. It was suggested that cardinal direction plates be added.

The relative size of the Ozark Trail markers in relation to the size of the state route markers and the locations of these markers in the installation were of concern. It was suggested that the State Highway route markers were the most important and, therefore, should be at the top of the sign installation and should be at least as large as, if not larger than, the Ozark Trail markers. There was one suggestion that the Ozark Trail markers be removed.

Both groups of subjects noted the placement of signs on a horizontal curve where they were fully occupied with the driving task. In one instance a "Stop for School Bus" sign was located on a tight curve and the driver left the roadway attempting to read the message. It was, therefore, suggested that this type of installation be carefully reviewed to determine if the information could not be presented at some other point along the roadway and be equally effective or possibly removed altogether.

Delineation - The proximity of the guardrail to the through roadway makes positive guardrail delineation very important. The team did not feel that point delineation of the ends of the guardrail would be adequate and suggested that some form of continuous guardrail delineation be used.

It was also noted that the edgeline was very important on this site due to the narrow roadway section and lack of paved shoulders. The edgeline appeared to be much "duller" than the centerline and nonpassing zones. The edgeline should be maintained with the same frequency as the other pavement markings.

The approaches to the rather narrow bridges were of concern to several observers during the night phase of the study. A recommendation was made that a pattern of crystal post mounted delineators be placed in advance of each structure which would give the illusion of funneling the driver into the narrow opening.

The centerline appeared to be the most important element to most of the drivers at night and, due to the narrow roadway, should be made to stand out to the greatest degree possible. Observation of the study driver's behavior on curves and observation of traffic on the roadway indicate that there is a tendency to cross over the centerline while negotiating the curves. A raised crystal pavement marker placed on every other centerline stripe would serve to emphasize the centerline and give the driver a more accurate impression of the roadway geometry. Also, the raised marker might tend to remind the driver that he is over the centerline of the roadway. The no passing zones might be similarly treated with yellow markers for added target value. This suggestion would have merit only if the frequency of snow and ice removal operations is extremely low.

Speed - The posted speed limit of 60 mph appears to be excessive and the team felt that consideration should be given to reducing the speed limit to 50 or 55 mph particularly at night. The inconsistency of having a 50 mph design on the state primary system has been discussed previously.

Maintenance - The driver interview summaries reveal the fact that several signs were dead at night; signs often were poorly located either with respect to the roadway element to which they apply or with respect to the amount of time the driver has available to process the information provided; hazard boards are located behind guardrails or well off the through roadway; a variation in the brightness of the reflective sheeting used on guide posts; sign copy too small for adequate visibility; and very rough pavement patches.

GENERAL SUMMARY

The most notable feature of this study section was the placement of the guardrail. The closeness of the guardrail with respect to the edge of the pavement made most drivers feel uncomfortable while driving through a guardrail section.

The design of major intersections along the study section was also noted. The turning manuevers at two of the intersections were confusing to the driver.

Signing on the study section was also frequently noted by the team. The location of signing on horizontal curves was of major concern to most team members. It was also suggested that signing be added for the two marinas. The relative size of the Ozark Trail sign as compared to the route marker was noted, and it was the general opinion that the Ozark Trail sign should be secondary to the route marker.

LIST OF APPENDICES

APPENDIX "A"

DESCRIPTION OF THE STUDY PROCEDURES

The diagnostic evaluation of a study is conducted in four separate phases:

a. Preliminary session
b. Day driving phase
c. Night driving phase
d. Diagnostic team review

The preliminary session is designed to introduce the interdiscipline team to the objectives of the study and to explain the study procedures. The diagnostic questionnaire is presented to the team and discussed with them. The explanation of the questionnaire concentrates on the fact that it is not designed to obtain a particular response from them but rather it is designed to direct their thinking into a particular area and thus elicit comments which the individual might care to make.

The day phase of the on-site review begins on the afternoon of the first day of the study. The diagnostic team members are transported to the rendezvous point at one end of the study section. Two cars are used in the driver interviews and, upon arrival at the study site, the number one drivers begin their driving runs with the other team members remaining in a car stationed at the rendezvous point. The driver is given instructions well in advance of the required maneuver and his comments regarding the communications systems provided are recorded on a portable tape recorder. The comments are tied to the roadway through reference markers located at the roadside. The marker numbers are read and recorded on tape as each is passed. After completion of the driving run, the team member moves to an observer position and the second driver begins his driving run. A different route is driven by the second driver. Errors made during the driving phase are corrected as soon as it is practical to do so. When both the driver and observer runs are completed, the team member is asked to complete the diagnostic questionnaire on the daylight phase. The process is repeated until all team members have served as a driver and as an observer.

The night phase is conducted in the same manner as the day phase and is held on the evening of the first day of the study.

The morning of the second day of the study is devoted to a team review of the study site. Problem areas are identified and suggestions regarding possible solutions are discussed. The team is not asked for a concensus of opinion on the improvements which should be made on the study site. Rather, all ideas are explored regardless of how many or how few of the team members might support them.

