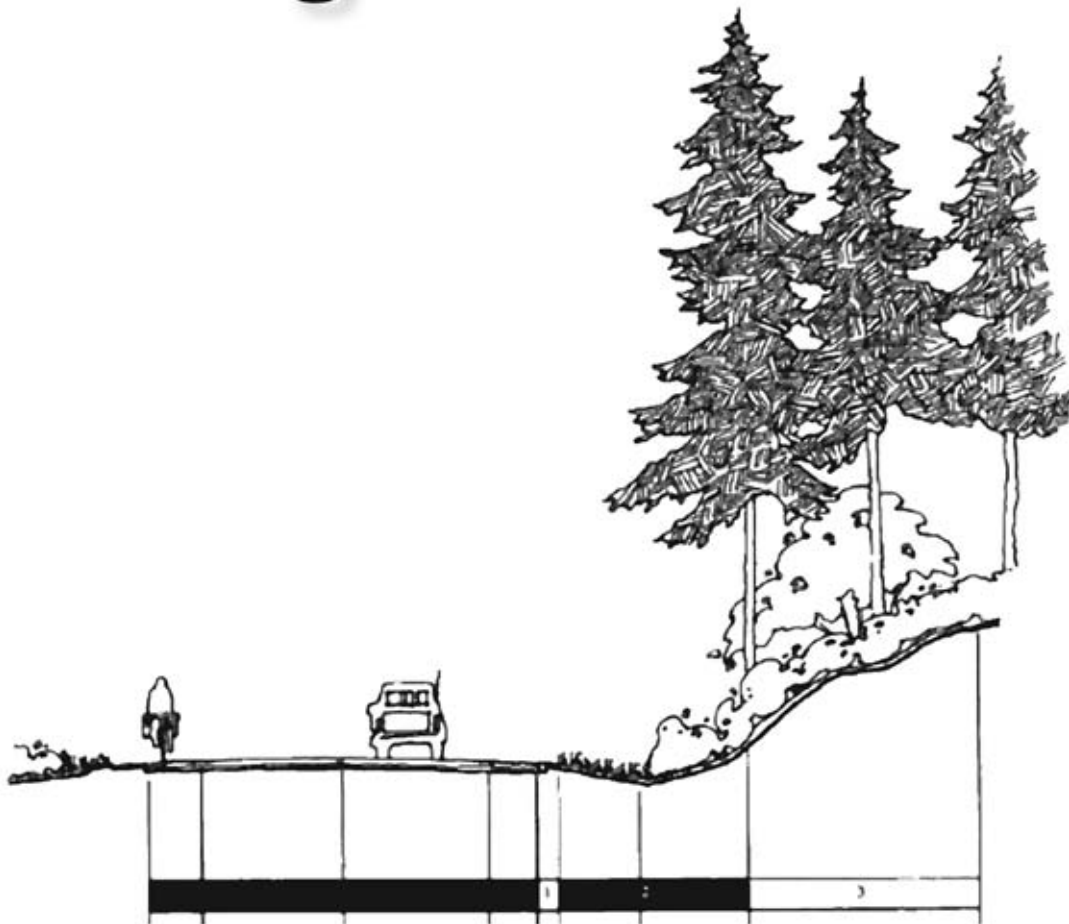


Guidelines for Vegetation Management



American Association of State Highway and Transportation Officials. **The Voice of Transportation**

© 2011 by the American Association of State Highway and Transportation Officials.
All rights reserved. Duplication is a violation of applicable law.

EXECUTIVE COMMITTEE 2010–2011

Voting Members

Officers:

President: Susan Martinovich, Nevada

Vice President: Kirk Steudle, Michigan

Secretary-Treasurer: Carlos Braceras, Utah

Regional Representatives:

REGION I:

George Campbell, New Hampshire, One-Year Term

Beverley Swaim-Staley, Maryland, Two-Year Term

REGION II:

Mike Hancock, Kentucky, One-Year Term

H. B. “Buck” Limehouse, South Carolina, Two-Year Term

REGION III:

Thomas K. Sorel, Minnesota, One-Year Term

Vacant, Two-Year Term

REGION IV:

