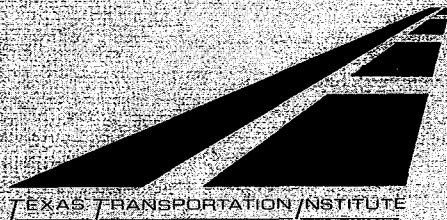




**DEPARTMENTAL  
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In cooperation with  
Texas Department of Transportation  
and the FHWA

**Summary Report**

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**Summary Report 1108-S**  
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# **NEW DATA AND UPDATED ANALYSIS TOOLS FOR ESTIMATING THE TRAVEL IMPACTS OF WORK ZONE LANE CLOSURES**

## **PROBLEM STATEMENT**

Freeway maintenance and construction activities often cause increases in congestion, fuel consumption, and mobile source emissions. When a lane closure has to occur due to the roadway work zone, the safety of workers and the traveling public is automatically an important issue as well. Transportation departments must be able to estimate traffic impacts and develop traffic management alternatives for both short-term maintenance operations and long-term reconstruction projects. An accurate data base of work zone traffic flows and efficient analysis tools are an important part of these processes.

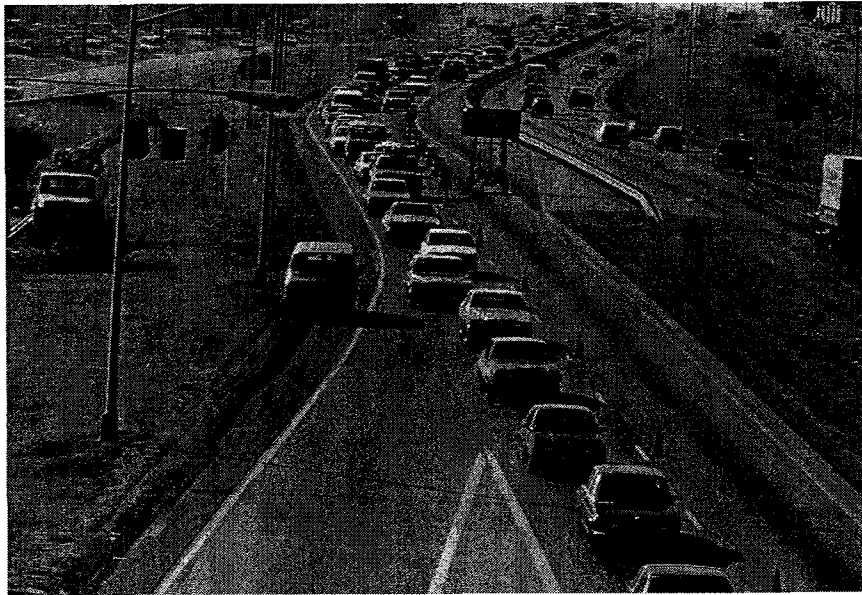
## **OBJECTIVES**

The Texas Transportation Institute (TTI) completed study 1108, *Traffic Pattern Assessment and Road User Delay Costs Resulting from Roadway Construction Options*, in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA) with an overall goal of improving the database and analysis tools used for estimating the travel impacts of road maintenance and construction activities.

Researchers reviewed and synthesized travel impact experiences outside of Texas, and collected and analyzed data from Texas projects such as the U.S.59 Reconstruction project in Houston. These activities involved looking at traffic volume data and travel time and speed data at the reconstruction sites. In working toward improved work zone safety and capacity estimation procedures, the following were also measured:

- accident experience before and during 5 major Texas freeway reconstruction projects from 1984 through 1988,
- the traffic handling capacities of 33 short term freeway work zone lane closures, and
- the diversion characteristics at 11 short-term freeway work zone lane closures.

Seven interim reports (see shaded box on page 4) detail the different tasks and phases of the study, and the final report (1108-8F) synthesizes the study's key findings.



## FINDINGS

### Improved Analysis Tool

The study culminated in an updated microcomputer version of an analysis tool for evaluating the impact of freeway work zone closures. QUEWZ stands for Queue and User Cost Evaluation of Work Zones; it is the computerized version of manual techniques for estimating the queue lengths and additional road user costs resulting from lane closures. The program has been revised and developed under several TTI research studies over the last 12 years. QUEWZ-92, enhanced by the data collected in this study, contains procedures for analyzing the travel impacts of *short-term* freeway work zone closures.

By simulating traffic flows through freeway segments both with and without a work zone lane closure, QUEWZ-92 estimates the changes in traffic flow characteristics and additional road user costs resulting from a lane closure (with time schedule and lane configuration described by

model user). QUEWZ-92 can also apply the same traffic flow simulations to identify alternate lane closure time schedules that will not produce excessive queue lengths and delays.

The model can be applied to freeway facilities, or other multi-lane highways, with as many as six lanes in each direction. It can also analyze work zones with any number of lanes closed in either one or both directions for up to 24 consecutive hours. Use requires an IBM-compatible, DOS-based microcomputer. A user's manual has been published as TTI Research Report 1108-7.

