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EVALUATION OF REFERENCE MARKERS

(Interim Report)

by

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in cooperation with

Kentucky Transportation Cabinet
Commonwealth of Kentucky

and

Federal Highway Administration
U.S. Department of Transportation

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16. Abstract

The objective of this research evaluation was to evaluate the reference markers which were installed on sections of interstates and freeways in the Cincinnati-northern Kentucky area, the Lexington-Fayette Urban County area, the Louisville-southern Indiana area, and the Indianapolis area. The evaluation was conducted to determine if the use of reference markers at spacings of 0.1 or 0.2-mile intervals could improve the effectiveness of the emergency response and incident management processes. Also evaluated were color of the markers and the placement location within the right-of-way. Both "white on blue" and "white on green" markers were installed on various projects, with some installed on the median barrier wall and some on grass medians or shoulders. Included were condition surveys of the marker installations and opinion surveys of those involved in the incident or emergency management process.

Nearly unanimous endorsement of the reference markers was received from interviews and surveys of highway agency personnel and participants in the emergency management process.

Recommendations were made for spacing of the markers at 0.2-mile intervals, with exceptions in curved sections to allow for placement of the markers at 0.1-mile intervals. Based on what appears to slightly increased conspicuity of the "white on blue" marker as compared to the "white on green" marker, it was recommended that a standardized reference marker be developed with white letters on blue background. Because of reduced exposure to mowing operations and errant vehicles, it was recommended that reference markers be placed on median barrier walls where practical.

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EXECUTIVE SUMMARY

Reference markers have been installed on sections of interstates and freeways in the Cincinnati-northern Kentucky area, the Lexington-Fayette Urban County area, the Louisville-southern Indiana area, and in the Indianapolis area. An evaluation was conducted to determine if the use of reference markers at spacings of 0.1 or 0.2-mile intervals could improve the effectiveness of the emergency response and incident management processes. Also evaluated were color and placement location.

The evaluation included a condition survey of the reference markers installed as part of the ARTIMIS project in the Cincinnati-northern Kentucky area and markers installed in the Lexington-Fayette Urban County area. In addition, separate efforts were made to obtain opinions of individuals who had exposure to the marker projects and who understood the intent and usage of the markers. The condition of the markers was found to be very good and there appeared to be only minor problems with maintenance within the relatively short time period since installation. The majority of the markers have been installed on median barrier walls and therefore have less exposure to the routine problems related to mowing and errant vehicles which may impact the markers and posts. Interviews and surveys of participants in the emergency response process and others involved in the traffic management systems indicate nearly unanimous endorsement of the reference markers. Dispatch personnel have indicated that drivers are using the markers for identification of locations where incidents occur, with the resultant effect of a more efficient process for responding to incidents and crashes. Tow operators have noted special benefits from the reference markers when calls for assistance were received directly from motorists.

Highway agency personnel and emergency response personnel have also expressed satisfaction with the markers, whether placed at 0.1 or 0.2-mile intervals. Results indicate highway agency and emergency response personnel generally favor the spacing of reference markers observed in their area, regardless of whether they are spaced at 0.1 or 0.2-mile intervals. It is apparent that more frequently spaced markers offer additional benefit and increased safety in curved sections, and where there are missing markers due to maintenance or vandalism problems. Considering all factors, it appears that the reduced clutter and economy of markers at 0.2-mile intervals outweighs increased benefits from more frequently spaced markers.

The use of markers with blue background color as compared to green was evaluated and some increased benefit was found related to the distinguishable color of blue and the consistency with motorists service markers. Green reference markers also appear to adequately serve the purpose of providing increased reference points along the roadway to help motorists and emergency response personnel identify and respond to incidents. The green color symbolizes the standard guide sign and the color results in a marker similar to the standard milepost. Again, those surveyed felt that blue or green markers were best, dependent upon the color being used in the areas they traveled and observed the markers. There appears to be added benefit for blue markers when considering the distinguishable color compared to landscape backgrounds and the ability of those with color weakness to distinguish blue more easily than green.

1.0 BACKGROUND

The Advanced Regional Traffic Interactive Management and Information System (ARTIMIS) for the Cincinnati-northern Kentucky urbanized area is a traffic management and traveler information system that includes a wide range of traffic control and operational components. Among those primary components included in the project for testing and development are the following: 1) highway advisory radio, 2) changeable message markers, 3) freeway service patrols, 4) closed circuit television cameras, and 5) traveler advisory telephone service. Another component that has been implemented is a reference marker system to assist in locating incidents/crashes for prompt and effective response by emergency personnel. The highway system instrumented and affected by ARTIMIS includes approximately 88 miles of freeway in the Cincinnati and northern Kentucky area.

A critical link in the emergency response process is the timeliness and accuracy of location information provided to responding personnel. The report of an incident or crash is typically initiated by the driving public and the responsiveness of emergency personnel is dependent upon the accuracy of location information. In addition, personnel in dispatch centers must make decisions about the location information and determine the appropriate emergency units to notify. In order to improve the emergency response process in Cincinnati and northern Kentucky , an experimental feature of the ARTIMIS project was reference markers at 0.1-mile intervals to supplement the current milepost referencing system. The increased frequency of the location of the reference markers was intended to allow accurate identification of an incident or crash on the freeway system.

Results from a preliminary evaluation of the reference markers installed as part of the ARTIMIS project were documented in Research Report KTC 95-11 titled "Preliminary Evaluation: ARTIMIS Reference Point Markers"(1). As a result of the success of the reference markers in the Cincinnati area, the concept was endorsed and installations were made in the Louisville and Lexington-Fayette County areas. The types and patterns of placement have varied somewhat from the markers installed as part of the ARTIMIS project. Reference markers installed in Louisville are white letters on blue background; however, the spacing interval for the markers is 0.2-mile rather than the 0.1-mile spacing used in ARTIMIS. For the installations in Lexington, the markers have also been spaced at 0.2-mile intervals; however, white letters on green background have been used instead of white letters on blue background.

Further building on the success of the installations of reference markers made in the Cincinnati, Lexington-Fayette County, and Louisville areas; installations were also made in the Indianapolis area. These markers incorporated the color scheme of white letters on blue background, and were spaced at 0.2-mile intervals.

2.0 OBJECTIVES

The objective of this evaluation is to determine if the installation of reference markers at intervals more frequent than the one-mile increments of standard mileposts will improve the ability of emergency personnel to respond to incidents or crashes on the freeway systems in the Cincinnati-northern Kentucky area, and in Louisville and Lexington-Fayette County. The evaluation includes the following three phases.

Phase 1

The objective of Phase 1, which was completed and documented as Research Report KTC-95-11(1), was a short-term evaluation of an experimental section of both white on blue and white on green markers to determine their effectiveness in providing location information for emergency response.

Phase 2

The objective of Phase 2 is to conduct a longer-term evaluation to determine the effectiveness of the enhanced reference marker system installed as part of the ARTIMIS project in Cincinnati and northern Kentucky. In addition, this phase was to serve as a preliminary status report on the installations in the Louisville and Lexington-Fayette County areas.

Phase 3

Phase 3 is intended to be a continuation of the long-term evaluation of reference markers installed as part of the ARTIMIS project and to evaluate the reference markers installed or to be installed in Louisville and Lexington-Fayette County. In addition, Phase 3 is expected to address the issues of adopting the reference markers as a standard for inclusion in the Manual on Uniform Traffic Control Devices.

3.0 SCOPE OF ACTIVITIES BY PHASE

Phase 1

As previously noted, reference markers installed as part of the ARTIMIS project in the Cincinnati-northern Kentucky area were evaluated and documented in an interim report titled "Preliminary Evaluation: ARTIMIS Reference Point Markers" (1).

Subjective evaluations were performed to determine if size, color, placement, and content of one type of reference point marker was more effective. Interviews were conducted with participating and affected agencies to determine if the enhanced reference marker had benefited the emergency response process.

Listed below are the general types of subjective information solicited from agency personnel responsible for I-275 in Ohio where experimental reference markers were installed.

1) Number of times the reference marker system has been used by motorists to report an incident.
2) Benefit to the communication unit in the identification of locations and dispatch of emergency response personnel.
3) Opinions of dispatch personnel relative to the expansion of the reference marker system.
4) Benefit to road service companies in the use of reference markers to assist in the location of disabled vehicles.

Evaluation of the test section was completed and the interim report was prepared in June 1995 (1). The report documents results of the initial evaluation and a recommendation was made for white letters on blue markers for systemwide installation.

Phase 2

The focus of Phase 2 is an evaluation the reference markers installed on most of the interstate highways and other major connectors included in the ARTIMIS system. A subjective evaluation procedure similar to that used for the preliminary test section has been employed to assess the effectiveness of the enhanced reference markers. In addition, agency personnel responsible for highway sections included in the ARTIMIS project have been solicited to address the frequency of use and benefit of the reference markers. As part of the survey, an attempt was made to determine if the frequently spaced reference markers have had an adverse aesthetic impact and whether the spacing of the markers should be altered. An assessment of the marker durability and maintenance issues has been addressed through review of highway department records and visual inventories. In addition, preliminary opinions were offered relative to the adoption of reference markers as a standard for inclusion in the Manual on Uniform Traffic Control Devices.

A subtask to this phase is a preliminary evaluation of the reference markers installed in the Louisville and Lexington-Fayette County areas. Also included in this evaluation is a general summary of the installations of reference markers in the Indianapolis area.

Phase 3

This phase will include a final evaluation of the reference marker installations with subtasks devoted to evaluation of reference markers in the Cincinnati-northern Kentucky (Phase 3A), Louisville-southern Indiana (Phase 3B), and Lexington-Fayette County (Phase 3C) areas. The systemwide evaluation will focus on the potential use of reference markers as a national standard. Within the constraints of the study, an attempt will be made to include evaluation variables which could distinguish the reference markers as a national standard for inclusion in the Manual on Uniform Traffic Control Devices. Evaluation measures similar to those used in Phase 1 and Phase 2 will be used to document reference markers as a component of the emergency response process. A final report will be prepared to document results of the subtasks of Phase 3.