The comments made on the diagnostic questionnaire and the summaries of the driver interviews are the basis of the Technical Memorandum on the study site which is the formal report of the opinions expressed by the team.

APPENDIX "B"

SUMMARY OF DIAGNOSTIC QUESTIONNAIRE

PILOT SITE NO. 1 - S.H. 10 LITTLE ROCK, ARKANSAS

The following is a detailed presentation of the comments made by the diagnostic team members on the diagnostic questionnaire.

Question: Did you, as a driver, lose visual contact with the roadway at a distance less than your desired distance at any point along the vehicle's projected travel path?

Answer: Yes	No	Comments
x		Restricted throughout by both vertical and horizontal alignment. Both the vertical and horizontal alignment are such that visual contact with road was repeatedly lost throughout the section at repetitive intervals.
x		Apprehension to vertical alignment blockage was initially due to unfamiliarity with vehicle.
x		Roadway vertical alignment between SH 113 and end.
x		Roadway Vertical Alignment. I do not recall the point location; but a few vertical alignments and perhaps on horizontal alignment locations (cut section) was a cause for this.
x		Practically all the hills. Due to short vertical curves I drove 10 mph slower than the speed limit.
		Roadway vertical alignment W.B. to Jim's Landing. V.C. with H.C. near end from W.B. Roadway Geometrics did not appear to fit a 60 mph speed limit. Combined vertical and horizontal curves lacked adequate sight distance.

Question: How would you evaluate the importance of the view of the road, or lack of it, in the driving task?

Answer: /__/ Of little importance /__/ Of some importance

/__/ Relatively important /__/ Critical problem

LI	SI	RI	C	
			x	For comfort of mind and related driving habits, a view of the road on a highway such as this one is absolutely essential.
	x			Type roadway is vital. This site view of road is relatively important, more so than in normal situation.
		x		I thought that alignment on this section of Hwy 10 allowed a very good view of the road which made the curves easier to drive.
		x		This would be especially true for drivers not familiar with the area.
			x	Sight distance too short to provide stopping sight distance or adequate time for decision.
		x		In this case, view of road was of less importance due to relatively low speed and light traffic. With higher speed and more passing maneuvers required it would be a critical problem.
			x	But not as much on this type of road as a high speed facility.

Question: Do you, as a driver (observer), feel that the points of divergency from the traffic stream are obvious in time for the normally alert driver to make a smooth, natural transition to the diverging roadway?

Answer:	Yes	No	Comment
		x	To the unfamiliar driver, the points of divergency were too abrupt without clear advance guidance or modern-day geometric configuration.
		x	On this site, most all points of divergency are normally unseen thereby increasing the importance of communication to the driver in advance of divergency.
		x	The turnoff at Jim's Landing could stand improvement.
	x		There probably should be a clearer marking to Jim's Landing from the Eastbound lane.
		x	Several locations where the side road is not visible in time to act.
		x	Poor sight distance on entering roadways. Location of exits over the crest of vertical curves.

Except entrances to boat docks.

Question: Does obscured visibility along the roadway create any noticeable degree of erratic behavior on the part of the driver?

Answer: Yes	No	Comment
x		Though not classified as "erratic", obscured visibility did cause fluctuations in speed.
	x	Some erratic vehicle control situations were observed but road and vehicle characteristics (smoothness, alignment, etc.) were probably more involved than obscured vision.
	x	
	x	
x		As the driver, I missed a decel lane located over the crest of a vertical curve - had to turn from thru lane. As an observer - the vehicle operator missed a turn locater over a crest.
	x	Not on this type of road.

Question: Does the driver appear to have difficulty in maintaining the vehicle within the lane (i.e. does he tend to encroach on adjacent lanes)?

Answer: Yes	No	Comment
x		Roadway was somewhat narrow with poor shoulder stability; however, lanes were wide enough to permit some lateral displacement. Tight curves tended to cause greater displacement.
x		
x		Any difficulty was the result of highway surface.
	x	The advisory signs for the curves are about right.
x		Narrow shoulders in horizontal curves gives uncomfortable feeling.
x		On some curves the driver encroached on opposite lane when traveling at the speed limit.
x		Pavement too wavy.

Question: Is the normal traveled-way clearly delineated from parking and emergency stopping areas?

Answer: Yes	No	Comment
x		Edge stripe - emergency stopping area almost non-existent.
x		Shoulder not adapted to parking or stopping except in a few well worn places.
x		Parking and emergency stopping areas very limited.
x		Edge stripe
x		Edge line
x		
x		

Question: Does there appear to be any substantial amount of vehicle encroachment on the parking areas?

Answer: Yes	No	Comment
x		There was evidence of potholes at pavement edge which indicated encroachment onto the shoulders.
	x	Mainline travelway did not apparently encroach in these areas.
	x	On Hwy 10 there would be little tendency to do this. The driver is aware to stay away from pavement edge due to narrow unsurfaced shoulder.
	x	
	x	Shoulders too narrow - too steep and not stable.
x		Edge of pavement is well raveled indicating considerable usage.
		Some, but the driver knows that he has to keep the vehicle on the pavement because of the bad shoulder condition.

