Report No. FHWA/RD-85/057

HIGHWAY MAINTENANCE IMPACTS TO WATER QUALITY — EXECUTIVE SUMMARY

Volume I

March, 1985
Final Report

Prepared for
FEDERAL HIGHWAY ADMINISTRATION
Office of Engineering and Highway Operation
Research and Development
Construction, Maintenance and
Environmental Design Division
Washington, D.C. 20590

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official policy of the Depoartment of Transportation. This report does not constitute a standard, specification, or regulation.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein only because they are considered essential to the object of this document.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3 PB86-228103
FHWA/RD-85/057		

4. Title and Subtitle	5. Report Date
Highway Maintenance Impacts to Water Quality -- Executive Summary -- Volume I	March 1985
	6. Performing Organization Code
7. Author(s) Kramme, A. D.	8. Performing Organization Report No.
9. Performing Organization Name and Address Dalton·Dalton·Newport/URS 3605 Warrensville Center Road Cleveland, Ohio 44122	10. Work Unit No. (TRAIS) 11. Contract or Grant No. DTFH61-82-C-00085
12. Sponsoring Agency Name and Address Federal Highway Administration Office of Research and Development U. S. Department of Transportation Washington, D. C. 20590	13. Type of Report and Period Covered Final Report - Volume I September 1982 - March 1985 14. Sponsoring Agency Code

15. Supplementary Notes

FHWA Contract Manager: Byron N. Lord, HNR-30

16. Abstract

This report, Volume I in a four-volume series of reports, summarizes a research project involving impacts from highway maintenance practices on water quality. Research efforts included 1) evaluating the impact potential of routine practices, 2) developing assessment methods for specific practices, 3) identification of measures to mitigate impacts and 4) conducting field studies to better define impacts from two common practices -- herbicide application and surface treatment (seal-coating).

The volumes in this series are:

Volume I - "Highway Maintenance Impacts to Water Quality - Executive Summary" (FHWA/RD-85/057)

Volume II - "Investigation of Impacts of Selected Highway Maintenance Practices on Water Quality" (FHWA/RD-85/058)

Volume III - "A Reference Manual for Assessing Water Quality Impacts from Highway Maintenance Practices" (FHWA/RD-85/059)

Volume IV - "Guidelines Manual for Minimizing Water Quality Impacts from Highway Maintenance Practices" (FHWA/RD-85/060)

17. Key Words	18. Distribution Statement
Highway Maintenance Water Quality Water Pollution Impact Assessment Mitigation Measures	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	74	$9.95

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Highway maintenance practices represent a potential source of pollutants to water resources within and adjacent to the highway right-of-way. In order to better define the magnitude and extent of impacts from maintenance practices on water quality and to identify measures to reduce impacts, the Federal Highway Administration (FHWA) sponsored a research study to:

- Evaluate maintenance practices with respect to their potential for impacting water quality.
- Develop detailed methods for predicting and assessing the significance of water quality impacts from maintenance practices.
- Identify mitigation measures used to minimize water quality impacts of maintenance practices and evaluate their cost-effectiveness.
- Perform field studies to evaluate the magnitude, extent, and significance of water quality impacts from maintenance practices which have been identified as potentially significant.

The methods and results of this project are documented in a four-volume series of reports relating to water quality impacts of highway maintenance practices:

- Volume I: "Highway Maintenance Impacts to Water Quality - Executive Summary" (Report No. FHWA/RD-85/057). This report provides a concise summary of the major findings and conclusions of this research project.
- Volume II: "Investigations of Impacts of Selected Highway Maintenance Practices on Water Quality" (Report No. FHWA/RD-85/058). This report presents the results of field research undertaken to improve the state of knowledge concerning impacts to water quality resulting from two highway maintenance practices, herbicide application and road surface treatment (seal-coating).

- Volume III: "A Reference Manual for Assessing Water Quality Impacts from Highway Maintenance Practices" (Report No. FHWA/RD-85/059). This manual provides full descriptions of the potential water quality impacts of most maintenance practices. Methods are detailed for determining if impacts are likely to be significant for a specific maintenance project or program.

