New York State Documents

ROADWAY AND RIGHT-OF-WAY MAINTENANCE

PREFACE

The Roadway and Right-of-Way Maintenance Management Practices Catalogue was prepared by the New York State Department of Environmental Conservation, in cooperation with agencies of the New York Nonpoint Source Coordinating Committee. Funds for this activity were provided by the U.S. Environmental Protection Agency-Region II under a Section 319 Grant of the Clean Water Act.

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ROADWAY AND RIGHT-OF-WAY MAINTENANCE MANAGEMENT PRACTICES FOR NONPOINT SOURCE POLLUTION PREVENTION AND WATER QUALITY PROTECTION IN NEW YORK STATE

I. INTRODUCTION

A. Background

The Water Quality Act of 1987 required states to prepare an Assessment Report identifying waterbodies affected by nonpoint source (NPS) pollution, to determine categories of significant NPS sources and to list state programs to control NPS pollution. States were also required to prepare a Management Program to deal with the source categories causing the major problems.

The New York State Department of Environmental Conservation (DEC) by virtue of its statutory authority for the management of water resources and control of water pollution assumed the lead responsibility for control of NPS pollution in New York State. As part of this responsibility, DEC developed a Nonpoint Source Management Plan in January 1990. The Plan outlines how DEC will identify, describe and evaluate management practices to be used to reduce NPS pollution and make other recommendations to control NPS pollution.

B. Candidate Management Practices

A list of candidate management practices was developed in 1989 by the Nonpoint Source Working Group, a task force under DEC leadership that is composed of federal and state agencies and groups representing a broad range of interests. The Group recognized that there are many ways to control NPS pollution, but that the management practices were not systematically inventoried or evaluated for effectiveness in preventing or remediating NPS water quality problems in a statewide context. Also, they were not catalogued in a form that was convenient to users.

The Nonpoint Source Management Practice Task Force was created in early 1990 according to the guidelines contained in Chapter IV of the Nonpoint Source Assessment Report. Agencies listed in that chapter met in February of 1990 to set the process to be followed for establishing the list of management practices. Also, each agency identified source category sub-committees on which they wanted to participate.

C. The Roadway and Right-of-Way Maintenance Management Practices Sub-committee

In June 1993 a working group representing different agencies were invited to serve on the Roadway and Right-of-Way Maintenance Management Practices Sub-Committee. Under DEC leadership, this working group was formed to address roadway and right-of-way maintenance as a source of NPS pollution. Working group members represented federal, state, and local agencies, research institutions, and private sector utility industries.

The working group revised a preliminary list of candidate management practices through the development of the catalogue incorporating their comments. DEC drafted summary sheets of the management practices deemed to be valuable. These sheets were then reviewed by the Sub-Committee, revised based on comments, and assembled to form the basis of the catalogue's Roadway and Right-of-Way Maintenance Section.

D. Roadway and Right-of-Way Maintenance as a Source of Pollution

The 1993 Priority Water Problem (PWP) list, published by the DEC Division of Water's Bureaus of Monitoring and Assessment and Water Quality Management, identified nearly 1,500 waterbody segments in New York State, comprising over 725,000 acres of surface (freshwater), marine (bay and ocean) water, and almost 500 miles of Great Lake shoreline that have been negatively affected by NPS pollution. Of these, 63 segments have been identified as being primarily affected by roadway and right-of-way maintenance operations. In addition, 219 waterbody segments have been impacted by roadway operations as a secondary source of pollution.

The PWP list identifies two sources within this category as the ones most commonly contributing to NPS pollution problems. Storage and application of deicing materials (including sand and salt) and sediment from roadbank erosion each contributed 49.3 percent of the pollutants identified in the study.

Sand and salt applied to roads to maintain public safety may eventually enter surface and/or groundwater. This can increase the chloride level in surface water and stratify lakes as a result of differing salt concentrations of water. Stratification causes incomplete mixing of shallow lakes and releases toxic metals from the bottom. High levels of salt in groundwater can lead to excessive sodium in human diets--a health hazard for people with high blood pressure, cardiovascular, kidney and liver diseases. [1]

Sediment (sand and silt) comes from roadbank erosion as well as deicing operations. It can destroy fish spawning areas, eliminate aquatic food sources, and cause gill abrasion. Sediment reduces the flow capacity of natural water channels, compromises recreational values and increases treatment costs of water supplies. In addition, nutrients and other pollutants become attached to sediment particles and are transported to waterbodies by stormwater runoff from roadway and right-of-way corridors.

Toxic substances are also associated with roadway operations. Toxics can enter waterbodies due to herbicide use during roadway maintenance operations.