4.0 DOCUMENTATION OF REFERENCE MARKER INSTALLATIONS

4.1 Cincinnati - Northern Kentucky Area (ARTIMIS)

The reference markers were installed as part of the ARTIMIS contract, which included various other traffic control components for an Advanced Traffic Management System (ATMS) and Advanced Traveler Information System (ATIS). As noted previously, the initial installations were made to attempt to determine if there were advantages to using "white on blue" rather than "white on green" as the color for reference markers. The results of this preliminary evaluation were reported and there was a general consensus that the "white on blue" markers could be more distinguishable and could serve to supplement the standard milepost marker which has traditionally been "white on green" in conformance with concept that the information presented serves as guide sign-type information. Similar arguments have been made for use of the color blue which traditionally has been considered for use as service-type signs.

Installations to evaluate the use of "white on blue" versus "white on green" markers were completed in the fall of 1994 and the evaluation report was completed in the summer of 1995 (1). The reference markers were installed on the mainline and ramps for approximately three miles of I-275 (between Mosteller Road and US 42) east of I-75 in Cincinnati. The experimental mainline reference markers had white letters on blue background for westbound traffic on I-275; with the marker containing information related to direction of travel, interstate route number, milepost number, and a number representing the tenth of a mile segment between mileposts. The "white on blue" mainline reference marker was 14 by 48 inches and mounted in the median on the concrete barrier wall where practical. For eastbound traffic, the markers were white letters on green background, 12 inches by 48 inches in size and placement generally consistent with the standard milepost marker. The "white on green" reference markers had MILE in 4-inch letters at the top, with vertically stacked 8-inch numbers indicating the milepost and tenth of a mile segment. A schematic showing the mainline marker and message dimensions is presented in Figure 1. Ramp markers used in the test section were also white letters on blue background. The marker size was 30 by 30 inches, with the message RAMP at the top of the marker and the message indicating where the driver would be coming from and going to when using the ramp. A schematic showing the ramp marker used as part of ARTIMIS is shown in Figure 2.

The primary installation of reference markers began in the summer of 1995 and all markers were installed in Ohio by June 1996. Installations were delayed for the Kentucky sections due to contract scheduling and were completed, with the exception of a few markers, in July 1997. Where concrete median barriers existed on the routes, the markers were installed on the barrier wall using a short post. On sections without median barrier walls, the markers were installed in the left median area on 2-inch square posts, and mounted back-to-back to allow viewing the markers from both directions. Highways on which reference markers have be installed include I-71, I-74, I-75, I-275, I-471, the Ronald Reagan Highway and the Norwood Lateral (OH Route 562). A map showing the locations where markers have been installed as part of the ARTIMIS project and other installations is presented in Figure 3. Examples are shown for

the ARTIMIS mainline markers in Figure 4 and the ramp markers in Figure 5.

For the ARTIMIS project in Ohio, a total of 1,106 mainline reference markers and 291 ramp markers were installed based on records maintained by the Ohio Department of Transportation. The total cost of the markers, including brackets and posts, was $232,042. This represented an average cost of $166 per marker. The total cost included 1,106 mainline markers at a cost of $62,577; 291 ramp markers at $18,465; 556 brackets at a cost of $47, 260; and 10,640 lineal feet of square posts at a cost of $103,740.

For the ARTIMIS reference marker installations in Kentucky, the unit bid price on mainline sections of I-75/I-71 was $127 for 240 markers. For markers on I-275 and I-471, the unit price was $74 for 358 markers. The 321 ramp markers in Kentucky were installed for $90 per marker. Total installation costs for mainline markers, ramp markers, brackets, and steel posts were $141,513; or an average cost of $154 for 919 markers.

4.2 Lexington - Fayette County Area

The reference markers in Lexington-Fayette County were installed on I-64 and I-75, the two interstates which traverse the county. Installation began in the summer of 1997 and was completed in October 1998. The first phase of installation included the section of I-75 between mileposts 105.6 and 120.0, and all interchanges except KY 418 which was being reconstructed. The second phase included the remaining sections of I-75 between mileposts 97.6 and 105.6, and all of I-64 in Fayette County. Materials were purchased and fabricated by the Lexington-Fayette Urban County Division of Traffic Engineering, and a separate contract was awarded for installation of the markers. A total of 322 mainline markers and 84 ramp markers were installed, with a materials cost of $43,749 and an installation cost of $15,220. This resulted in a cost per marker of approximately $145. Excluded were the fabrication costs assumed by Lexington-Fayette Urban County Division of Traffic Engineering. Markers have been installed on the median barrier wall where possible, which includes most of I-75 in Fayette County except for a short section north of the Clays Ferry Bridge. On I-64, the markers have been installed on the right side rather than the median, apparently for the convenience of maintenance crews. A map showing locations of reference marker installations in Fayette County is presented in Figure 6. A photograph showing an example of the mainline reference marker used in Fayette County is shown in Figure 7 and a ramp marker is shown in Figure 8.

4.3 Louisville - Southern Indiana Area (TRIMARC)

The reference markers in Louisville and southern Indiana will be installed on sections of I-64, I-65, I-71, I-264, and I-265. A map showing the reference marker installations in the TRIMARC area is presented in Figure 9. As of December 1998, all markers had been installed in Indiana and in Kentucky on sections of I-64 between mileposts 6.0 and 9.0 and I-71 between mileposts 0.0 and 3.0. Sections where markers had not yet been installed in December 1998 included I-64 between mileposts 2.0 and 6.0, I-65 between mileposts 128.0 and 137.0, and I-264

between mileposts 9.0. and 15.0. A total of 985 reference markers are expected to be installed; including 454 mainline markers and 531 ramp markers. All markers are to be installed on the median barrier wall where possible, and in the grass median otherwise. An exception was I-65 in southern Indiana where the barrier wall is to be replaced and the markers were installed on the right side of the road. The total costs for reference marker installations in the TRIMARC project area are estimated to be $42,417; for an average cost per marker of $137. This does not include the costs associated with maintenance of traffic which was a separate bid item that permitted the contractor and subcontractors to charge traffic control costs. Specific costs included mainline markers at $77 per marker; ramp markers at $82 per marker; steel posts at $15.50 per meter; and 107 brackets at a cost of $131. A photograph showing an example of the TRIMARC mainline reference marker is shown in Figure 10 and the TRIMARC ramp marker is shown in Figure 11. Ramp markers for the TRIMARC project provided additional information in the form of a number for each ramp to distinguish them from similar markers which could occur on each side of the city when a route intersects both sides of the city. An additional number was placed below the ramp marker when there was more than one marker on a ramp. This allows a driver to distinguish which ramp marker was being identified along the length of the ramp. The extra sign was needed due to the ramp configurations of the I-65/I-264 and I-64/I-65/I-71 interchanges.

4.4 Indianapolis Area

The reference marker installations in the Indianapolis area were completed in the summer of 1998. The markers were installed on all interstates within the urban area, including I-65, I-69, I-70, I-74, and I-465. A map identifying routes where markers have been installed is shown in Figure 12. A numbering scheme similar to the TRIMARC project was used on ramp markers in the Indianapolis area to insure the uniqueness of routes which may intersect other routes at more than one point. There were 1,190 mainline markers and 320 ramp markers. This was a total of 1,510 markers which were installed at a cost of $231,728; or an average cost of $153 per marker. This cost did not include the contract bid items related to maintenance of traffic, mobilization, construction engineering, and the project field office. A summary on the status and experiences of the Indianapolis project as documented by the Indiana Department of Transportation is attached as Appendix A (3).

5.0 EVALUATION PROCEDURE FOR PHASE 2 OF STUDY

5.1 Condition Survey of Reference Markers

A survey was conducted to determine the number and condition of markers installed as part of the ARTIMIS project in the Cincinnati-northern Kentucky area and markers installed in the Lexington-Fayette County area. Only I-75 was surveyed in Lexington-Fayette County because the reference markers had not yet been installed on I-64 at the time of the survey. The survey was conducted in the summer of 1998 and included visual observations and videotaping of each section of highway where the markers were installed. Both mainline markers and ramp

markers were included in the survey, with comments noted relative to the condition number missing.

5.2 Opinion Survey of Reference Markers

There were three separate efforts made to obtain information concerning opinions of individuals who had exposure to the markers and understood the intent of installing the markers. First, a form was developed containing questions related to usage of the markers and possible benefits to be gained from their usage. This survey was distributed to the Hamilton County Communications staff in Cincinnati in March 1997. The second was a slightly revised survey form which was prepared and distributed to participants in the ARTIMIS Regional Incident Management Task Force meeting in January 1998. The revised survey form contained questions related to preferences for the "white on blue" markers used as part of ARTIMIS or the "white on green" markers used in Lexington-Fayette County. For comparative purposes, photographs of the reference markers were enlarged and displayed while the survey was being completed. A third survey was distributed by mail to members of the Lexington-Fayette County Incident Management Committee and responses were received from 15 of approximately 30 members.

6.0 EVALUATION RESULTS

6.1 Condition Survey of Reference Markers

Results from the survey of the ARTIMIS reference marker installations are presented in Table 1. The total number of markers was counted as1,763; with 77 observed to be missing from locations where they were expected to have been installed. A separate installation by the Ohio Department of Transportation and not as part of the ARTIMIS contract, but included in the ARTIMIS summary in Table 1, were 301 reference markers on Ohio State Route 562 and the Ronald Reagan Highway. Only 12 of these markers were determined to be missing during the survey conducted in the summer of 1998. It was noted that missing markers were predominately on sections where they had been installed on the shoulders of I-71 and I-275. This was expected since there would be much more opportunity for markers to be impacted by mowing equipment or errant vehicles if they were located on grass shoulders or median sections rather than placed on median barrier walls.