- Volume IV: "Guidelines Manual for Minimizing Water Quality Impacts from Highway Maintenance Practices" (Report No. FHWA/RD-85/060). This manual provides guidance for minimizing water quality impacts for any maintenance activity which may adversely affect water quality.

APPROACH AND FINDINGS

EVALUATION OF WATER QUALITY IMPACTS

As the first step in evaluating the potential water quality impacts of highway maintenance practices, a comprehensive listing of practices in common use by highway agencies was compiled. At the same time, information on each practice was obtained from case studies, literature reviews, State maintenance manuals, highway maintenance personnel, and researchers actively involved in studies related to maintenance practices and their potential water quality impacts.

Each practice was then compared to a set of criteria, which revealed the degree of potential for impacting water quality, and classified by type: Type I - practices which can have a probable impact, Type II - practices which can have a possible impact, and Type III - practices which have no probable impact (see also Table 1).

ASSESSMENT METHODS

As an aid to highway officials who are required to document the severity of impacts of certain maintenance practices, detailed impact assessment methods were developed for each Type I practice. These methods are designed to be location-specific and to predict the severity of any disturbance to water quality caused by a given maintenance activity.

As Figure 1 illustrates, these assessment methods are based on a habitat evaluation method which involves evaluating the resource value of the water body of concern prior to performance of the maintenance practice, evaluating the resource value of the water body after performance of the maintenance practice, and determining if the difference is significant. Four specific assessment methods, each tailored to a particular type of maintenance activity, permit determination of the resource value of the water body after performance of the maintenance practice.

Table 1. Maintenance practices organized according to water quality impact types.

Maintenance practices which can have a probable impact (Type I)

- Repairing slopes, slips, and slides
- Cleaning ditches, channels, and drainage structures
- Repairing drainage structures
- Bridge painting
- Substructure repair
- Chemical vegetation control

Maintenance practices which can have a possible impact (Type II)

- Full depth repairs
- Surface treatments
- Blading and restoring unpaved berms and/or shoulders
- Repairing curbs, gutters, and paved ditches
- Bridge surface cleaning
- Bridge deck repairs
- Mowing
- Planting or care of shrubs, plants, and trees
- Seeding, sodding, and fertilizing
- Application of abrasives
- Care of rest areas
- Washing and cleaning maintenance equipment
- Bulk storage of motor fuels
- Disposal of used lubricating oils

Maintenance practices which have no probable impact (Type III)

- Blading unpaved surfaces
- Pothole patching
- Surface repairs
- Filling and sealing joints and cracks
- Pavement jacking
- Planing pavements - bituminous and concrete
- Bridge joint repair
- Superstructure repair
- Cleaning pavement
- Guardrail repair
- Snow plowing
- Crash attenuator repair
- Snow fence installation and removal
- Highway lighting
- Flat sheet, side-mounted, and overhead sign maintenance
- Pavement marking
- Bulk storage of nonfuel materials
- Controlling and disposal of roadside litter

NOTE: The use of deicing chemicals for snow and ice removal was specifically excluded from this study.