Question: Are the roadside hazards (bridge abutments, piers, guardrails, sign supports, etc.) removed a sufficient distance from the traveled-way to insure reasonable safety?

Answers:	Yes	No	Comment
		x x	Roadside signs had some tendency toward element of surprise, generally because of vertical-horizontal alignment. Guardrail ends (standup type) were unusual in view or latest standards.
	x		Assuming vehicle stays on pavement, no appreciable interference with driving should be expected. When off surface, there is not much room for recovery.
	x		
	x		The guardrail seems a bit close in places, but the sight distance is usually good enough to offset any potential alarm.
	x		For this type of road - however, for higher type design they would be too close.
	x		In this case there was very light traffic which permitted operation close to the centerline. I believe with heavier traffic I would have tended to operate nearer the pavement edge where obstructions may have been more of a safety factor.
		x x	But the guardrail is placed back as far as possible because of narrow shoulders. The signs would not be as effective if moved out any farther.

Question: What do you feel is a minimum safe distance from the outside edge of the shoulder to an obstruction?

Answer: _____feet

20 feet
10 feet
20 feet
24 feet FOR THIS TYPE FACILITY
10 feet
16 feet
10 feet

Average = 15.7 feet

Question: Does the horizontal alignment along the desired path of travel (particularly reverse curvature) require an excessive amount of driver concentration and thus increase the hazard of other roadway appurtenances?

Answer:	Yes	No	Possibly	Comment
	x			If a driver adhered to 60 mph, he would need all of his concentrated ability to simply retain his place within his lane, leaving no time for other observations.
			x	I felt a little pressure in attempting to maintain proper vehicle placement on this site. Should have been more natural.
		x		Excessive concentration not required possibly because of the low amount of opposing traffic.
			x	The long curve near the west end of the site requires attention at 60 mph.
	x			
			x	With the very little traffic present, this was not too much of a factor. I do not believe this road is comfortable to drive at the 60 mph speed limit.
	x			Poor superelevation.

Question: Is there sufficient advance notification of diverging roadways or turn lanes under light to moderate traffic conditions?

Answer:	Yes	No	Comment
	x		"Yes" as regards highway-highway intersections. "No" as regards to private development. Advance notification more by sight distance than due to signing.
		x	Noticed lack of advance turn arrows at route junctions. Entrance to private areas were of such awkard design that little margin of error in understanding need to turn was available.
		x	Maumelle Harbor and Jim's Landing could be improved. SH 113 was satisfactory but could be improved with larger signs.
	x		Perhaps the side road signs should be refurbished or replaced.
	x		The safe speed signs under the side road sign are not obeyed.
		x	Intersecting roadways do not have adequate advance signing.

	x			But the copy on destination signs at SH 113 is too small.

Question: Is there sufficient advance notification of diverging roadways or turn lanes under heavy traffic conditions (i.e. limited land change capability)?

Answer:	Yes	No	Probably	Comment
	x			Same as 1 - hard to evaluate since only light traffic was in evidence on test section.
	NA			
	x			It would have to be worse with more traffic - even though we didn't see any.
			x	We did not observe under heavy traffic conditions.
	NA			
		x		
			x	For this type of road

Question: Where lane assignments are indicated, are the assignments clear and easily understood?

Answer:	Yes	No	Comment
	x		Not really applicable to two lane highway.
	NA		
	x		Not indicated. At the junction of SH 10 and 113 the signs are dead at night (eastbound direction).
	NA		
		x	The one added turn lane I saw did not have advance notifications. Channelization at one intersection was confusing.
	x		This really does not apply.

Question: Do the existing lane assignments result in an unnecessary lane change (i.e. indicate a change to another lane when both lanes continue in the desired direction)?

Answer:	Yes	No	Comment
		x	Not applicable to two lane highway.
	NA		
		x	None indicated.
		x	
	NA		
	NA		
	NA		

Question: Is the exit ramp, turning roadway or turn lane clearly identified and outlined?

Answer:	Yes	No	Comment
	x		Not really applicable to two lane highway turn lanes at intersections were not well marked or outlined; however, they were adequate for the type of highway involved.
		x	Inadequate signing - Physical tie with road system not obvious to vehicle driver.
		x	The exit ramp for Westbound traffic at Maumelle Harbor was hidden. It was short and pavement texture change was the indication of a ramp.
		x	The landing entrances are not marked at all well by signs.
	x		By widened pavement at the deceleration lanes are too short.
		x	The one added lane I saw was located over the crest of a vertical curve with no advance notice. There was lane striping in place but not far enough in advance of the turn.
	x		Pavement markings.

Question: When advisory speeds are posted, are they reasonable in light of the downstream geometric and traffic conditions?

Answer:	Yes	No	Comment
	x		Advisory speeds were reasonable - speed zone was too high throughout.
	x		This area of communication was not impressive to me. I really could not evaluate the road speed condition and relate it to judgment posted. By the time I had, I was by the sign.
	x		
	x		About right.
		x	The method of determining the figure or speed to use is questioned.
	x		Advisory speed signs seemed to fit geometrics reasonably well.
	x		But I do not think that these should be placed on side road signs.