As part of the survey conducted during the summer of 1998, a total of 187 markers were observed on I-75 in Lexington-Fayette County. Only 2 of the 187 markers were found to be missing at the time of the survey. All of the markers on I-75 were placed on the median barrier wall. The locations of the installations on I-75 included in the Lexington-Fayette County project are summarized in Table 2. Markers on I-64 were installed after the survey in the summer of 1998 and all of the markers were placed on right-side grass shoulders rather than the median. The status of these markers has not yet been assessed relative to the durability.

Reference markers for the TRIMARC project were in the early stages of installation during the summer of 1998 and no attempt was made to survey the number and condition. Only 214 of the 985 markers installed as part of the TRIMARC project were placed on median barrier walls. A high percentage of the markers for the project were installed on ramps (531 of the 985 markers); therefore, increasing exposure and the probability for damaged or missing markers.

6.2 Opinion Survey of Reference Markers

Results from opinion surveys of reference markers were obtained from six members of the Hamilton County Communications staff. These staff members were asked to offer opinions whether they felt the markers were beneficial to the emergency response process. In addition, they were asked whether there had been positive impressions from the public regarding the usefulness of the markers. Overall response from the staff members who interact with the public routinely was that the reference markers were very beneficial to the emergency response process. All six respondents noted that motorists had made referred to the markers to identify their location when they called to report an incident. Comments were offered which indicated that in addition to the driving public, others benefitting from the markers included highway department maintenance personnel, police, fire, EMS, and tow operators. A copy of the survey form and summarized responses to each question from the Hamilton County Communications staff are presented in Appendix B.

The second attempt to assess opinions from professionals involved with or knowledgeable of the incident management process resulted in 22 responses from a survey distributed to the members of the Regional Incident Management Task Force during a meeting of the group in January 1998. Results from the survey indicated that 17 of the respondents felt the markers were very beneficial and that 5 felt they were possibly beneficial. The focus of this second survey was to determine whether the spacing and color of the markers used as part of the ARTIMIS project were preferred as compared to the markers installed on I-75 in Lexington-Fayette County. It was found that 15 of the 22 felt that the 0.1-mile spacing of the markers for the ARTIMIS project were appropriate and preferred as compared to the 0.2-mile spacing in Lexington-Fayette County. When asked to respond concerning a preference of the "white on blue" markers in the ARTIMIS area versus the "white on green" markers in Lexington-Fayette County, it was found that 17 of the 22 preferred the "white on blue" markers. In general, there was a very positive response to the markers from the Incident Management Task Force and there was a clear preference for the color and spacing of markers similar to those used as part of the ARTIMIS project. A copy of the survey form and summarized responses from the Regional Incident Management Task Force are presented in Appendix B.

Members of the Lexington-Fayette Incident Management Committee were requested to respond to a survey similar to the surveys conducted for the ARTIMIS project. There were 15 respondents from representatives of traffic engineering, police, fire, tow operations, and others associated with the emergency response process. The responses were very supportive of the reference markers and the opinions were nearly unanimous that the markers should be placed at

0.2-mile spacings. There was also strong support for the "white on green" markers as compared to the "white on blue" markers; however, several felt that the "white on blue" markers used for the ARTIMIS project were also appropriate. A copy of the survey form and the summarized responses from the Lexington-Fayette Incident Management Committee are presented in Appendix B.

7.0 SUMMARY AND RECOMMENDATIONS

The use of reference markers has been shown to be a beneficial supplement to the emergency response process. Interviews and surveys of participants in the emergency response process and other representatives involved in traffic management systems have offered nearly unanimous endorsement of the reference markers. Dispatch personnel and tow operators have indicated that drivers are routinely using the markers for identification of the location where an incident has occurred. The resultant effect has been a more efficient process for responding to incidents and crashes.

Separate issues addressed as part of the evaluation were the comparative benefits of reference markers placed at 0.1-mile intervals versus 0.2-mile intervals and "white on blue" versus "white on green" markers. Based on a survey of members of the ARTIMIS Incident Management Task Force, results indicate they were clearly in favor of the markers being spaced at 0.1-mile intervals and that the "white on blue" markers were preferred. This result could be somewhat biased by the respondents being most familiar with the ARTIMIS markers and therefore more likely to endorse the spacing and color of markers observed in their area of travel. Representatives of the Lexington-Fayette County Incident Management Committee also strongly endorsed the reference markers as an addition to the emergency response process for more precise location of incidents. Respondents from Lexington-Fayette County appear to be satisfied with the use of markers at 0.2-mile spacing and favor the use of "white on green" markers even though there does not appear to be strong opinions favoring "white on green" rather than "white on blue" markers. In general, it appears that the respondents were favorable to the spacing and color of markers used in their areas of travel. Overall support for the concept of reference markers was unanimous from those surveyed; regardless of whether the spacing is 0.1 mile or 0.2 mile, and whether the markers are "white on green" or "white on blue". It is anticipated that additional information will be collected prior to the end of the project to determine opinions related to size, location, spacings, and colors for the markers.

There have been approximately 1,400 reference markers installed in Ohio as part of the ARTIMIS project at a cost of approximately $166 per marker. A separate contract for 919 markers in Kentucky as part of the ARTIMIS project resulted in costs of $154 per marker. The costs were generally in the same range for the 406 markers installed in Lexington-Fayette County at a cost of $145 per marker; and in the TRIMARC project where 985 markers were installed at a cost of $137 per marker. For the Indianapolis installations, the cost was $153 per marker for 1,510 markers. A summary of the number installed and cost per marker for each of the projects

is presented in Table 3.

Based on information gathered on the project to date, indications are that placement of markers at either 0.1 or 0.2-mile can benefit the emergency response process. Considering the minimal reduction in benefits that could be expected from the greater spacings, and the decreased cost, the 0.2-mile spacing of reference markers is recommended at this time. Exceptions should be considered for locations where curvature of the roadway would not allow a driver to see a marker at every point on the road when installed at 0.2-mile spacings. Color of the reference markers is important from the perspective of standardization and the ability of motorist to distinguish the markers for emergency notification. The "white on green" marker symbolizes the standard guide sign and arguments could be made for use of a marker which is similar to the standard milepost marker. The "white on blue" marker is representative of motorist service signs, including police services and rest areas. Either color of marker could be used with supportive arguments from the Manual on Uniform Traffic Control Devices(2). Documentation was presented in the initial proposal for reference marker installation as part of the ARTIMIS project indicating that there are fewer drivers color deficient for blue than green. It was also noted that red/green is the most common color weakness and that blue/yellow is less common. Therefore, if the objective was to provide signing with the least potential for color weakness problems, then the "white on blue" markers would be more clearly distinguishable to a higher percentage of drivers. Based on the overall acceptability of both colors of markers and what appears to be increased conspicuity of the color blue as compared to green, it is recommended that a standardized reference marker be developed with white letters on a blue background.

All projects evaluated had reference markers installed on both median barriers and on either grass shoulders or grass medians. From the inventory of damaged and missing markers, it appears that there were considerably fewer problems on sections where the markers were placed on the median barrier wall. This result was expected from the standpoint of less exposure to mowing operations and errant vehicles which could come into contact with the posts and/or markers. Because of the reduced exposure and increased visibility due to the close proximity to the driving lanes, it is recommended that markers be placed on median barrier walls where practical.

The size of the reference markers were significantly larger than the standard milepost marker because of the need to place more letters on the markers to distinguish the direction, route indicator, mile number, and tenth of a mile number. The largest milepost marker is 10 inches by 36 inches compared to the largest reference markers with dual interstate shields which are 18 inches by 48 inches. The difference in marker size did not appear to be an issue with any of those offering opinions; however, the specific question was not asked during the surveys.

It is anticipated that evaluation of reference markers will continue through 1999 and a final report will be prepared. The final evaluation report will include results from the installations made in Cincinnati-northern Kentucky, Lexington-Fayette County, Louisville-southern Indiana, Indianapolis, and in the Nashville and Knoxville areas of Tennessee. The

evaluation will focus on the advantages and disadvantages of reference markers being adopted for use as a national standard. Costs and benefits of the markers will be documented, with supplemental information related to subjective opinions of the markers as part of the emergency response process.

8.0 REFERENCES

1. Pigman, J.G.; "Preliminary Evaluation: ARTIMIS Reference Point Markers", Research Report KTC-95-11, Kentucky Transportation Center, University of Kentucky, June 1995.

2. "Manual on Uniform Traffic Control Devices for Streets and Highways". U.S. Department of Transportation, Federal Highway Administration, 1988.

3. Correspondence from James Poturalaki, Indiana Department of Transportation, Speciality Projects Section, January 1999.