Amadeo Saenz, Jr., Texas, One-Year Term

Francis G. Ziegler, North Dakota, Two-Year Term

Non-Voting Members

Immediate Past President: Larry L. “Butch” Brown, Mississippi

AASHTO Executive Director: John Horsley, Washington, DC

SUBCOMMITTEE ON MAINTENANCE 2010–2011

Chair: Carlos Braceras, Utah

Vice Chair: Robert “Chris” Christopher, P.E., Washington

Secretary: Celso Gatchalian, FHWA

Liaison: Steve Olson, AASHTO

STATE MEMBERS

ALABAMA	G. Mike Harper George H. Conner, P.E. Ronald D. Pruitt	MARYLAND	Russell A. Yurek
ALASKA	Michael Coffey	MASSACHUSETTS	Thomas Loughlin, P.E. Ron Dionne
ARIZONA	Lonnie D. Hendrix Marwan Aouad Dennis G. Halachoff	MICHIGAN	Jon W. Reincke, P.E.
ARKANSAS	Tony Sullivan Emanuel Banks	MINNESOTA	Steven M. Lund
CALIFORNIA	Steve Takigawa Alan R. Mills	MINNESOTA	Susan J. Lodahl, P.E.
COLORADO	David C. Wieder, P.E.	MISSISSIPPI	John D. Vance Celina Sumrall
CONNECTICUT	Robert P. Mongillo Richard Baron Alastair Probert	MISSOURI	Don Hillis, P.E. James Carney
DELAWARE		MONTANA	Jon Swartz
DISTRICT OF COLUMBIA	Mesfin Lakew Aaron Horton	NEBRASKA	Michael T. Mattison, P.E. Craig R. Lind
FLORIDA	Tim Lattner	NEVADA	Richard J. Nelson, P.E.
GEORGIA	Eric Pitts Keith Golden, P.E. Rachel Brown	NEW HAMPSHIRE	William Hoffman, P.E. Caleb B. Dobbins, P.E. Douglas Gosling
HAWAII	John Williams	NEW JERSEY	William Carter
IDAHO	Brent Jennings, P.E. Steve Spoor	NEW MEXICO	Dennis Ortiz
ILLINOIS	Aaron Weatherholt, P.E.	NEW YORK	Peter Weykamp
INDIANA	Todd Shields	NORTH CAROLINA	Lacy D. Love, P.E. Jennifer P. Brandenburg, P.E. Dan Holderman
IOWA	Bob Younie, P.E.	NORTH DAKOTA	Brad Darr
KANSAS	Roy D. Rissky, P.E. Peter Carttar, P.E. Tim D. Cunningham	OHIO	David Ray, P.E., P.S. Halle Jones Capers, P.E., S.I.T.
KENTUCKY	Nancy B. Albright	OKLAHOMA	Kevin S. Bloss Tom Wadley
LOUISIANA	Gill M. Gautreau Janice P. Williams, P.E. William Drake Jr.	OREGON	Lucinda M. Moore
MAINE	Michael E. Burns Brian T. Burne John E. Buxton David Bernhardt, P.E.	PENNSYLVANIA	Daryl R. St. Clair W. James Smith Charles C. Goodhart
		PUERTO RICO	Jorge A. Vega-Barrios
		RHODE ISLAND	Paul R. Annarummo
		SOUTH CAROLINA	James J. Fedra
		SOUTH DAKOTA	Ed Rodgers, P.E. Jason Humphrey

TENNESSEE	Joe Holt Greg Duncan Chris Harris	VIRGINIA	Erle W. Potter Anwar S. Ahmad, P.E., C.E.M. Robert E. Prezioso, P.E.
TEXAS	Toribio Garza	WASHINGTON	Robert "Chris" Christopher, P.E.
UTAH	Carlos Braceras Richard L. Clarke, P.E. Steven J. McCarthy, P.E.	WEST VIRGINIA	Steven B. Cole, P.E.
VERMONT	Scott A. Rogers Wayne Gammell, P.E.	WISCONSIN	David I. Vieth Thomas R. Lorfeld
		WISCONSIN	John Kinar, P.E.
		WYOMING	Ken L. Shultz, P.E.