Question: Are the directional sign messages clear and concise so as to minimize the possibility of driver confusion?

Answer:	Yes	No	Comment
	x		
	x		Limited application at this site but was apparently sufficient.
	x		
	x		
	x		Letters too small.
		x	Cardinal direction signs missing on route markers.
		x	Legend too small.

Question: In your opinion, is the sight distance to right-of-way control device (signals, stop signs, etc.):

Answer: /__/ Adequate /__/ Questionable

/__/ Inadequate /__/ Critical

A	Q	I	C	Comment
x				Sight distance is a problem throughout section. However, signs were visible as well as could be expected under the circumstances.
x				Not many to judge, but no particular difficulty experienced in this phase of the problem.
x				
x				
x				
x				No stops were required.
x				For this type of road.

Question: Are the control devices located in positions where they are readily apparent to a normally alert driver?

Answer: /_/ Yes /_/ Possibly /_/ Poorly located

Yes	P	PL	Comment
x			
x			They were present in normal locations to my experience.
x			I thought the "stop for school buses" which was located fairly close to the pavement on the inside of a curve was located poorly - other seemed OK.
	x		
x			
	x		No stops were required.
x			

Question: Is there sufficient advance warning of devices which are not readily apparent?

Answer:	Yes	No	Comment
	x		
	NA		
	x		
		x	As I recall, the advisory speed near the landings are only posted near the entrances. If traffic is to slow down, perhaps more advance information should be given.
		x	Side roads need stop ahead signs.
	NA		
	x		

Question: Are the required speed changes accomplished in a manner which minimizes driver alarm and discourages rapid deceleration?

Answer:	Yes	No	Comment
	x		
	x		With exception of missing a directed diverge, speed reduction for route transfer curves was normal.
		x	Drivers going Eastbound on SH 10 slows abruptly to make left turn into Jim's Landing.
	x		Only advisory signs are posted other than the 60 mph speed limit.
	x		
	x		
	x		I mean reducing speed for curves.

Question: Are adequate speed change areas provided so as to eliminate the need for a substantial speed reduction in the through traffic lanes?

Answer: /__/ Always /__/ On occasion

/__/ Usually /__/ Seldom

A	U	O	S	Comment
			x	All intersections should be provided with speed change lanes. Full width, paved or stabilized shoulders would provide for speed change at private turnouts.
NA				
			x	
NA				
		x		There should be safe speed sign on each curve sign.
			x	One speed change lane for an intersecting roadway was not visible to approaching traffic.
NA				

Question: Could sign and/or signal standards be relocated so as to reduce the associated accident potential and still retain an acceptable degree of effectiveness?

Answer: /__/ Yes /__/ Possibly /__/ Probably not

Yes	P	PN	Comment
x			It is doubted whether any reduction in effectiveness would result if signs were displaced laterally to provide greater horizontal clearance.
NA			Although some channelization should be reconditioned since it does contribute to awkward movements that could increase accident potential.
x			Stop for school bus sign mentioned previously.
	x		Probably at the landing entrances.
		x	
x			Signs could be located further out from the pavement edger and still retain effectiveness.
		x	Because of the nature of the road.

Question: Where hazard warnings are provided, can they easily be associated with the hazard involved?

Answer: /_/ Yes /_/ In some cases /_/ No

Yes	I	No	Comment
	x		In some cases hazard boards are located in the middle of the guardrail section. This I could not understand.
x			
x			Sideroad signing and guardrail - main warnings of potential hazard.
x			
x			Ice on bridge signs as an example.
	x		
		x	Intersection warning signs too close to the intersection. "Watch for school bus Loading" sign located just ahead of a vertical curve crest - poor location.

Question: Are warnings provided for hazards which are obvious and for which little if any warning is actually required?

Answer: /_/ Yes /_/ In a few cases /_/ No

Yes	I	No	Comment
	x		See comment under #7 - maybe I was being warned that the guardrail was a hazard.
		x	
		x	I didn't get the sensation of being overly warned.
x			Culverts are marked with hazard markers even though the headwalls are behind guardrail.
		x	
x			Some culverts are marked while the ends of guardrail are not.
		x	

Question: In your opinion, is there a question as to which traffic stream a right-of-way control device applies?

Answer:	Yes	No	Comment
		x	
		x	
		x	Maybe a directional control but right-of-way was clear to me.
	x		Yield sign missing at SH 113.
		x	But there should be a stop or yield sign at the park egress near the west end of the site.
		NA	
		x	

Question: Does there appear to be an excessive amount of informational signing within the right-of-way?

Answer: /__/ Yes /__/ Possibly /__/ No

Yes	Possibly	No	Comment
	x		Meaning Ozark Trail signs.
		x	
		x	Comparable to similar signing in my state. This site is sparse.
		x	
		x	
		x	
		x	

Question: In your opinion, the roadside advertising in this section competes with the traffic control devices for the driver's attention to:

/__/ A marked degree /__/ A limited degree

/__/ Some degree /__/ A very limited degree, if at all

Answer:	MD	SD	LD	VLD	Comment
				x	
				x	Actually, in this section roadside advertising may even benefit drivers operation.
				x	I consider this type signing supplemental in situations similar to that along this study site.
x(Helpful)					On this section of road there are no highway signs for the two access points to Lake Maumelle - both sites are heavy traffic generators during the summer.
				x	Only near the landing entrance.
				x	The advertising signs furnished the directional information to points of interest.
				x	Very little commercial signing.