TABLE 1. SUMMARY OF REFERENCE MARKER INSTALLATIONS
ARTIMIS PROJECT - SUMMER 1998

Ohio Installations (ARTIMIS)

Route	County	Mile Point Range Mainline	Mile Point Range Ramps	No. of Markers	No. Missing or Condition
I-75 NB	Hamilton	0.1-17.4		172	3-MISSING
I-75 SB	Hamilton	17.4-0.1		171	4-MISSING
I-75 NB	Hamilton		0.1-17.4	32	3-NO RAMP Markers
I-75 SB	Hamilton		17.4-0.1	46	None
I-75 NB	Butler	17.5 - 17.9		5	1-MISSING
I-75 SB	Butler	17.9 - 17.5		5	1-MISSING
I-275 WB		0.1-84		214	11-MISSING
I-275 EB		84-0.1		220	7-MISSING
I-71 NB	Hamilton	9.1-21.9		126	7-MISSING
I-71 SB	Hamilton	21.9-9.1		125	4-MISSING
I-71 NB	Hamilton		9.1-24	12	1-DAMAGED
I-71 SB	Hamilton				
OH 562 EB Hamilton	Hamilton	0.1-2.5		23	2-MISSING
OH 562 WB Hamilton	Hamilton	2.5-0.1		23	2-MISSING
OH 562 EB Hamilton	Hamilton	0.1-2.5		8	None
OH 562 WB Hamilton	Hamilton	2.5-0.1		6	Trees obstructing view
RR Hwy EB Hamilton	Hamilton	1-16.5		120	5-MISSING
RR Hwy WB Hamilton	Hamilton	16.5-1		121	3-MISSING

TABLE 1. (CONTINUED)
Kentucky Installations (ARTIMIS)

Route	County	Mile Point Range Mainline	Mile Point Range Ramps	No. of Markers	No. Missing or Condition
I-75 NB	Boone	179.0 - 183.3		43	1-MISSING
I-75 SB	Boone	183.3 - 179.0		43	1-MISSING
I-75 NB	Boone		180.0 - 182.0	11	None
I-75 SB	Boone		182.0 - 180.0	21	None
I-75 NB	Kenton	183.4 - 191.0		73	4-MISSING
I-75 SB	Kenton	191.0 - 183.4		74	4-MISSING
I-75 NB	Kenton		184.0A - 191.0	25	3-MISSING
I-75 SB	Kenton		191.0 - 184.0A	32	None
TOTALS FOR OHIO AND KENTUCKY				1,751	64 - MISSING

Note: Reference markers on I-275 have been installed on the following three sections;
Milepoint Range 0.1 - 2.0
Milepoint Range 40.0 - 49.9
Milepoint Range 73.4 - 84.0

TABLE 2. SUMMARY OF REFERENCE MARKER INSTALLATIONS
FAYETTE COUNTY - SUMMER 1998

ROUTE	COUNTY	MAINLINE MILEPOST RANGE	RAMP MILEPOST RANGE	NUMBER OF MARKERS	NUMBER MISSING OR CONDITION
I-75 NB	Fayette	105.8-120.8		75	1 Missing
I-75 SB	Fayette	120.8-105.8		76	None
I-75 NB	Fayette		104.0-120.0	19	1 Damaged
I-75 SB	Fayette		120.0-104.0	17	None
TOTALS				187	1 Missing

TABLE 3. COST SUMMARIES FOR REFERENCE MARKER INSTALLATION PROJECTS

PROJECT	MAINLINE MARKERS NUMBER	RAMP MARKERS NUMBER	TOTAL MARKERS NUMBER	TOTAL MARKERS COST/MARKER
ARTIMIS - Ohio	1,106	291	1,397	$166
ARTIMIS - Ky	598	321	919	$154
FAYETTE CO.	322	84	406	$145
TRIMARC	454	531	985	$137
INDIANAPOLIS	1,190	320	1,510	$153

Notes:

1) Separate contacts were awarded as part of the ARTIMIS contract for installation of markers in Ohio and Kentucky.
2) The cost for markers in the Lexington-Fayette County project did not include fabrication of the markers, which was performed in-house by Lexington-Fayette Urban County Traffic Engineering.
3) Traffic control and maintenance of traffic was not included in the cost of the markers used for the TRIMARC project.
4) Maintenance of traffic, mobilization, and construction engineering were not included in the price of markers for the Indianapolis project.

Figure 1. Schematic Showing Mainline Reference Marker Used in the ARTIMIS Project.

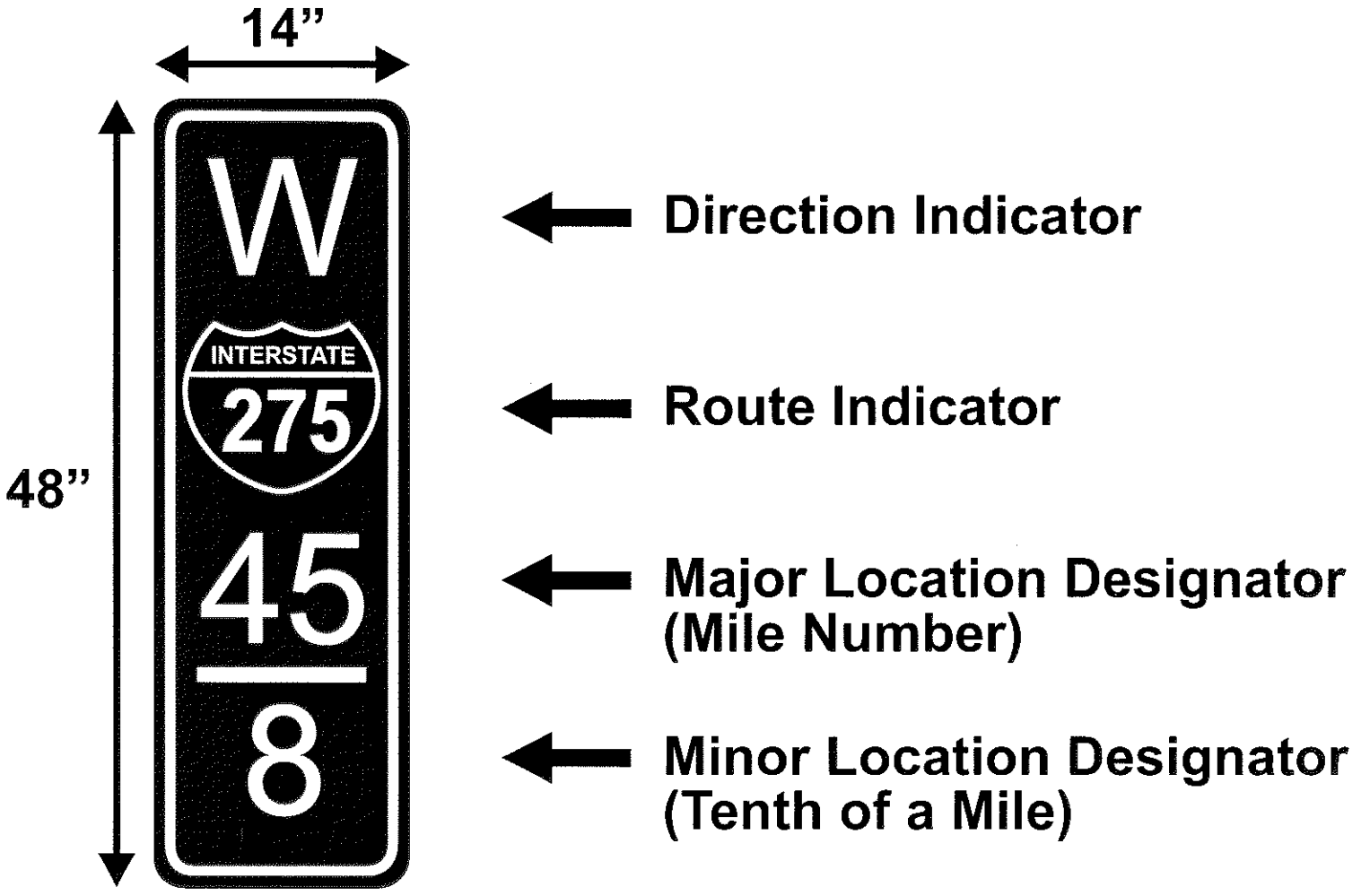


Figure 2. Schematic Showing Ramp Reference Marker Used in the ARTIMIS Project.