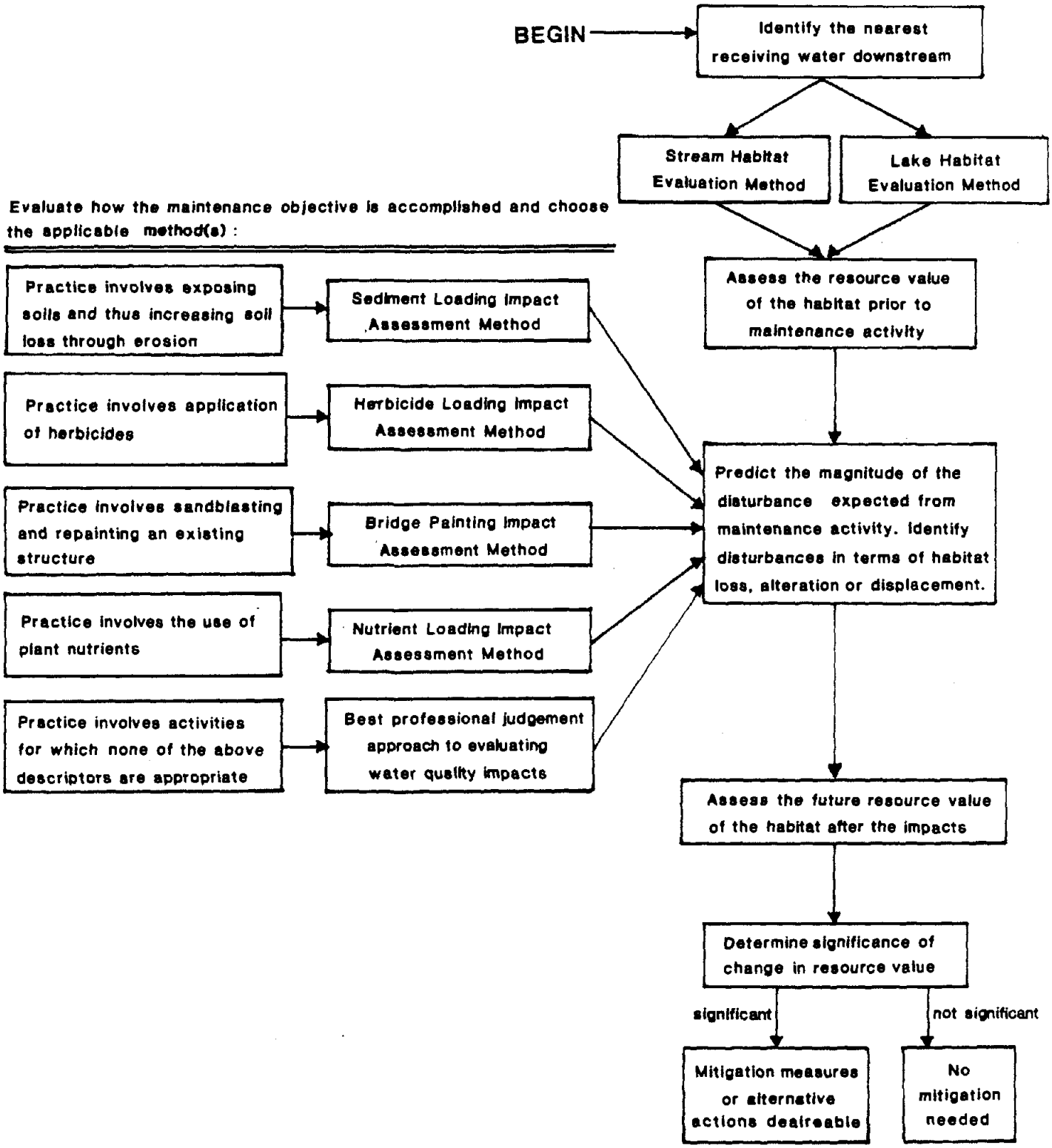

Figure 1. General impact assessment method for evaluating potential impacts to water quality from highway maintenance practices.

MITIGATION OF IMPACTS

Practical guidance for reducing impacts using mitigating measures is provided (see Volume IV), along with a method to evaluate and select the most cost-effective measure under specific applications. Ranges of costs for Type I and Type II practices and their recommended mitigating measures are provided to assist the maintenance engineer when agency-specific cost data are lacking. Table 2 summarizes possible techniques to minimize water quality impacts for each of the six Type I maintenance practices. It should be noted that even Type I maintenance practices can be easily controlled, e.g., increased sediment load is controlled via riprap, sod, sediment traps, and other general erosion control measures. Most impacts are considerably reduced through best management practices, which are, in fact, frequently standard practices for most agencies.

In addition, reflecting their increasing use, special attention is given to herbicides and insecticides used to control roadside vegetation. Data on typical application rates, persistence, and aquatic life toxicity are used to rank each compound according to its potential for causing water quality impacts. The highway engineer is thereby given guidance in selecting the chemical which, while offering effective control, minimizes aquatic life impacts.