Question: Are the points of divergency from the traffic stream obvious to the normally alert driver a sufficient time in advance of the necessary maneuver such that a smooth, natural transition to the divergency roadway is possible?

Answer:	Yes	No	Comment
	x		Except at Jim's Landing.
		x	Advance warning signs poorly placed, not far enough in advance of intersection, poor reflectance. Intersection legs confusing.
		x	Requires even more effort than the day run.
		x	Maumelle Harbor hidden at night.
			Not from the eastbound direction at the junction of SH 10 & 113.
		x	At several side roads the roadway of the side road dropped away from the highway and was not visible.
		x	None of the intersecting roadways were considered adequate - either geometrically or with the existing signing and delineation.

Question: Is the normal traveled-way clearly delineated from the parking and/or emergency stopping areas?

Answer:	Yes	No	Comment
	x		Edge Stripe
	x		Emergency stopping areas virtually non-existent.
	x		Only visible area is normal traveled-way.
	x		Edge striping is fading and could be restriped.
	x		Edge stripe is visible in most areas.
	x		Edge lines will soon need repainting.
	x		Edge striping showed up very effectively. Also the grass shoulders stood out more at night.

Question: Are the roadside hazards visible for a sufficient distance to prevent the driver's being startled by them?

Answer:	Yes	No	Comment
	x		I think the driver expects hazards on this type of road and adjusts to the situation.
	x		
	x		There is even more comfort in driving this site at night than day.
	x		
	x		
	x		At some locations the vertical and horizontal sight distance was short.
	x		Possible hazards such as deep ditches, rock outcrops, etc., did not appear as hazards at night.

Question: Does the existing delineation provide a clear and distinct outline of the roadway ahead?

Answer:	Yes	No	Comment
	x		Edge stripe sufficient for this type of road.
		x	Delineators almost non-existent on curves. Edge stripe is only definite guide.
	x		Edge line was in need of repainting yet the roadway was clearly outlined.
		x	Delineators only across high fills needed in curves.
	x		It appears that the edge stripe should be repainted.
	x		Additional delineation could be used in some areas.
	x		Adequate for the conditions - dry pavement, very light traffic.

Question: Is the illumination provided by the vehicle's headlights sufficient for safe operation on this facility?

Answer:	Yes	No	Comment
	x		
		x	Not at normal highway speed - alignment reduces cone of vision but not uncomfortable at 50-55 mph.
	x		Even nonreflected objects were perceived adequately.
		x	Only on high beam when going 55-60.
	x		
	x		
	x		I drove at a lower speed at night.

Question: Does the glare from opposing headlights obscure the driver's view of the roadway ahead?

Answer: /__/ Probably /__/ Possibly /__/ Not to any marked degree

Probably	Possibly	Not to any marked degree	Comment
x			This is probably true on any two lane road.
x			Narrow road, absence of delineators, etc., all contribute to loss of perspective beyond opposing vehicle.
		x	I would note this factor comparable to any other two lane travel.
x			The driver would not be able to pick out an object such as an animal shortly after passing an opposing car.
	x		This happens at times because of vertical alignment.
		x	This would become a problem with higher traffic volume.
x			Necessary to focus on edge striping and reduce speed when meeting opposing traffic.

Question: Is there sufficient advance notification of diverging roadways or turn lanes?

Answer:	Yes	No	Comment
	x		Except at boat dock entrances.
		x	Advance signing very poor.
	x		Except advance turn arounds are still needed. Notion to put entrance roads was greatly reduced due to non-reflective signing.
		x	Improvement needed at Maumelle Harbor and Jim's Landing.
			It would be difficult to determine the marina entrances if it were not for the commercial signs.
		x	The entrances to the recreation areas were not signed in advance.
		x	Must rely on commercial signing which was also inadequate. Turns not clearly marked at highway junction.

Question: Can the existing directional signs be easily read at a glance?

Answer: Yes	No	Comment
	x	Legend too small.
x		
	x	Inadequate design - legend too small.
	x	Jct of 113 - the SH 10 and SH 113 could not be read until the driver was right on top of them.
		Most of them (Not at the Jct SH 10 & 113).
	x	Sign letters too small - too much reflectorization of the background.
	x	Legends too small. Signs not maintained well. Nonstandard signs used.

Question: Is the existing lane delineation adequate?

Answer: Yes	No	Comment
x		Edge stripe needs repainting in some cases.
x		Lane delineation - yes Shoulder delineation - no
x		
x		
		I suspect a heavy rain would cause the edge stripe to be difficult to see.
x		
x		For the dry conditions.

Question: Does the glare from opposing headlights make it difficult to read roadside and/or overhead signs?