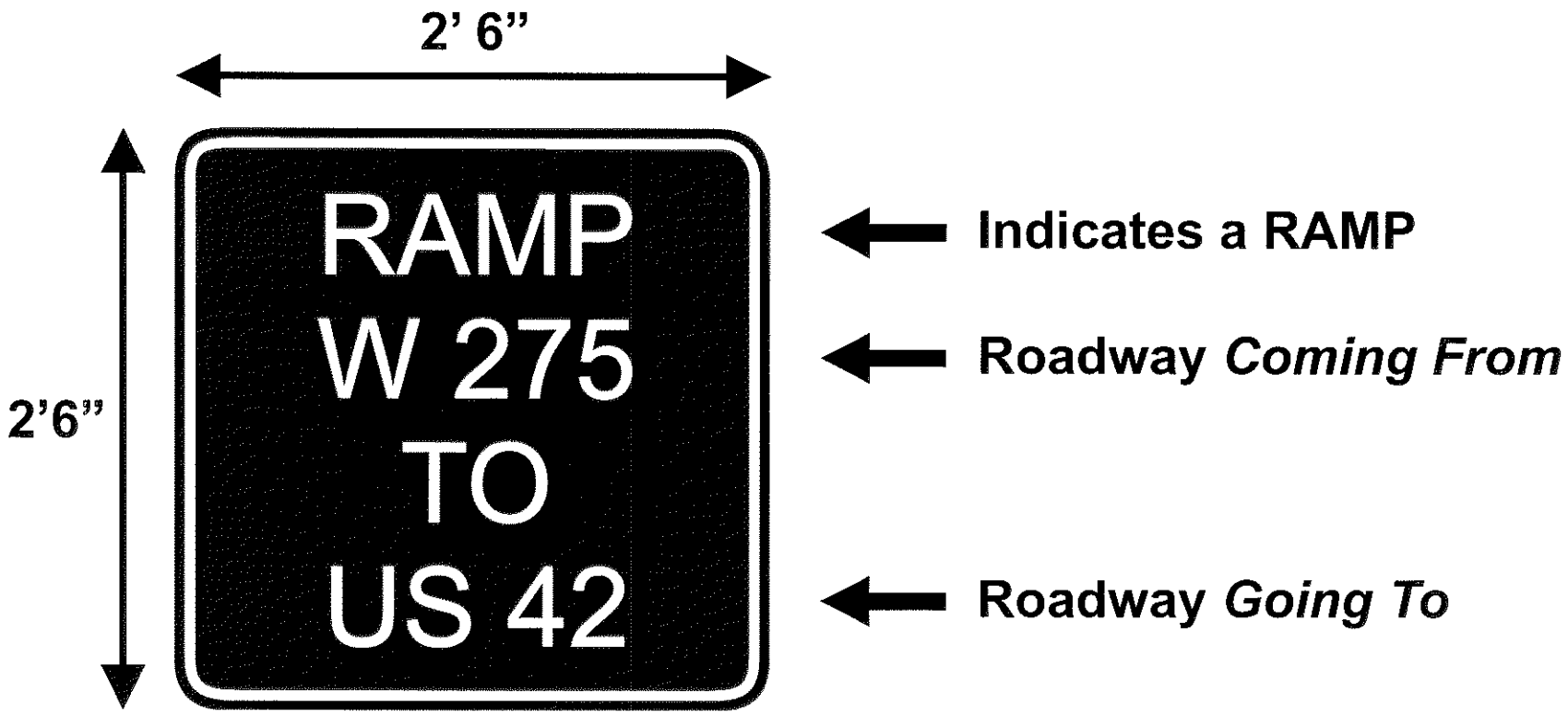
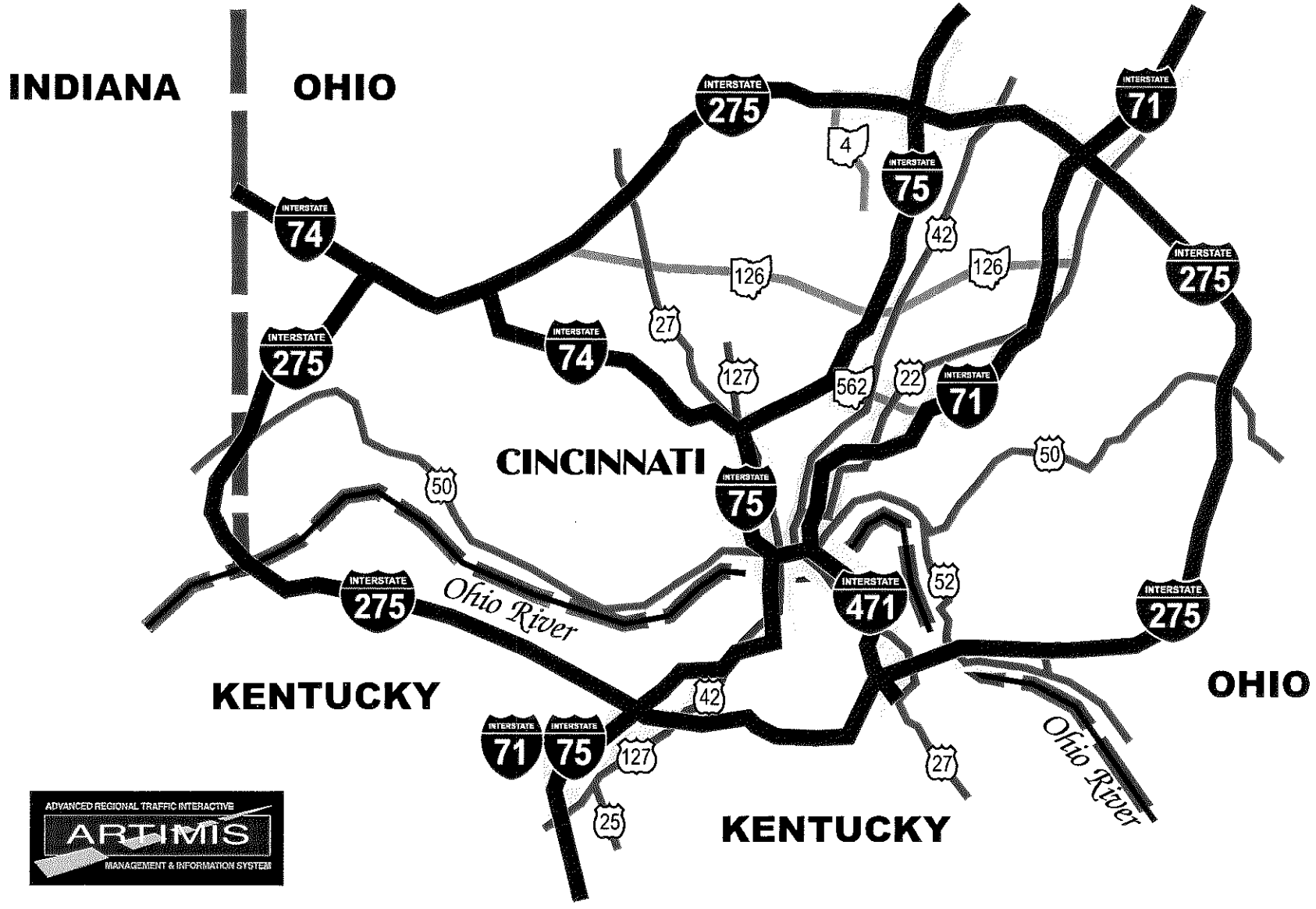


Figure 3. Map Showing Reference Marker Installations - ARTIMIS Project.



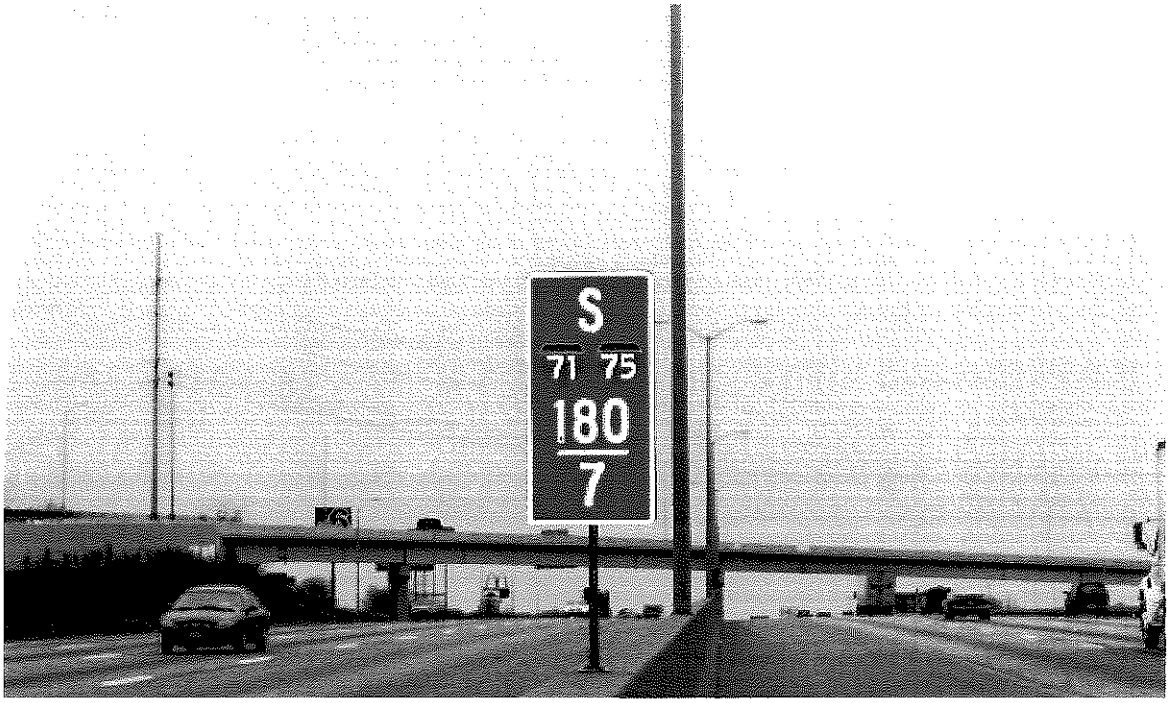
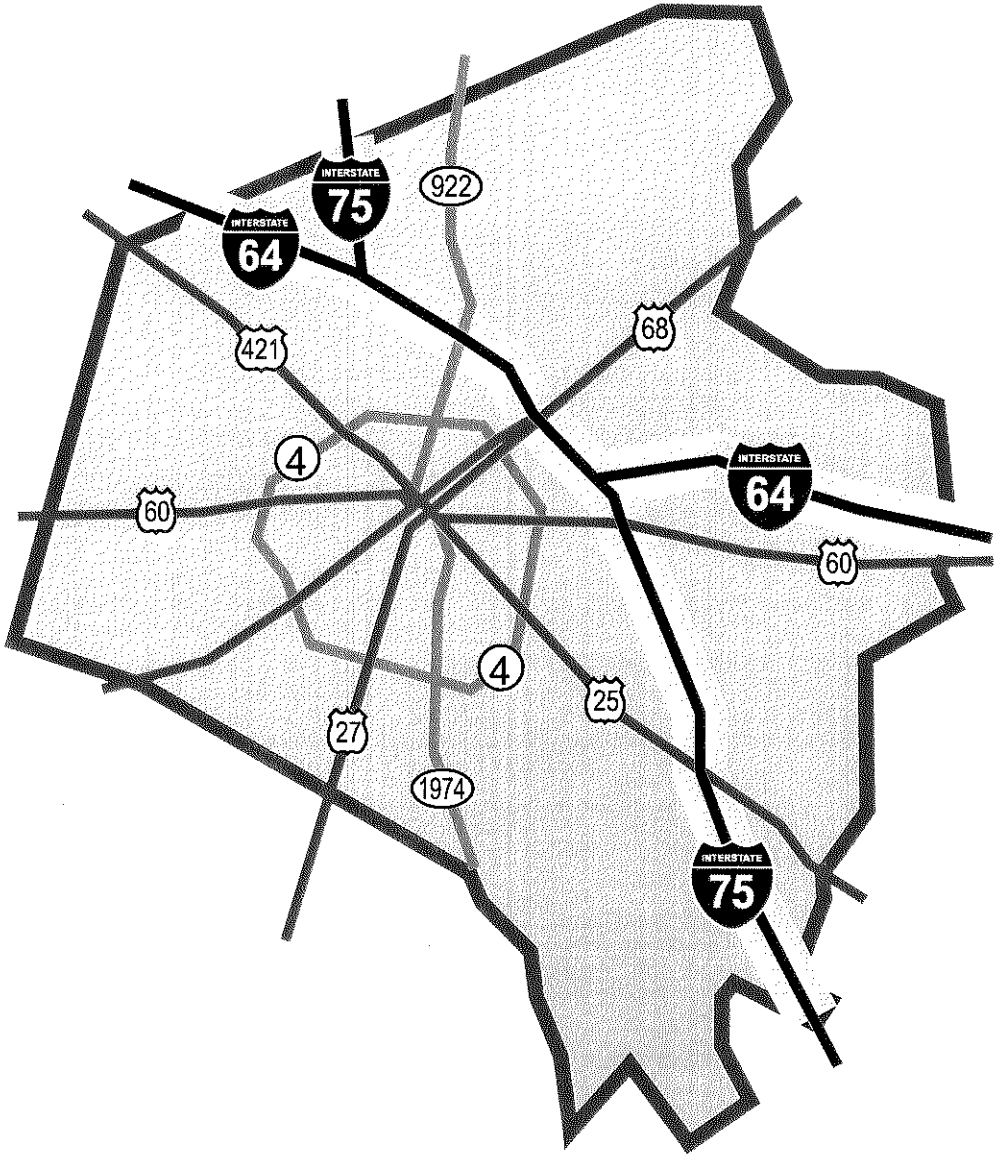


