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A REGRESSION MODEL TO PREDICT LITTER IN URBAN FREEWAY OUTFALLS AFTER RAINSTORMS

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INTRODUCTION

Passage of the Clean Water Act (CWA) amendments in 1972 had profound effects for upgrading wastewater treatment facilities and improving discharge quality. Despite major progress in point source pollution, non-point source pollution remains the nation's largest source of water quality problems in recent time (Horan, 1990; Larsen et al., 1998; Parr et al., 1998). To address the combined effects of point and non-point sources, Section 303(d) of the CWA mandated the implementation of total maximum daily loads (TMDLs). A TMDL is a calculation of the maximum amounts of pollutants that can be discharged to receiving water and still meet water quality standards. The TMDL includes the allocation of loads to the various dischargers and is the sum of the allowable loads of a single pollutant from all contributing point and non-point sources.

In a recent 303(d) list prepared by the California State Water Resources Control Board, at least 36 water bodies were identified where trash or litter is considered a pollutant of concern (CSWRCB, 1999). The first trash TMDL was adopted by the Los Angeles area Regional Water Quality Control Board for the Los Angeles River (CRWQCB, 2001). Other litter TMDLs are being developed for other watersheds.

Concerned with litter accumulation at freeway sites, and in response to the Los Angeles trash TMDL, the California Department of Transportation (Caltrans) is actively assessing the characteristics and potential impacts of litter generated from their freeways (Caltrans, 2000). Caltrans is also evaluating the practical applications and performances of several litter capturing devices (Caltrans, 2001). Litter characterization was an integrated part of the Caltrans First Flush Study where both water quality and litter characteristics during the first flush and the entire storm event were being evaluated (Kayhanian et al., 2002). These data will provide a basis for Caltrans to develop potential treatment technologies and best management practices to control pollutants in runoff from Caltrans roadways. As part of this effort, an attempt was also made to develop a mathematical model to estimate the amount of litter that can be captured from freeway outfalls. The focus of this paper addresses this issue.

Research conducted during the last 25 years has shown that the rate of accumulation of litter along roadsides is a function of such variables as traffic volume, neighborhood income, temperature and rainfall during the accumulation period, and the roadway type or adjacent land use (Syrek, 1986). A recent study of data from 1,400 sample sites in major litter surveys in 15 states has also shown that other factors, such as county population, occupants per vehicle, and the duration of litter control programs significantly influence the rate at which litter accumulates (Syrek, 1998). While the model described by Syrek (1998) characterized the rate of litter buildup along roadsides, additional factors are required to provide estimates of the portion of accumulated litter that would be transported into the drainage system following rainstorm events. These parameters include: total magnitude and intensity of the storm, time elapsed since the previous storm (antecedent dry period), the portion of accumulated litter close enough to the drainage channels to be moved during a storm, and the percentage of litter small enough to pass through the gratings. Earlier estimates indicated that in the U.S., 41 percent of roadside litter is picked up, 42 percent is either

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degraded or covered by soil or vegetation, and 17 percent is washed into the drainage system (Miller-Hooks et al., 2000).

This paper describes how a model was developed to incorporate the factors affecting the rate of litter accumulation as well as the fraction of litter that is transported into the drainage system during a rainstorm. The model was evaluated by comparing the predicted rate of litter in runoff at four urban freeway sites in the Los Angeles Area in the Caltrans Litter Management Pilot Study (Caltrans, 2000) and the actual amount measured at freeway outfalls. Based on the results of this comparison of predicted and actual collected litter, recommendations are provided for improving the urban freeway model. The extension of the model to cover rural freeways and roadways is discussed along with its applicability for predicting the amount of litter transported from streets and freeways in urban areas.