FIELD STUDIES

A program of field monitoring was conducted to better define and evaluate water quality impacts from two routine maintenance practices--chemical vegetation control and surface treatment (seal-coating) using asphaltic emulsions (see Volume II). For chemical vegetation control, 2,4-D and picloram were chosen for study. The basic research design involved monitoring stormwater runoff from a control and treatment drainage area within two study sites, before and after herbicide application to the treatment areas. Chemical analyses and hypocotyl growth test bioassays were conducted on runoff samples. Concentrations of 6.2 and 25 mg/L of 2,4-D were measured in runoff samples 11 and 35 days, respectively, following treatment. Over half of the 2,4-D was sediment-attached. Picloram was detected only once in runoff at a concentration of 0.92 mg/L following treatment. Comparisons of runoff concentrations with estimated safe concentrations for aquatic life indicate that significant impacts to aquatic life are not likely. Dilution of runoff concentrations with receiving stream waters would further reduce the probability of water quality impacts. Bioassays generally showed no significant effects.

Table 2. Potential water quality impacts from Type I highway maintenance practices.

Maintenance practice	Potential water quality impacts	Mitigating measures
Repairing slopes, slips, and slides	Increase in erosion due to disturbance of vegetative cover; increased nutrient load from fertilizer use	Construction of interceptor ditches or retention basins; use of sediment traps; seeding and mulching; use of slow-release fertilizers; use of plantings; best management practices[a]
Cleaning ditches, channels, and drainage structures	Increase in sediment load through erosion of newly exposed soils or resuspension of deposited solids; deposits may be high in metals content; increased nutrient loads with use of fertilizers	Sodding or seeding and mulching; use of jute matting or riprap; proper disposal of excavated materials; limited use of herbicides; best management practices[a]
Repairing drainage structures	Increase in sediment loads through eroding soils disturbed during repairs	General erosion and sediment control practices including use of riprap, sod, or seeding and mulching; best management practices[a]
Bridge painting	Introduction of blasting abrasives and paint chips (high metals content); overspray and solvents may be toxic to aquatic life	Use of shrouding to collect solid waste generated from sandblasting; use of floating straw or boom-type collectors to prevent direct entry into waterway; use of airless sprayers; avoidance of solvent cleaning; best management practices[a]
Substructure repair	Increase in sediment load through bank erosion and in-stream sediment disturbance	Use of straw bales or fabric filter cloth as sediment traps; minimize disturbance of soils near streams; avoidance of in-stream work; best management practices[a]
Chemical vegetation control	Toxicity to aquatic life from residual runoff and accidential or incidental direct application to receiving waters	Proper application of herbicides; applicator training; use of surfacants and drift control agents; minimizing or avoiding use in waterways, wetlands, or drainage courses; use of herbicides least likely to produce toxic effects based on toxicity, mobility, and persistence; best management practices[a]

[a] Best management practices include prior planning, proper conduct of the maintenance practice, good housekeeping, etc.

For the road surface treatment (seal-coating) field study, stormwater run-off was monitored from a road surface following treatment with an asphalt emulsion (WS-90). Runoff samples were analyzed by 48-hour static bioassays using Daphnia magna and chemically for polynuclear aromatic hydrocarbons (PAHs). Also, a sample of the asphalt emulsion as applied was analyzed for PAHs. Bioassays showed runoff samples to be relatively nontoxic. PAHs were not found in runoff samples at a detection limit of 3 mg/L, nor in the asphalt emulsion at a detection limit of 4 mg/kg.

CONCLUSIONS

Three conclusions may be drawn from this research project:

- Generally, highway maintenance practices have a low potential for significant water quality impacts. Out of the almost 40 routine highway maintenance practices studied, only 6 were shown to have any marked potential for impacting water quality.

- Most highway practices have no potential to impact water quality; for those that have a possible or probable impact, most can be minimized or reduced through the use of readily available control technologies or through improved best management practices.

- Results of field studies conducted in conjunction with this project indicate that two common practices studied, chemical vegetation control through the use of 2,4-D and picloram and surface treatments using asphalt emulsions, do not impact water quality.