Estimating Wet-Pavement Exposure with Precipitation Data: Final Report

Deliverable for the Caltrans Research Project
Entitled "Validate Percent Wet Time Statewide" (Contract 65A0226)

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EXECUTIVE SUMMARY

Achieving the best safety record in the nation is a primary goal for Caltrans. To this end, Caltrans develops a list of high collision concentration locations (Table C) every quarter using the Traffic Accident Surveillance and Analysis System (TASAS) database. Table C identifies the ramps, intersections and highway segments with accident rates that are significantly higher than the statewide average in 36-, 24-, 12-, 6-, and 3-month periods. The identified locations in Table C are then investigated individually to evaluate collision risk based on observed frequency. Caltrans also develops a Wet Table C annually that analyzes updated lists of wet accidents alone using a similar methodology as Table C.

The existing table of percent wet time (i.e., wet pavement factors) was developed in 1972 using eleven years of data from 1957 to 1967. A Caltrans task force that investigated the methodology used to develop the Table C and Wet Table C recommended that the table of percentage wet time be updated. This research is the update of that table. The use of more recent data is expected to better reflect current climatic trends being taken into account in identifying significant wet-pavement crash locations in Wet Table C.

In addition to updating wet-percent factors, this research examined current views toward Wet Table C within Caltrans, as well as the practices of other states in identifying wet pavement crash locations. It also examined the preparation and use of precipitation data in generating wet percent factors. Finally, the research examined what, if any, differences arose when using wet percent factors of a finer resolution than the countywide scale employed in the current Wet Table C. A singular value for an entire county may not reflect the climatic variation that occurs along the length of a particular roadway.

Results from updating the wet percent factors, indicated that the new factors that were generated were reasonably similar in value to the older factors. This would suggest that, although changes have occurred over time in terms of precipitation received by county, these changes have not been radical. Given the quantity and accuracy of the data that were available to the researchers in generating the new factors, a factor that excluded the contribution of snow (i.e., included only rainfall data) was also produced. This new type of factor may prove to be useful in areas where substantial rain and snow precipitation both occur throughout the year and thus present inherent problems for measurement accuracy and have differing impacts on safety. As a result, the development of such a factor allows for new avenues of analysis to be made within the Wet Table C process.

McNemar tests were employed to evaluate what, if any, differences existed between the Wet Table C locations identified as having wet-accident significance using the 1972 countywide factors and the updated 2008 countywide factors. The same evaluation was performed comparing these factors against factors generated at a finer resolution. The finer resolution factors were generated for quarter-mile sections along the study roadways, with consecutive identical values subsequently combined to form segments of varying length. Based on the results of the McNemar tests, two conclusions were drawn. First, no significant differences were observed between lists developed using the 1972 and the 2008 countywide factors, indicating that the sites identified for further investigation were similar despite the use of newer data. Second, based on the statistical

evaluation performed on a limited sampling of highways, no difference was found between the lists produced using a singular wet percent time factor and one produced using finer resolution factors. Therefore, the research suggests that Caltrans can continue its use of the countywide average when producing Wet Table C lists.

To generate the new wet percent factors, the dataset required activities to ensure its gaps in the data were filled. Gaps were the result of a number of different causes, including equipment malfunctions, deletion through quality control checks, and others. Results of the processes employed to address missing data indicated that the adopted infill procedures, specifically revision and Nearest Neighbor Frequency Assignment (NNFA), functioned well in addressing the gaps that existed in the data. A simulation test was used to determine the effectiveness of the infill procedures. A total of 384 hours of missing data was simulated, of which 30 hours were originally rainfall hours for one station. A neighboring station located 10 miles away had complete data for the same month. NNFA was employed as the infilling procedure, with the results indicating that the method effectively infilled 24 of the 30 rainfall hours, along with 360 of the 384 non-rainfall hours. Using these figures, the error percentage of infilling was calculated as (30-24)/384=1.6%.

An examination of the various steps and processes employed by the researchers in updating the wet percent factors indicated that that there are some aspects that could be automated through the use of computer programs. These included activities such as data collection and reprocessing. However, the central tasks of data quality control and missing data handling primarily involved human intervention, which was time consuming. At present, it is not possible to develop an automatic data-quality-control algorithm to handle these critical steps by code. As a result, the need remains for some human intervention in the process, at least for the foreseeable future. Additionally, the processes identified as candidates for automation still require further investigation before a conclusion can be drawn regarding the practicality and utility of an automated updating process.

While no significant differences were noted between the 1972 and 2008 factors or the Wet Table C lists produced using them, there were some minor increases and decreases in the factors produced for the new (2008) table. The overall recommendation that can be made as a result of this research is that Caltrans may proceed with phasing out the use of the 1972 factors as soon as it is deemed practical. This recommendation is based on the evidence provided both through the statistical tests performed and the direct comparison of individual county factors. The processes and procedures employed to generate the new wet percent factors appear to have successfully produced new factors that did not significantly deviate from those currently employed. This was primarily evidenced by the similarity in factors that were developed for each county compared to the original factors. Additionally, the Wet Table C lists of site significance developed with each of these factors showed no significant statistical differences.