U.S DOT MEMBER

FHWA	Eugene Hoelker Wade Casey Christopher Newman Paul Pisano William Beatty Steve Mueller Peter Kopac Mike Moravec Celso Gatchalian
------	---

ASSOCIATE MEMBER— INTERNATIONAL

BRITISH COLUMBIA	Rodney Chapman
NEW BRUNSWICK	Kenneth Connell
NOVA SCOTIA	Bruce Fitzner
ONTARIO	Jeff Baker
SASKATCHEWAN	Brent Marjerison, P.E.

OTHER

TRB	Frank Lisle Jr., P.E. Amir N. Hanna
-----	--

NCHRP PROJECT 14-16 PANEL FOR AASHTO GUIDELINES FOR VEGETATION CONTROL

Chair

John W. Rowen
Vegetation & Environmental Program
Manager
New York State DOT

Juanita M. Owens, P.E.
Assistant Bureau Chief Research &
Development
Alabama DOT

Other Liaison

John W. Bell, P.E.
National Road System O&M Engineer
USDA Forest Service

AASHTO Monitor

Mark C. McConnell, P.E.
Assistant State Maintenance Engineer
Mississippi DOT

Joy H. Williams
Agronomist
Iowa DOT

William W. Witt
Professor
University of Kentucky

NCHRP Staff

Christopher J. Hedges
Senior Program Officer

Danna Powell
Senior Program Assistant

Members

Jack Broadbent
Roadside Management
California DOT

Charles Edson
Vice President
Greenman-Pedersen, Inc.

FHWA Liaison

Bonnie Harper-Lore
Restoration Ecologist
Federal Highway Administration

TRB Liaison

Frank N. Lisle
Engineer of Maintenance
Transportation Research Board

FOREWORD

These guidelines will be of interest to local, regional, state and federal officials as well as other transportation professionals who work with them in dealing with roadside vegetation management. They will be of particular interest to those roadside vegetation managers just beginning their careers. The guidelines provide an overview of current agency practices, recent literature findings, and research on roadside vegetation management. Their primary purpose is to assist roadside vegetation managers in integrated roadside vegetation management decision-making processes into highway project planning, design, construction, and maintenance, as well as to document existing research and practice. Roadside vegetation managers are often faced with problems for which information already exists, in the form of reports and documents, or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated and as a result much of this useful information may go unused by the majority of roadside vegetation managers. These guidelines incorporate the current knowledge and practice of roadside vegetation management. The guidelines also include information extracted from survey responses from 29 state agencies, a glossary that defines technical terms and acronyms, and a compendium of 40 common roadside invasive species, with descriptions of each species, its biology, and common methods of control.

PREFACE

The impetus to writing these guidelines came about from the realization that there was an enormous amount of practical information on roadside vegetation management available but much of it was not being used because it was scattered and unevaluated. The information was dispersed not only in the mainstream literature, but in localized documents and research reports within government agencies. Upon undertaking this task, it quickly became apparent that another major source of the most current practical information on roadside vegetation management was that of the undocumented experience and expertise of roadside vegetation management practitioners. The unselfish cooperation of these individuals has greatly enhanced the utility of these guidelines. These guidelines provide DOT executive managers, middle managers, and supervising practitioners with a toolbox of effective strategies for planning and executing integrated roadside vegetation management programs.

ACKNOWLEDGEMENTS

This study was requested by the American Association of State Highway and Transportation Officials (AASHTO), and conducted as part of the National Cooperative Highway Research Program (NCHRP) Project 14-16. The NCHRP is supported by annual voluntary contributions from the state Departments of Transportation. The report was prepared by a team led by Ian Heap and including David Nelson and Joseph DiTomaso. The work was guided by a task group led by John Rowen and including John W. Bell, Jack Broadbent, Charles T. Edson, Bonnie Harper-Lore, Frank Lisle, Mark C. McConnell, Juanita M. Owens, Danna Powell, Joy H. Williams, and William W. Wit-tand. Thanks are also given to the many state department of transportation vegetation managers that participated in the survey. The project was managed by Christopher Hedges, NCHRP Senior Program Officer. Graphic design and layout by Mario Olivero, AASHTO Senior Graphic Designer.