Answer: Yes	No	Comment
		I don't recall trying to read any sign when meeting another car.

Yes	No	Comment
x		
	x	
	x	Not enough traffic to notice this as a problem.
	x	
	x	
	x	Very little opposing traffic encountered.

Question: In your opinion, is the sight distance to right-of-way control devices at night:

Answer: /_/ Adequate /_/ Questionable

/_/ Inadequate /_/ Critical

A	Q	I	C	Comment
x				For this type of road.
x				
x				
x				
x				
x				
	x			No stops were required. Sight distance to other signs was less than desirable in many cases.

Question: Where hazard warnings are provided, can they be easily associated with the hazard involved?

Answer:

Yes	No	Comment
x		Except in some cases where hazard boards are located in the middle of guardrail sections.
x		
x		

Yes	No	Comment
	x	Hazard markers at culverts protected with guardrail unnecessary.
x		Watch for ice signs, for example.
x		In some locations the hazard board is not at the point of hazard.
	x	Large flashboards well away from the roadway (as at culvert ends) are confusing.

Question: Do signs and lights outside the right-of-way detract to a marked degree from the effectiveness of traffic control devices?

Answer: Yes	No	Comment
	x	
x		Spot lighting at private road intersections causes some distraction.
	x	
	x	
	x	
	x	Practically no commercial development in the section other than entrances to boat launching areas.
	x	None present.

Question: Is the informational signing provided of real value to a majority of the traffic?

Answer: /__/ Yes /__/ Possibly /__/ No

Yes	Possibly	No	Comment
	x		
x			
		x	Could be during certain seasons but during this observation, majority traffic was not destined to sites advertised by informational signs in my opinion.

Yes	Possibly	No	Comment
x			
	x		The advisory speed signs near the landing entrances fail to make an impression because the sight distance usually defies this.
x			Signs too small.
x			The few commercial signs for boat landings are needed for public information.

APPENDIX "C"

SUMMARY OF TECHNICAL INTERVIEWS

PILOT SITE NO. 1 STATE HIGHWAY 10 LITTLE ROCK, ARKANSAS

GEOMETRIC DESIGN

DAY PHASE

The lanes are a little narrow.
I can't see the road as far ahead as I would desire, but it doesn't bother me.
The steep ditches don't bother me on this type of road.
The deep ditches don't bother me - but the 60 MPH speed limit is too high for this facility.
The vertical alignment is a primary restriction.
The fear associated with that high embankment and the rolling pavement has a tendency to make me slow down.
The warped cross-section is disturbing.
The guardrails don't bother me even though the ends are of old design.
I would be afraid to pull off onto the shoulders especially in heavy traffic.
These shoulders are inadequate.
The sight distance to Jim's Landing road is too short from the east.
The comfortable speed for this road is 50 MPH rather than the posted 60 MPH. This is probably due to the steep ditches and other roadside elements.
I wouldn't use the shoulder in wet weather; it doesn't appear to be stable.
You just expect a horizontal curve after the crest of a hill. It doesn't appear to be a 60 MPH design.
The effect of the slopes would be reduced if the roadway were wider.
Widening would not solve critical vertical and horizontal alignment problems.
The roadway is narrow, but for this type of roadway I feel safer with a guardrail than without it.

NIGHT PHASE

The ditches don't look as sharp as at night - the ditches take on less depth perspective at night and don't look as deep at night as they do in the daytime.
I feel more comfortable at night - maybe because the deep ditches are not as visible.
The turn into Jim's Landing from the west is bad.
These cut sections bothered me today - I just felt a little strange, at night the effect is diminished.
There was a slight optical illusion at the curve back there; the road just appears to be a road up to the roadside park.
The superelevation on the curve is inadequate. (Curve approaching bridge over Maumelle Lake - westbound.)
The intersection with SH 113 needs to be redesigned.
I feel more comfortable at night - it may be due to the restricted visibility.
(This was the comment of two drivers.)
The poor geometrics don't bother me as much at night.

GEOMETRIC DESIGN (Con't.)

DAY PHASE

I tend to crowd the center line a little due to the way the shoulders drop off.
The SH 113 intersection is of the old Y-type and needs to be redesigned - so that 113 needs to be redesigned.
The exit from and entrance to the roadside park is poorly located. It is just at the end of a horizontal curve. Also the sharp side ditch is of concern and with the lack of shoulders causes the driver to hug the center line.
The rough surface is of some concern - the loss of visibility of the road is of more concern to me. (The driver adds to the guardrail discussion that the concrete posts are of greater concern than the rail itself.)
There is much confusion on entering Jim's Landing - it appears to be designed for westbound traffic only.
This roadway appears to be more of a geometrical design problem than a control problem.

NIGHT PHASE

SIGNING

DAY PHASE

No advisory speed sign on curve. I feel that there should be.
The only indication of Maumelle Harbor is an advertising sign. There is no advance warning of the stop sign on Maumelle Harbor Road.
The curve warning sign on that last curve is probably unnecessary.
The lightweight sign pole is a good feature.
Advisory speed signs bother me - on that curve it was 50 - and I could easily do 55 around it. (Curve in advance of the roadside park - westbound.)
The cardinal directions are a problem when entering SH 10 from SH 113.