Figure 4. Photograph of Reference Marker Used in the ARTIMIS Project.

Figure 5. Photograph of Ramp Marker Used in the ARTIMIS Project.

Figure 6. Map Showing Reference Marker Installations -- Lexington-Fayette County.



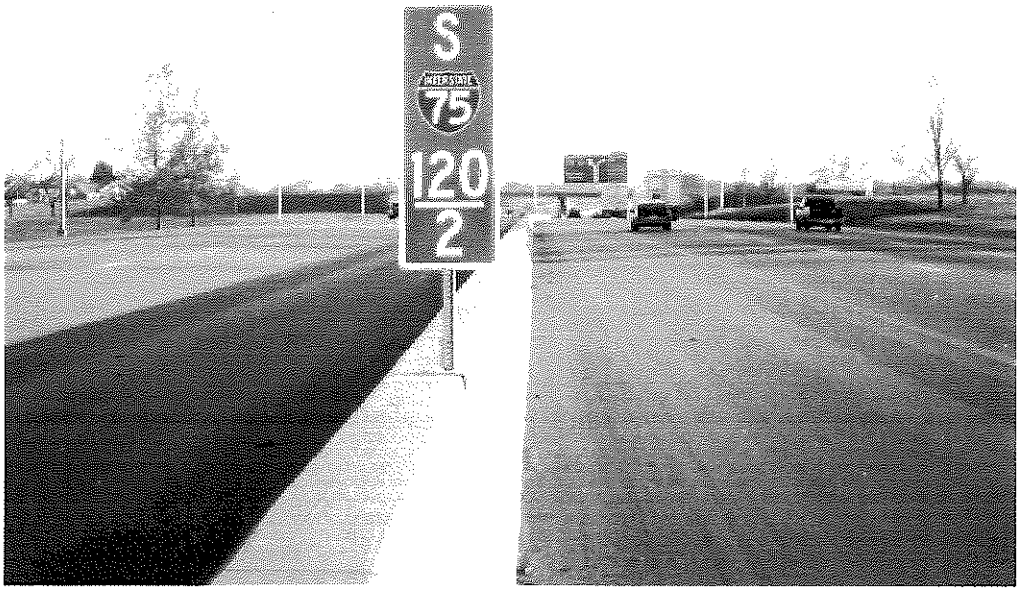


Figure 7. Photograph of Reference Marker Used in Lexington-Fayette County.

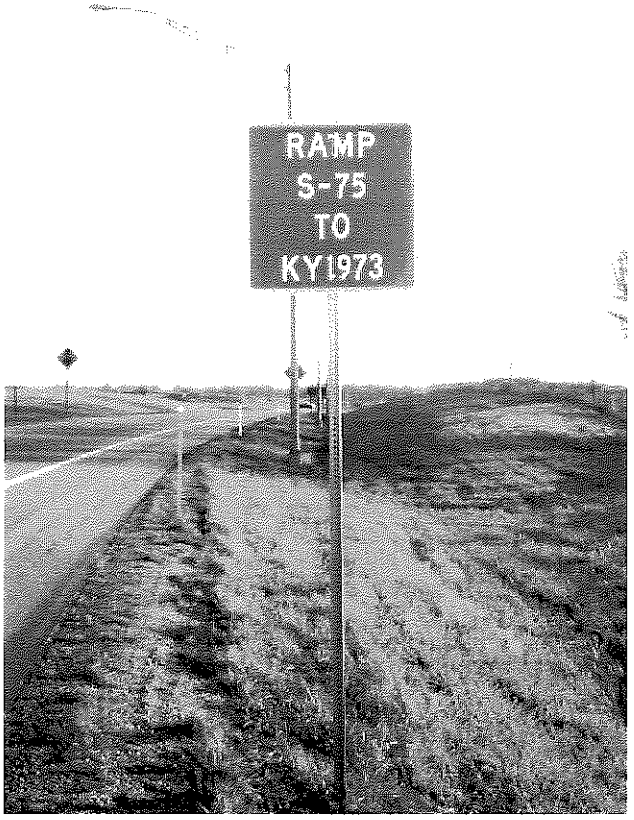
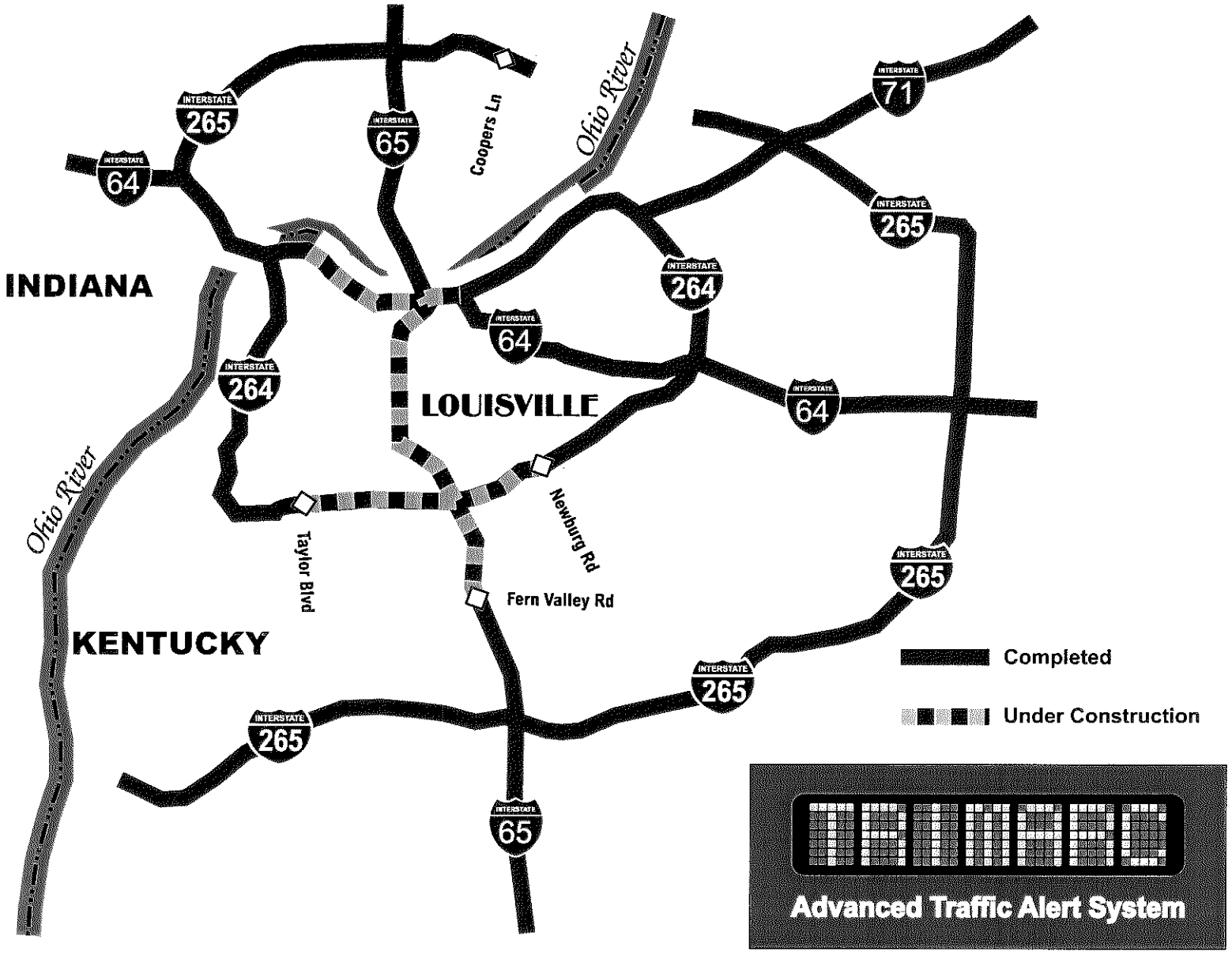


Figure 8. Photograph of Ramp Marker Used in Lexington-Fayette County.

