

# National Evaluation of Water Quality Issues for Highway Planning

FRED BANK, KENNETH D. KERRI, G. KENNETH YOUNG, AND STUART STEIN

The results of past research on highway stormwater runoff are gathered and synthesized into a single-volume user's manual on water quality impact assessment and mitigation. The manual will be useful to highway designers and environmental professionals by presenting the available and appropriate impact prediction and mitigation tools for use during highway project planning and development activities. A status report on the first phases of the study, literature search and interviews, is presented. The project has three components: (a) a literature search of existing research results and operational findings on highway stormwater runoff that identifies existing water quality impact assessment and mitigation techniques; (b) interviews with highway practitioners concerning the use of research results, including maintenance of mitigation measures; and (c) development of the single-volume, practical guidance manual. Components of this study include an iterative search and interviews with highway practitioners. A detailed questionnaire was developed and sent to nine highway departments in different areas of the country (each of the FHWA regional offices). A major finding is that many of the departments recognize and follow the often restrictive water quality regulations associated with National Pollutant Discharge Elimination System Stormwater and Clean Water Act Sections 404 and 401. However, hard supporting data on highway runoff water quality impacts are generally not available and studies are based on extrapolative science and hypotheation.

Prior Environmental Protection Agency (EPA) and FHWA research was performed during the early to mid-1970s on highway runoff and its water quality impacts to receiving waters. The Midwest Research Institute (MRI) compiled an EPA manual in 1973 (1) to predict runoff water quality, which served as a planning tool until additional measurements and research occurred. Much of this subsequent research was performed in a multiphased approach by various consulting organizations. About the time of the MRI report in 1972, the need to gather information on highway runoff was established (2). The report (2) included recommendations for mitigating runoff effects and for conducting an intensive study of highway runoff water quality and its significance. The following summarizes the multivolume research reports concerning highway impacts on water quality, developed by FHWA beginning in the mid-1970s:

1. *Constituents of Highway Runoff* (3). This six-volume report, completed in 1981, developed a predictive procedure for determining the pollutant characteristics of stormwater draining from roadway surfaces. The procedure is composed of equations that predict runoff volumes and pollutant wash-off coefficients for 17 water quality parameters for three types of highways.

2. *Sources and Migration of Highway Runoff Pollutants* (4). This four-volume report, completed in 1984, identifies the sources of potential water pollutants, their deposition and accumulation within the highway facility, and their subsequent removal to the surrounding environment. The purpose of this research was to develop methods for controlling pollutant sources and mitigation measures to lessen pollutant levels entering receiving waters.

3. *Effects of Highway Runoff on Receiving Waters* (5). Completed in 1985, this five-volume report analyzes the effects of highway stormwater runoff on receiving waters. Included in the effort were 1-year field studies at three sites and preparation of three user-oriented manuals that provide guidelines for collecting information for use in highway projects environmental assessments.

4. *Highway Maintenance Impacts to Water Quality* (6). This four-volume series of reports, completed in 1985, summarizes a research project describing the impacts of highway maintenance practices on water quality. Research efforts included (a) evaluating the impact potential of routine practices, (b) developing assessment methods for specific practices, (c) identifying measures to mitigate impacts, and (d) conducting field studies to better define impacts from two common practices—herbicide application and surface treatment (seal-coating).

5. *Detention, Retention, and Overland Flow for Pollutant Removal from Highway Stormwater Runoff* (7). This report, completed in 1987, provides interim guidelines for the removal of pollutants from highway stormwater runoff. Three general types of management measures have been determined, through previous FHWA studies, to be effective in treating highway runoff: (a) vegetative controls (overland flow and grassed channels), (b) detention basins (wet detention basins and wetlands), and (c) retention measures (retention basins, trenches, and wells). These interim design guidelines have been developed based on the experience of the project team and by a thorough review of available literature.

6. *Pollutant Loadings and Impacts from Highway Stormwater Runoff* (8). Published in 1990, this is a culminating analytical effort using the results of previous water quality studies with hydraulic, environmental, and related concerns. The results of this study include a probabilistic design procedure for estimating impacts to waters receiving highway stormwater runoff. The procedure uses and expands the predictive model developed in the first series of reports. Additional runoff water quality data collected by this and other studies after the original work in the first phase were used to refine the regression analyses supporting the predictive procedure. Procedures are also included for evaluating the likelihood of the predicted pollutant discharges causing water quality problems. The design procedure is available in both text and personal computer formats.