NIGHT PHASE

This is something that concerns me - the state route marker for SH 10 is only about 1/4 the size of the Ozark Trail sign. I don't think most people are interested in the Ozark Trail sign.
This curve sign placed right before this hazard board could possibly lead someone off the road into the lake. It should be placed after the hazard board. (1-1/2 miles from east end of the study section.)
This side sign is dead and needs to be refurbished.
If a person is looking for Jim's Landing, it should be marked here; a person would never see it way over there in the tree line.

SIGNING (Con't.)

DAY PHASE

This curve (one mile from west end of study section) should have an advisory speed less than 60 MPH.
Sometimes I wonder about putting Stop for School Bus signs like that one when the driver must concentrate on the curve.

NIGHT PHASE

A sign on the top of the vertical curve helps me as the headlights reflect directly on it.
The sign behind the guardrail is not visible. (West end of study section.)
The directional signing at SH 113 makes the sign show up fine but the letters are too small to find.
The mileage marker for the next town has reflectorized background which fades out the message; the stroke-width is too small.
You can't read the sign to SH 113 until you are on top of it.
The signs on SH 10 and SH 113 are not reflectorized - maybe they are just old.
The route marker back there would be confusing with those Ozark Trail signs being so much larger. (Approximately one-half from west end of study section.)
The advance blazer (westbound traffic) is too close to the intersection for an unfamiliar driver and is poorly reflectorized.
In that case, the Ozark Trail sign was placed on top and you are attempting to read it rather than this route marker. I think it should be below the state route marker if it has to be used at all.
Too many messages are presented at one time. They should be presented one at a time.
Warning signs are used more at night than during the day.
The large Ozark Trail marker attracts more attention so that you miss the informational sign.
The curve sign placed right before the hazard board could possibly lead someone off the road and into the lake. It should be placed after the hazard board.

ILLUMINATION

DAY PHASE

NIGHT PHASE

That light up there really helps. (Reference to the lighting standard on the island at Jim's Landing road at intersection.)

DELINEATION

DAY PHASE

The guardrail is situated such that you could drive right behind it - it starts too late.
The guardrail is close, but it does not bother me. I think people expect it on this type of highway.
The guardrail section is too short. A car could go behind it into the lake. (At Maumelle Lake Bridge)
The lack of shoulders is of great concern. The guardrail is too short and you could go right behind it into the lake. (Maumelle Lake)
Edgestripe is well worth the money. It is better than delineators.

NIGHT PHASE

The points of divergency are somewhat obscured both day and night.
Some of those guide posts have old 3-M material on them and some have new material. They should all be replaced at one time.
Those guide posts show up well.
Those hazard paddles for the bridge are about the only thing that show up.
I didn't see those guide posts during the day, but they show up well at night.
The delineators that are in place are dead and worthless. There is no delineation of the guardrail ends.
Continuous delineation might help, but doubtful.
The bridge end reflectors are bright but the guardrail does not appear until after you are on it.
I still like the guide posts in preference to the delineators.
The bridges, and possibly the guardrails, should have crystal delineators which taper into the structure. The nine-button amber delineator at the obstruction isn't very good.
I don't understand the hazard board. It is placed about 100 ft. in advance of the guardrail.
The guardrail doesn't seem as close at night.
The guardrails look closer at night and I feel more restricted. The posts stand out. (Referring to the guardrail supports.)

DELINEATION (Con't.)

DAY PHASE

NIGHT PHASE

The delineators which don't show up during the day are effective at night.
This spot delineation is poor. Either full continuous delineation or none at all should be used.
The guardrail outlines the roadway well when there is an approaching vehicle.
The guardrail is a better delineator at night.
The hazard board behind the guardrail is of no value.
Guardrail posts have reflective material which shows up better than paint.
These wooden posts are spaced about 100 feet apart and are supposed to serve as delineators. In the day they were rather unsightly, but at night they serve a very useful purpose to outline the roadway.
The gore at SH 113 might not have been obvious if this had been the first time through. In the day you have the advantage of the contrast in pavement which I don't have tonight.
Those delineators back there - I guess they have some kind of funny effect when you have them on both sides.
Here is another hazard board right close to the end of the guardrail. I don't see the purpose in that.

PAVEMENT MARKINGS

DAY PHASE

The edge line reduces the effective width of the roadway.
The edge stripe is very useful.
This no passing zone should be extended to meet with the zone ahead. The gap between it is too short in which to pass. (This is approximately 3 miles on the westbound run.)

NIGHT PHASE

The center line in no passing zones are adequately reflectorized.
The center line stands out very well.
The edge stripe shows up well at night, but not as well as the center line.
The edge line is dim and needs repainting.