Figure 9. Map Showing Reference Marker Installations - TRIMARC Project.



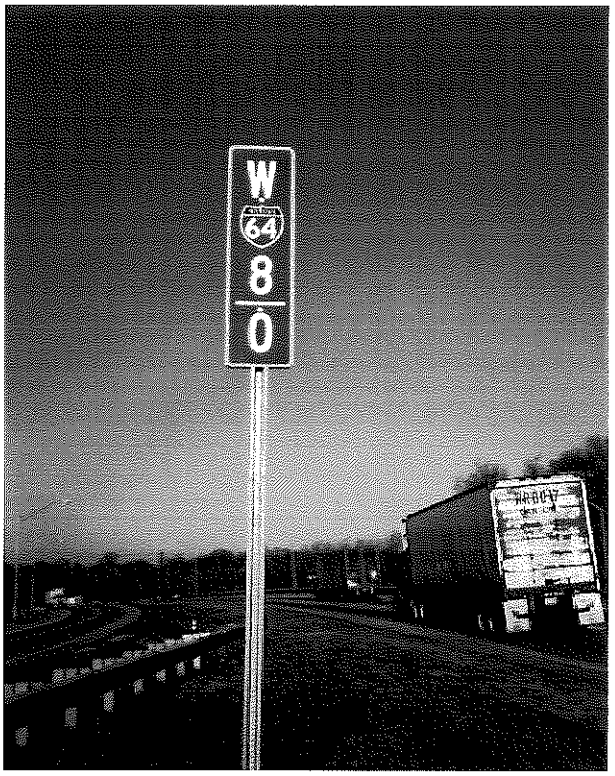


Figure 10. Photograph of Reference Marker Used in TRIMARC Project.

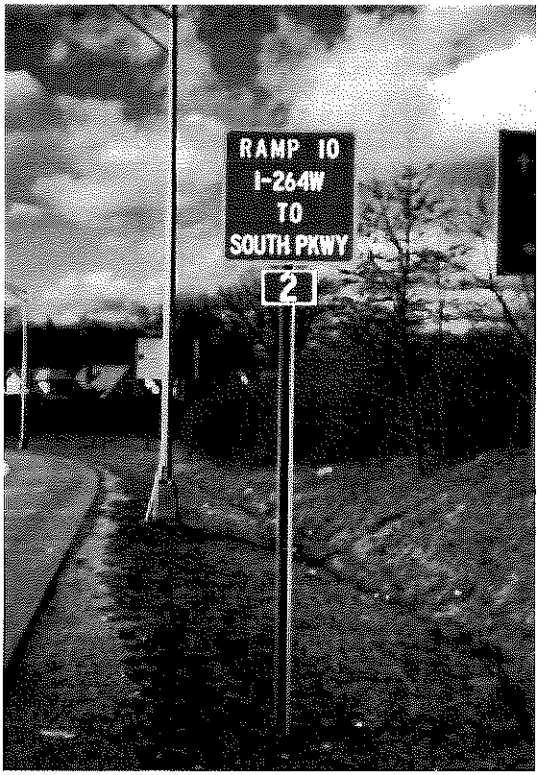
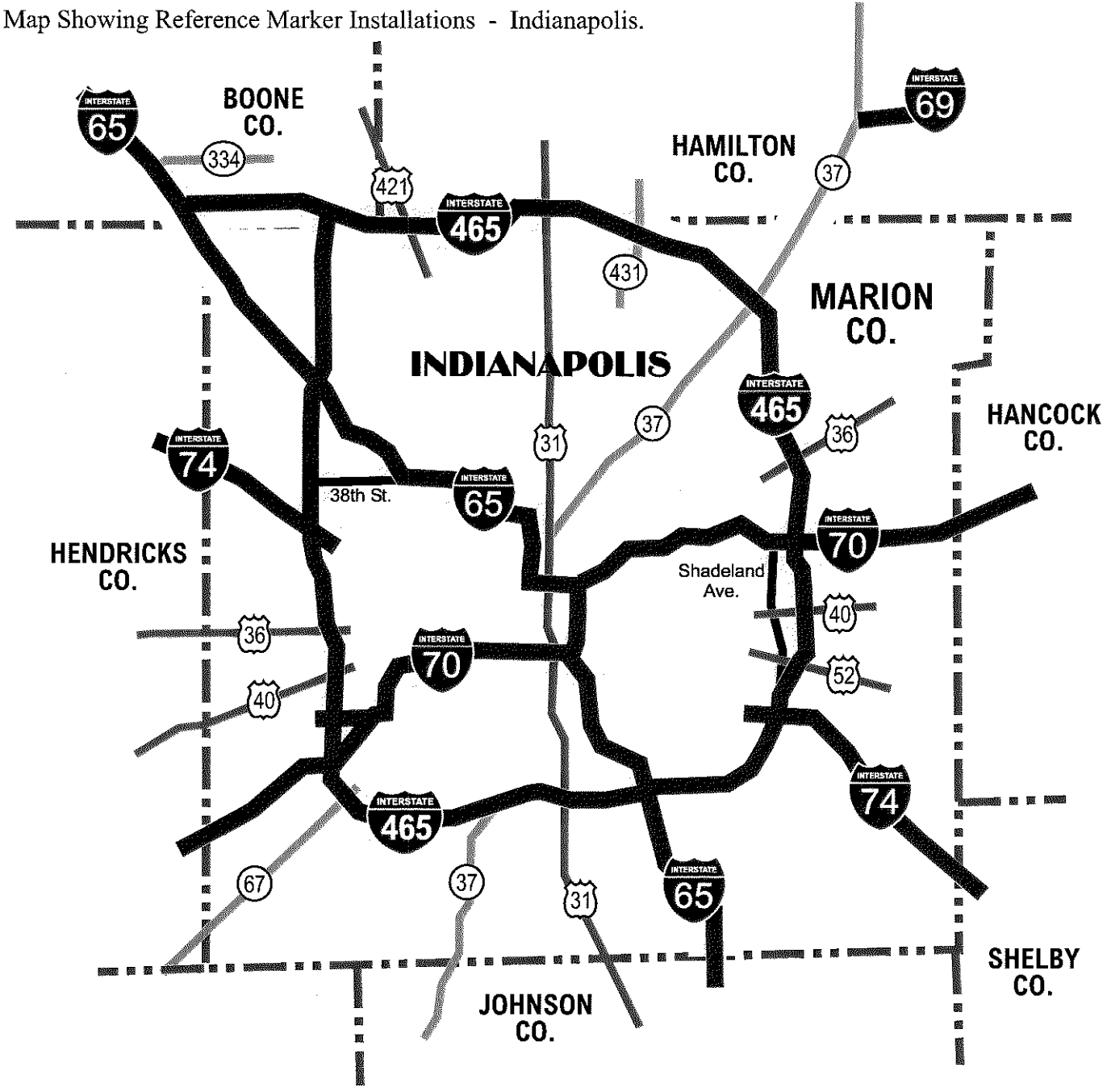


Figure 11. Photograph of Ramp Marker Used in TRIMARC Project.

Figure 12. Map Showing Reference Marker Installations - Indianapolis.



APPENDIX A

STATUS REPORT

REFERENCE MARKER INSTALLATIONS IN THE INDIANAPOLIS AREA

INDIANA DEPARTMENT OF TRANSPORTATION
100 North Senate Avenue
Room N755
Indianapolis, Indiana 46204-2249
(317) 232-5533 *FAX: (317) 232-0238*

FRANK O'BANNON, Governor
CURTIS A. WILEY, Commissioner

January 5, 1999

Writer's Direct Line

Mr. Jerry Pigman
Kentucky Transportation Center
University of Kentucky
Raymond Building
Lexington, Kentucky 40506-0281

RE: Two-tenth mile reference markers and ramp reference markers

Dear Mr. Pigman:

In response to our deployment of the two tenth mile reference markers and ramp reference markers, we are supplying the following information for your use if you choose to include it in your final evaluation report for similar devices in the Cincinnati, Lexington, and Louisville areas.

First of all, I am enclosing a map of the Indianapolis area interstate system on which we recently deployed the two tenth mile reference markers and ramp reference markers. The signs were installed on all the interstates in the Indianapolis area (I-65, I-69, I-70, I-74, and I-465). The mile markers shown on the enclosed map are the limits of the areas that we placed the reference markers. The contract to install these signs was completed in the late summer of 1998. The contract bid price was for the contract was $231,728.55. Included in the contract were 1190 two tenth mile signs (595 reference points) and 320 ramp reference signs. The two tenth mile signs and the ramp reference signs were somewhat variable in dimensions to take into account the interstate shield for I-465 on the two tenth signs and the variable message widths on the ramp signs. However, the dimensions were very close in size to those used in Cincinnati, Lexington and Louisville. One difference on the ramp signs is that we included the interchange number on the first line of the ramp sign, e.g., "Ramp 31" instead of "Ramp". We felt this was necessary to avoid confusion on I-465 where there were two interchanges on either side of town with intersections with other Interstates or state highways, e.g., I-465 intersects with I-70 on both the east and west side of town.

In regard to the bid items for the contract, the cost to install a back to back two tenth marker on a center concrete median bracket (two signs, one bracket) was about $200. A majority of the two tenth signs were on back to back center concrete median brackets. The cost to install a two tenth marker on a square sign post in the grass median area was about $140 each. The cost to install an average ramp sign on a square post in the grass side slope was about $160 each. These costs represent the bid items related to the sign and post material and their installation and does not include the contract bid items related to maintenance of traffic, mobilization, construction engineering and the project field office. The $231,728.55 total project cost listed above does include these total costs.