The information gathered in this research effort is scattered through numerous multivolume reports, a variety of computer software, and other sources. These scattered sources have been useful

F. Bank, FHWA, 400 7th St., S. W., Washington, D.C. 20590. K. D. Kerri, California State University, 6000 J St., Sacramento, Calif. 95819. G. K. Young and S. Stein, GKY & Associates, Inc., 5411-E Backlick Rd., Springfield, Va. 22151.

in providing techniques and guidelines that can be used to address highway impacts on water quality. Because of the fragmentation of the research results, it has become necessary to centralize (focus) the results into a single report that can be used effectively by FHWA, State Highway Administrations (SHAs), and other highway professionals. In fact, organization and centralization of such information was identified as the priority for FHWA/TRB research efforts on water quality by a broad-based committee of federal employees, state DOT employees, and highway practitioners. A problem with the computerized design procedure is the indiscriminate use of the computer program without checking the written procedures, which contain caveats, particularly the need to verify results with site-specific data.

Also, since the initial research was performed, highway maintenance activities and automobile technology has changed, resulting in a revived interest in transportation impacts on water quality. There currently is greater awareness of the impacts of trace amounts of contaminants and their changing nature. Changes such as the disappearance of leaded fuel, the evolution of construction materials (e.g., rubber tires are being pulverized and added into pavement mixtures), and an increase in environmental awareness have stimulated the need to revisit earlier studies. In addition, EPA's shifting emphasis on diffuse (nonpoint) pollution sources has begun to focus on the highways and transportation system under the National Pollutant Discharge Elimination System (NPDES) and the Coastal Zone Act Reauthorization Amendment. This study responds to the need to develop a unified user's manual that condenses prior research results, while still being sensitive to technological and administrative changes that have shaped the need for this research.

## INTERVIEW FORMAT

The interview objective is to contact selected researchers and highway practitioners to collect available results of research, development, and current practice activities. The main reasons for the interviews are to ensure that relevant information sources are included and to gauge the institutional and operational requirements that the manual will address.

The first step in the interview process was to develop a detailed questionnaire to mail to the practitioners. A five-page form was developed that encompassed 25 fundamental questions. The questions were organized into the following major categories:

- Coordination with environmental agencies and the public;
- Available data and materials;
- Evaluation methods; and
- General information.

## INTERVIEW RESPONSE

Questionnaires were sent to nine highway departments in different states, and all responses were received within 2 months. In addition to the completed questionnaires, many of the practitioners also sent copies of state-funded research reports. The following summarizes the responses to questions in the four general categories.

### Coordination with Environmental Agencies and the Public

Each state has an environmental agency with water quality oversight (e.g., Department of Environmental Quality, Water Resources

Control Board, etc.). In addition, state fish and wildlife agencies have jurisdiction over water quality issues relating to the biological community, and state health departments oversee drinking water issues.

The most restrictive water quality regulations for highway practitioners to follow include NPDES stormwater and Clean Water Act Sections 404 and 401. Total maximum daily load requirements are starting to catch on and have the potential to be restrictive on highway projects.

Public involvement is typically handled through public hearings and meetings on Environmental Assessments and Environmental Impact Statements, as well as any other mandates of the National Environmental Policy Act. The public is always given opportunity to review and comment on environmental documents.

## Available Data and Materials

Most practitioners cited previous FHWA research as a source of information on pollutant loads generated by highway activities. Also cited was EPA's *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (9).

Practitioners also cited the FHWA research as a source of information on best management practice (BMP) effectiveness and design guidance. Other cited references include: *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban Best Management Practices BMPs* (10), prepared by the Metropolitan Washington Council of Governments; various research reports by Yousef for the Florida Department of Transportation (11,12); and various SHA BMP manuals such as those prepared for California (13) and the Puget Sound area (14).

Most practitioners did not know of (or at least did not list any) computer models that could contribute to this manual. Some listed EPA's Stormwater Management Model and the software companion to FHWA's *Pollutant Loadings and Impacts from Highway Stormwater Runoff* (8).

Most practitioners did not know of monitoring programs that could contribute to this manual, although many recognize that monitoring will be conducted as part of their SHA NPDES compliance program. Monitoring data are scarce and the expense probably will work to make additional data sparse.

## Evaluation Methods

Most states do not require that highway operations and maintenance runoff impacts be assessed. Where assessment is required, FHWA's model (8) is used as are other models, including regression equations.

More detail may be required for analysis of high average daily traffic projects or projects that may affect sensitive habitat.

## General Information

Salt programs and construction are the highway operations and maintenance activities that are of greatest concern for water quality impacts.

Practitioners want this manual to include current research on BMP effectiveness, design guidance, and cost.

## CONCLUSION

Although runoff water quality has become a major environmental issue with the passage and implementation of the NPDES stormwater program, quantification of nonpoint source pollution loads and resulting water quality impacts are not typical activities within highway planning and design procedures. Actual data are scarce. The surveys indicate that the selected practitioners are aware of current environmental regulations, but are not necessarily familiar with research funded at the state and local levels. This manual will assist practitioners through the identification and summarization of numerous important research efforts into a unified user's manual on water quality impact assessment and mitigation.

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