DAY PHASE	NIGHT PHASE
The passing sight distance is too short (just at the four mile point) although no passing zone is indicated.	The markings are more apparent at night and the ditches don't bother me as much. The edge line is good but tends to make the lane look narrower than it is. To me, the edge line along here doesn't show as well at night. You get better delineation from the vegetation, but I would not want to be without the edge stripe. The no passing lines are more apparent at night, however, I wasn't really looking for passing opportunities during the day. At night a few things stand out which didn't stand out in the daylight. For example, just after I met that car I used the edge line to guide me so I wouldn't have to look directly into the light. The target value of the road is reduced considerably at night. The edge line faded out but it didn't bother me as much as the center line was much brighter anyway and I was using it as a guide. The edge line is dead. I bet this edge line increases driver fatigue on this narrow roadway. The edge line is poorly maintained. It must be maintained to be of any value. I use the edge line during curves to the right when meeting opposing vehicles as a point of reference in general. The center line is used otherwise. This is true both day and night and with good or bad shoulders. The edge line is the weakest on the inside of curves which would indicate that people are running very close to the edge at that point. A while ago, we were discussing right edge markings. I find myself using these when opposing headlights bother me. I line up with the right edge line.

MISCELLANEOUS

DAY PHASE

The rough pavement is more critical to me than the side slopes.
This pavement is certainly rough.
The condition of the road surface was of more concern than the lack of good shoulders or alignment.

NIGHT PHASE

You really lose a lot when you have to switch to low beam. A better low beam headlight is needed.
The pavement is very rough in spots that have been patched. I did not see it in the daylight until I heard it, but at night I can pick up the contrast.

APPENDIX "D"

SUMMARY OF NON-TECHNICAL DRIVER INTERVIEWS

PILOT SITE NO. 1 STATE HIGHWAY 10 LITTLE ROCK, ARKANSAS

Three non-technical drivers were used in the Arkansas Pilot Studies to supplement the other phases of the study. Included were two young ladies from the stenographic pool of the Arkansas Highway Department and a maintenance foreman of the same organization. Every effort was made by the interviewer to make the subjects comfortable; however, there was no familiarization time as the driver of the test car.

DAYLIGHT PHASE

Most of the comments made by the non-technical drivers fell into common categories. All three test subjects reported that under daylight operating conditions they used the centerline and edgeline almost equally in guiding the vehicle. They also agreed that an unfamiliar driver would be confused by cardinal directions as none were indicated and they all recognized the hazard paddle as indicating a hazard of some type. The two ladies reported that they used the edgeline to guide the vehicle in curves, that the proximity of the guardrail does not bother them and that the channelization at Jim's Landing was confusing. (The male subject did not make this turn during the day phase.) The male subject and one of the ladies reported that the lack of adequate signing at Jim's Landing and Maumelle Harbor was a critical problem.

In addition to these common comments, there were several statements of interest made during the interviews. One of the ladies reported that even though she lost visual contact with the roadway, it did not concern her because she was certain that adequate warning was provided for any changes in alignment which occurred ahead of her. Also she reported that the advisory speed or curves was desirable and that she followed them. The edge markings took on particular importance for her at the bridges as it guided her into the proper path. The male subject indicated that the guardrail was too close to the pavement and made him hug the centerline. He also noted a rough section of pavement approximately five miles into the study site which he felt was dangerous. The third non-technical driver (the other feminine subject) reported that a loss of the view of the roadway did not bother her for speeds below 50 MPH but were of real concern at 60 or 70 MPH. She had a noticeable tendency to move away from the bridge rails on narrow bridges. The interviewer asked, "Do you adjust your speed to the advisory speeds posted for curves and intersections?". The reply was, "Sometimes". A follow-up question on how she decided which was too slow and which one to ignore indicated that she did not know exactly. This young lady was convinced that the pavement markings were the most important communication element to the average driver.

NIGHT PHASE

During the night interviews only one area produced a common response from all three subjects. All three reported that they used the edgeline to guide their vehicle on curves (particularly curves to the left) and when meeting an opposing vehicle. The two ladies reported that their primary guide device at night was the centerline. The male subject and one of the female subjects reported that the guardrail was too close to the pavement and created a tendency to cross over the centerline. Also, they again indicated that the channelization of Jim's Landing was very poor and that both Jim's Landing and Maumelle Harbor needed some type of signing. The 60 MPH operating speed at night was questioned by all three drivers, but only the male subject suggested that the safe speed was somewhat less than the posted 60 MPH (50 to 55 MPH).

Individual comments were made regarding various elements within the study section. One of the ladies reported that the light at Jim's Landing was a problem for her as she left the intersection (had difficulty adapting to darkness). She also noted that a roadside park sign was located on a curve where she really did not have time to read it - (she was fully occupied with the driving task). This subject also suggested that post mounted delineators might be of value to her in driving this section at night. The male test subject noted that several signs were dead and needed to be replaced - particularly the warning sign on the westbound approach to the Jim's Landing intersection. The second female subject reported that the loss of visual contact with the roadway was of concern to her at night and she had a tendency to slow her vehicle. She also stated, in response to a direct question on use of the edgeline in the tangent sections at night, that she did not use the edgeline in a straight section even when meeting an oncoming vehicle. She also suggested that post mounted delineators might be of some value on this section of roadway.