TABLE OF CONTENTS

1.0 INTRODUCTION	1-1
2.0 EXECUTIVE SUMMARY OF BENEFITS	2-1
3.0 SCOPE AND ORGANIZATION OF GUIDELINES	3-1
4.0 OBJECTIVES OF ROADSIDE VEGETATION MANAGEMENT	4-1
4.1 Safety	4-1
4.2 Economics	4-3
4.3 Erosion Control	4-3
4.4 Environmental	4-4
4.5 Legal and Regulatory Compliance	4-5
4.6 Aesthetics	4-6
4.7 Sustainable Transportation	4-6
4.8 Other Objectives	4-6
4.9 Context Sensitive Solutions (CSS)	4-6
5.0 DETERMINING PROGRAM GOALS AND PERFORMANCE MEASURES	5-1
5.1 Mission Statement	5-1
5.2 Establish and Prioritize Goals	5-1
5.3 Balance Cost and Benefits	5-3
5.4 Determine Performance Measures	5-3
6.0 PUBLIC AND LEGAL ISSUES	6-1
6.1 Laws and Regulations Related to Vegetation Management	6-1
6.2 Tort Liability	6-2
6.3 Environmental Stewardship	6-4
6.4 Customer Demands and Expectations	6-4
6.5 Public Communication and Involvement	6-4
6.6 Partnership/Coordination with Stakeholders	6-5
7.0 INCORPORATING VEGETATION MANAGEMENT AS A PART OF PROJECT DEVELOPMENT, DELIVERY AND CONSTRUCTION	7-1
7.1 Planning (Scoping) Phase	7-1
7.2 Design Phase	7-1

7.3 Construction Phase	7-3
7.4 Maintenance Acceptance	7-4
8.0 ROADSIDE VEGETATION MANAGEMENT ZONES	8-1
8.1 Defining Roadside Vegetation Management Zones	8-2
8.2 Defining Linear Areas	8-3
8.3 Other Management Areas	8-3
9.0 ESTABLISHING VEGETATION	9-1
9.1 Establishing and Maintaining Vegetation	9-1
9.2 Establishing Low-Maintenance Vegetation	9-1
9.3 Native Plants in Revegetation Programs	9-2
9.4 Sustainable Landscapes	9-2
9.5 Choice of Species	9-3
9.6 Revegetation Techniques	9-3
10.0 BASIC PLANT BIOLOGY	10-1
10.1 Integrated Roadside Vegetation Management (IRVM)	10-1
10.2 Biology of Weeds	10-1
10.3 Weed Classification	10-2
10.4 Life Cycle	10-3
10.5 Growth Stages	10-4
10.6 Anatomical and Morphological Structures	10-5
10.7 Plant Growth and Development	10-6
10.8 Environment and Plant Growth	10-7
10.9 Factors Influencing Plant Growth	10-8
10.10 Factors Influencing the Movement and Persistence of Weeds	10-9
10.11 Summary	10-11
11.0 MECHANICAL CONTROL	11-1
11.1 Mowing	11-1
11.2 Tree Removal and Brush Control	11-6
11.3 String and Hand Trimming	11-6
12.0 PERMANENT VEGETATION CONTROL (BARRIERS)	12-1
12.1 Minor Concrete	12-1
12.2 Minor Concrete Pavement	12-2
12.3 Asphalt Concrete Pavement	12-2
12.4 Asphalt Composite	12-2
12.5 Stamped Asphalt Paving	12-3
12.6 Patterned Concrete Pavement	12-4
12.7 Rock Blanket	12-4
12.8 Gravel Mulch	12-5
12.9 Aggregate Base	12-5