One construction related comment is that our contractor had a problem with the detail for the center concrete median bracket in that the square post didn't always fit snug into the bracket and they used a straight bolt rather than a corner bolt and several signs slightly leaned to one side. We had used the Cincinnati project detail for this bracket assembly. On future contracts, we will need to detail this item differently.

We marketed these installations by showing these signs at our State Fair booth and we also did media contacts while the signs were being placed. The response from various outside agencies is very encouraging. The State Police have favorable comments as they use the signs for reporting incidents. The

emergency services groups are very pleased with both types of signs and are especially happy with the ramp signs. INDOT has regular meetings with each of these groups and has received regular feedback. Dispatchers are also using the calls from motorists to dispatch emergency equipment to their staff using these reference markers. We recently had conversations with the Metro Traffic people and they indicated that motorist call-ins routinely had motorists calling out the two tenths reference markers in their calls and that enabled them to more accurately relate incidents on both TV and radio reports. One concern that we have heard is that some motorists may be having difficulty on those sections of highway with single digit mile marker numbers, e.g., mile marker 3 and two tenth marker 4. Some motorists may be thinking this is mile marker three fourths (3/4). One possible solution to this would be to consider placing a "point" before the bottom number on the sign. We have not evaluated how prevalent this issue is among the public and it seems to only be on that section of I-465 will mile markers in the single digits. Another benefit that INDOT has internally recognized is that our maintenance crews using the two tenth markers for setting up traffic control for maintenance operations, call-ins for dead animal pickups, etc.

As a response to the incident management meetings with the local fire departments, we will soon be deploying a fire hydrant locator system along the Indianapolis Interstate system. This system will allow fire departments to more quickly locate existing fire hydrants beyond our Right-of-Way fence when responding to incidents requiring fire hydrant use. I am enclosing a detail of the proposed plan which will be deployed in the upcoming months. We are in the process of getting FHWA approval to piggyback this request to our reference marker evaluation.

Lastly, we installed the two tenths mile signs on an eight mile rural Interstate construction project last year where we had a temporary ITS system set up (which included a full time wrecker service receiving calls and monitoring the project). The feedback that we received from these individuals on this project was extremely encouraging in that truckers and motorists were routinely calling out the references listed on the two tenth mile signs to report minor and major incidents.

We have plans to install permanent two tenth mile reference and ramp reference signs on I-65 and one tenth mile reference and ramp reference signs on I-80/I-94 in Lake County (northwest Indiana) by the fall of 1999. These were approved as part of our request for the signs in the Indianapolis area.

If you have additional questions, you may contact me at 317-232-5226.

Sincerely,

James M. Poturalski

James M. Poturalski
Specialty Projects Section Manager

Enclosures

JMP/jmp

Doc:pigman010599

cc: David Boruff
Dan Shamo

APPENDIX B

SURVEY FORMS AND SUMMARY OF RESULTS

HAMILTON COUNTY COMMUNICATIONS STAFF

ARTIMIS REGIONAL INCIDENT MANAGEMENT TASK FORCE

LEXINGTON-FAYETTE COUNTY INCIDENT MANAGEMENT COMMITTEE

REFERENCE MARKER SURVEY
HAMILTON COUNTY COMMUNICATIONS STAFF

1. Are you familiar with the reference signs which have been installed as part of the ARTIMIS project?
   Yes ----__6_____ No----_____

   If you are familiar with the signs, what is your personal impression of the effects or potential effects which the signs may have on the emergency response process?
   Very Beneficial--___6_____ Possibly Beneficial--_____ Not Beneficial--_____

2. Have you received calls from motorists who have used the reference signs in their description of the Location where emergency response is needed?
   Yes----___6_____ No----_____

   If you have received calls where these signs have been mentioned, has there been any response from the public which would indicate a positive impression of the signs?
   Yes----___4_____ No----___1_____ Unknown----___1_____

3. Are you aware of incidents where the reference signs have had an effect on the response times for emergency personnel as a result of being provided better location information?
   Yes----___6_____ No----_____ Unknown----_____

4. Do you have an opinion whether the number of signs and frequency of spacing is appropriate?
   Appropriate--___5_____ Not Appropriate--____1_____ No Opinion--_____

   ¼ mile spacing; with 1/10 mile spacing you can always see the next sign

5. Are there others in the emergency response process who have or could gain benefit from the use of the reference signs?
   Yes----___5_____ No----_____

   If yes, please list those who could be benefitted (such as police, fire, EMS, tow/wrecker operator, etc.)

   All the above, plus maintenance for ice, dead animals, potholes, etc.;
   Any emergency response or service agency responding to interstates;
   ODOT notifications, energy co.

6. Do you have an opinion whether the reference signs should be placed on other sections of roads in order to assist with the emergency response process?
   Yes----___3_____ No----_____ No Opinion----__2_____

7. Please provide other comments related tot he reference signs.

   I would like to see them on all limited access roads in the country;
   Excellent reference points in areas with multiple jurisdictions;
   In rural areas on roads with few intersections;
   Signs are hard to read, all overpasses should have a sign on them stating what road it is;

REFERENCE MARKER SURVEY
ARTIMIS REGIONAL INCIDENT MANAGEMENT TASK FORCE

1. Are you familiar with the reference signs which have been installed as part of the ARTIMIS project?
   Yes ----___22____ No----_____

   If you are familiar with the signs, what is your personal impression of the effects or potential effects which the signs may have on the emergency response process?
   Very Beneficial--___17_____ Possibly Beneficial--____5____ Not Beneficial--_____

2. Have you received calls from motorists who have used the reference signs in their description of the Location where emergency response is needed?
   Yes----___16_____ No----____6_____

   If you have received calls where these signs have been mentioned, has there been any response from the public which would indicate a positive impression of the signs?
   Yes----__14_____ No----_____ Unknown----____6____ NA---__1___

3. Are you aware of incidents where the reference signs have had an effect on the response times for emergency personnel as a result of being provided better location information?
   Yes----___11_____ No----____3_____ Unknown----____6_____

4. Do you have an opinion whether the frequency of sign spacing is appropriate?

   Spacing of signs for ARTIMIS Project is 0.1 mile or approximately 500 feet.
   Appropriate--___15_____ Not Appropriate--__4_____ No Opinion--__2_____

   Spacing of signs for Lexington Project is 0.2 mile or approximately 1000 feet.
   Appropriate--___7_____ Not Appropriate--____6_____ No Opinion--___5____

   Signs could be placed a little farther apart;
   Perfect Spacing;

5. Which sign color do you feel is most appropriate or effective for emergency response use?

   The ARTIMIS signs are white numbers and letters on blue background.
   Appropriate--___17_____ Not Appropriate--_____2_____ No Opinion--__3____

   The Lexington signs are white numbers and letters on green background.
   Appropriate--___4_____ Not Appropriate--___8_____ No Opinion--___8____

   Blue;
   Blue or white;
   White on blue;

6. Do you have an opinion whether the reference signs should be placed on other sections of roads in order to assist with the emergency response process?
   Yes----___15_____ No----__2_____ No Opinion----___5_____

   Major arteries;

7. Please provide other comments related to the reference signs.

Do we have potential for information overload?;
Spacing, color, location all great!!;
Extremely valuable for precise location determination, and "easy to use" for the "below average" motorist (just ask them to "read" the sign to the dispatcher and location can easily be determined).;
Had occasion to talk to an out of state motorist who loved them, she felt like she always knew where she was even though it was unfamiliar territory.;
Signs are quite effective.;
More signs with different information could cause confusion at highway speeds, current plan is simple and easy.;
Place signs where addresses are not available.;
The signs are a great aid in getting more precise information from the public and relay and send the appropriate agency to a problem.;
Great idea!;
This project is overdue and should be expanded without delay!;

EVALUATION OF REFERENCE SIGNS
Prepared by the University of Kentucky Transportation Center
(Return survey to Jerry Pigman at Fax No. 257-1815)

1. Are you familiar with the reference signs which have been installed as part of the ARTIMIS project and in the Lexington area? 15 Yes ___ No

   If you are familiar with the signs, what is your personal impression of the effects or potential effects which the signs may have on the emergency response process?
   7 Very Beneficial 8 Possibly Beneficial ___ Not Beneficial

2. Have you received calls from motorists or are you aware of anyone who has used the reference signs in their description of the location where emergency response is needed?
   5 Yes 10 No

   If you have received calls or are aware of incidents where these signs have been mentioned, was there a positive impression of the signs?
   4 Yes ___No 5 Unknown

3. Are you aware of incidents where the reference signs have had an effect on the response times for emergency personnel as a result of providing better location information?
   3 Yes 3 No 8 Unknown

4. Do you have an opinion whether the frequency of sign spacing is appropriate?

   Spacing of signs for ARTIMIS Project is 0.1 mile or approximately 500 feet.
   4 Appropriate 8 Not Appropriate 3 No Opinion

   Spacing of signs for Lexington Project is 0.2 mile or approximately 1000 feet.
   15 Appropriate ____Not Appropriate ____No Opinion

5. Which sign color do you feel is most appropriate or effective for emergency response use?

   The ARTIMIS signs are white numbers and letters on blue background.
   4 Appropriate 9 Not Appropriate 1 No Opinion

   The Lexington signs are white numbers and letters on green background.
   13 Appropriate 1 Not Appropriate 1 No Opinion

6. Do you have an opinion whether the reference signs should be placed on other sections of highways in order to assist with the emergency response process?
   9 Yes 4 No 2 No Opinion

7. Please provide other comments related to the reference signs.

Other Comments

Increased maintenance costs associated with reference signs
Opinion that 0.1 mile spacing is too frequent
Signs help improve location identification for drivers
Milepost signs are too far apart to be effective and reference signs fill void
Red/white signs may be better for emergency location use
Use 0.2-mile sign except where there is a need for closer spacing
Helps to eliminate driver confusion about location in times of incidents