### Relevance of New Data

A comparison of new capacity data for short-term freeway work zone lane closures and corresponding old values in the 1985 *Highway Capacity Manual* indicates that for some configurations (closures from 3 to 1 lanes and from 2 to 1 lanes), the new average capacities are significantly higher than those taken from the old HCM data. While

*Based on the new data, researchers recommend using an overall average capacity of 1600 pcphpl as a base capacity value for all short-term freeway work zone lane closures.*

for other configurations, the old and new averages are not significantly different. The higher observed capacities might be due to more consistent work zone control and a more experienced driving population.

Basically, the new 1108 data collected at five different lane configurations indicate that after adjusting for heavy vehicles, there is no statistically significant difference among the average capacities of each lane closure configuration. The individual capacities all fell within a range of 10% of 1,600 passenger cars per hour per lane (pcphpl). Researchers thus felt it appropriate to use an overall average capacity of 1,600 pcphpl as a base capacity value for all short-term freeway work zone lane closures, regardless of the lane closure configuration. This value is also based upon work zones whose traffic control is in compliance with the *Manual on Uniform Traffic Control Devices*.

The new base capacity value has been incorporated into

QUEWZ-92, and the researchers recommend that it be used in place of the older values in the 1985 HCM, which uses a different value for each configuration. Note, however, that when certain conditions are present, the base capacity value should be adjusted. TTI Research Report 1108-5 discusses the data that supports the recommendation for using an overall base value and details adjustment options for the intensity of work activity, effect of heavy vehicles, and presence of entrance ramps.

The new data on diversion

characteristics corroborated the diversion algorithm previously incorporated in QUEWZ and provided better information on two parameters of the algorithm: maximum acceptable (or likely) queue length in miles and delay in minutes. The algorithm was retained in QUEWZ-92. Although an option was not directly programmed into the model, reducing historical demand volumes by 5% may improve the accuracy of the analysis results because the data also indicate that traffic volumes at lane closure sites will be slightly lower than normal his-

torical counts. It appears that advance traffic information (newspaper reports, television, and radio reports, word of mouth, or seeing the lane closure from the opposite direction of travel) led enough motorists to divert from the freeway before reaching the work zone that traffic conditions often remained near normal. TTI Research Report 1108-6 provides a more detailed discussion of observed diversion characteristics at the study sites.

## CONCLUSIONS

The information from this study should assist engineers in minimizing road user delay as they plan construction activities and develop traffic controls around work zones. QUEWZ-92 was demonstrated at TxDOT's 1992 Short Course, and researchers recommend the user's manual for training TxDOT personnel. The new database will be useful for other related studies, and in continuing to track the effectiveness of the procedures and different lane closure configurations. In fact, the data base has already been instrumental in developing "Corridor Traffic Management Planning Guidelines for Major Urban Freeway Reconstruction," TTI Research Report 1188-4F. Additional research which specifically focuses on certain traffic control and geometric design features of short-term work zones is needed to better understand exactly how site-specific conditions influence accident rates and capacity values.

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## QUEWZ-92 SIMULATES AND COMPARES TRAFFIC FLOWS THROUGH A FREEWAY SEGMENT WITH AND WITHOUT A WORK ZONE LANE CLOSURE.

### INPUT DATA REQUIREMENTS

- Lane Closure Configuration
- Schedule of Work Activities
- Traffic Volumes Approaching the Freeway Segment
- Alternative Values to the Defaults Provided for Various Model Constants



### OUTPUT OPTIONS

- Road User Cost  
(Volumes, capacities, speeds, and queue lengths for each hour during which traffic conditions are affected by the lane closure.)
- Lane Closure Schedule  
(Summarizes the hours of the day during which a given number of lanes can be closed without causing excessive queueing.)

The information in this summary is presented in detail in the following TTI research reports:

1108-1, "Travel Impacts of Freeway Reconstruction: Synthesis of Previous Experience," R.A. Krammes, G.L. Ullman.

1108-2, "Analysis of Accidents at Long-Term Construction Projects in Texas," G. L. Ullman, R. A. Krammes

1108-3, "Travel Impacts of Urban Freeway Reconstruction Projects in Texas," R. A. Krammes,

K. D. Tyer, G. L. Ullman, J. J. Dale, T. R. Hammons

1108-4, "Travel Impacts of the US-59 Southwest Freeway Reconstruction Project in Houston," M. A. Shafer, K. D. Tyer, R. A. Krammes.

1108-5, "Updated Short-Term Freeway Work Zone Lane Closure Capacity Values," R. A. Krammes, G. O. Lopez.

1108-6 "Natural Diversion at Temporary Work Zone Lane Closures on Urban Freeways in

Texas," G.L. Ullman

1108-7, "User's Manual for QUEWZ-92," R. A. Krammes, G.L. Ullman, J. L. Memmott, and Conrad L. Dudek

1108-8F, "Traffic Pattern Assessment and Road User Delay Costs Resulting from Roadway Construction Options," R.A. Krammes, et al.

The information in this summary does not necessarily reflect the official views or policies of TxDOT or the FHWA.