12.10	Rock Slope Protection	12-6
12.11	Weed Control Mat (Fiber)	12-6
12.12	Herbicidal Geofabric	12-7
12.13	Rubber Weed Mat	12-7
12.14	Irrigated Ornamental Vegetation	12-8
12.15	Native and Non-Irrigated Vegetation	12-9
12.16	Organic Mulch	12-9
13.0	CHEMICAL CONTROL	13-1
13.1	Introduction	13-1
13.2	Herbicide Regulations	13-2
13.3	General Characteristics of Herbicides for Rights of Way Vegetation Management	13-4
13.4	Herbicide Classification Systems	13-6
13.5	Herbicide Activity	13-9
13.6	Factors Influencing Herbicide Selectivity	13-13
13.7	Toxicology	13-18
13.8	Plant Growth Regulators (PGRs)	13-20
14.0	TARGET SPECIES	14-1
14.1	Noxious and Invasive Weeds	14-1
14.2	Aquatic Weeds	14-2
14.3	Herbicide-Resistant Weeds	14-2
15.0	CULTURAL AND BIOLOGICAL CONTROL	15-1
15.1	Cultural Control	15-1
15.2	Biological Control	15-3
15.3	Emerging Technologies	15-6
15.4	Emerging Issues	15-6
16.0	ROADSIDE VEGETATION ASSET INVENTORY AND CONDITION	16-1
16.1	Introduction	16-1
16.2	Assessing Existing Conditions	16-1
16.3	Methods to Collect the Inventory Data	16-3
16.4	Integration of Inventory and Conditions Survey with Zone Concepts	16-3
16.5	Integration of Inventory with Existing Asset Management Systems and Budget	16-3
17.0	PROGRAM BUDGETING AND COSTS	17-1
17.1	Prioritize the Budget Dollars	17-1
17.2	Include Overhead and Administration Costs in the Budget	17-1
17.3	Prepare an Itemized Budget of Expected Costs	17-2
17.4	Make Adjustment as Necessary Based on the Performance of the Program	17-3
17.5	Monitor Spending Compared to Budget	17-3
17.6	Alternative Funding Sources	17-4

18.0 PROGRAM MANAGEMENT 18-1

18.1 Structure of Vegetation Management Personnel 18-1

18.2 Operations (Maintenance) Personnel 18-2

18.3 Expertise and Credential Requirements (Authority and Duties of Staff) 18-3

18.4 Research Services. 18-3

18.5 Legal Services 18-4

18.6 Quality Assurance. 18-4

18.7 Equipment Resources 18-4

18.8 Facilities 18-6

18.9 In-House vs. Contracting Activities 18-6

18.10 Long-Term Management Plan 18-7

18.11 Performance Monitoring. 18-7

18.12 Required Documentation 18-7

18.13 In-House Activities. 18-8

18.14 Public Outreach and Public Relations 18-8

19.0 CONTRACTS AND PROCUREMENTS 19-1

19.1 Contract Types and Procurement Methods. 19-1

19.2 Purchase Orders 19-7

19.3 Prequalification Lists 19-7

20.0 SURVEY 20-1

20.1 Program Planning. 20-1

20.2 Program Execution 20-2

20.3 Program Training, Research 20-3

20.4 Budget. 20-4

20.5 Conclusion 20-6

21.0 IRVM DECISION SUPPORT SYSTEM 21-1

21.1 Introduction 21-1

21.2 The Computer-Aided Decision. 21-1

21.3 How We Choose a Decision Support System. 21-2

21.4 Introduction to the Analytical Hierarchy Process (AHP). 21-3

21.5 Integrated Vegetation Management Decision Support System (IRVMDSS) 21-4

21.6 Weighting Process 21-5

21.7 Outcome 21-9

21.8 Conclusion 21-9

REFERENCES. R-1

I.0 INTRODUCTION

To the uninitiated, roadside vegetation management may seem a routine job involving mowing, chopping down trees, and chemical applications. This is far from the truth.

Effective roadside vegetation management requires a high level of expertise and resources to plan, design, construct, and maintain the roadside environment. It requires the vegetation manager to make informed choices among management techniques and to integrate different techniques to achieve the greatest benefits. Such management is known as Integrated Roadside Vegetation Management (IRVM). IRVM involves the planting and establishment of sustainable vegetation on roadsides, and maintaining it through the use of cultural, mechanical, biological, and chemical methods (*161, 163, 183*).

The roadside vegetation manager today is faced with dwindling resources, increasing environmental and legal constraints, and increasing public pressure to provide safe and aesthetically pleasing roadsides.

Throughout the United States, and the world, roadside vegetation managers face similar challenges and opportunities. This project draws on the long term experience and expertise of these vegetation managers to create guidelines that provide the basic knowledge required to establish a roadside vegetation management program.

The guidelines are intended for any highway agency/organization, but will be particularly useful to those employees just beginning their career and needing to establish or improve their own vegetation management program. We are greatly thankful to the many roadside vegetation managers (from virtually every state) who provided us with literature and their feedback. The development of these guidelines would not have been possible without them.