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[1] "Road Salt and Groundwater Protection". Groundwater Information Flyer #9, Groundwater Protection Project. Massachusetts Audubon Society, February 1987, 2.

E. How To Use This Catalogue

The Roadway and Right-of-Way Maintenance Management Practices Catalogue is a reference document for those who develop or implement ROW maintenance plans or provide educational and technical assistance to equipment operators during maintenance activities. Nonpoint source pollution problems from various forms of maintenance activities including roadway and utility rights-of-way are addressed by the practices in this Catalogue.

This Catalogue can be used during the preparation of a maintenance plan as a guide to selection of appropriate management practices for the control of NPS pollutants from roadway rights-of-way. The Catalogue is not a design manual and should not be used to replace practice standards and specifications. Best management practices (BMPs) can be selected from the Catalogue based on the application of professional judgement to solve a particular NPS pollution problem in a specific location or to develop a maintenance plan. These practices, whether used by private, commercial or governmental entities will generally diminish pollution from roadway and right-of-way maintenance operations.

This Catalogue contains two types of information that will help you select and implement roadway maintenance operations:

1. **Management Practice Summary Sheets**, each of which describes a pollution control method, identifies the pollutants it controls, the circumstances under which the method should be used, positive and negative impacts on natural resources, other advantages and disadvantages and costs;

2. **Tables** which will help you select the most appropriate maintenance practices described in the Summary Sheets.

Table I lists the Roadway and Right-of-Way Maintenance Management Practices, by category and lifespan.

Table II lists the Roadway and Right-of-Way Maintenance Management Practices and the pollutants they control.

Some of the maintenance activities described in this Catalogue may require new construction or reconstruction. In such cases, practices from other Catalogues are listed and cross-referenced.

For additional information on erosion and sediment control practices, refer to New York Guidelines for Urban Erosion and Sediment Control. This publication can be purchased from the Empire State Chapter of the Soil and Water Conservation Society, P.O. Box 1686, Syracuse, NY 13201-1686.

F. Roadway and Right-of-Way Maintenance Management Practice Summary Sheet Overview

The following defines the terms used on the Management Practice Summary Sheets:

i. *Title*: name of the management practice as found at the top of the summary sheet.

ii. *Definition*: summary statement of the management practice.

iii. *Water Quality Purpose*: why the practice is used.

iv. *Source Category*: Roadway and Right-of-Way Maintenance is the source category for all entries in this Catalogue.

v. *Pollutants Controlled*: NPS pollutants controlled by the management practice.

vi. *Where Used*: land uses or situations where the management practice can be applied.

vii. *Practice Description*: description of the management practice in terms of its vegetative, structural and/or operational components.

viii. *Practice Effectiveness*: summary, in either qualitative or quantitative terms, of the effectiveness of the management practice as documented by water quality modeling and research findings. Practice effectiveness can vary widely according to watershed location, site conditions and other factors.

ix. *Impact on Surface Water*: possible impacts on water quality are defined as None (neutral), Beneficial (positive), Slight (negative), Moderate (negative), and Severe (negative).

x. *Impact on Ground Water*: possible impacts are defined as None (neutral), Beneficial (positive), Slight (negative), Moderate (negative), and Severe (negative).

xi. *Advantages*: address cost-effectiveness, additional practice benefits, and other tangible and intangible benefits.

xii. *Disadvantages*: projected unfavorable conditions associated with the management practice; they address economics, operations and maintenance and expected problems.

xiii.	*Practice Lifespan*:	described in quantitative or qualitative terms. Table I is a summary of practice lifespan expressed as "temporary", or "permanent".
xiv.	*Cost*:	estimated statewide average unit costs, system costs, or costs in qualitative terms.
xv.	*Operation and Maintenance*:	practical suggestions to help implement the operation and maintenance practice on an ongoing basis.
xvi.	*Miscellaneous Comments*:	regulatory requirements; additional management practices that are needed; availability of technical assistance or equipment, other pertinent information.
xvii.	*References*:	references used to evaluate the management practice, including publications and university research.

G. Updating the Roadway and Right-of-Way Maintenance Management Practices Catalogue

The New York Nonpoint Source Coordinating Committee (NYNPSCC) is responsible for updating the Roadway and Right-of-Way Maintenance Management Practices Catalogue. NYNPSCC meets quarterly but dedicates one meeting each year to considering updates to Management Practices Catalogues. NYNPSCC, which is composed of 17 member organizations and agencies, including DEC as the lead agency, will be responsible for:

* Reviewing proposed additions, deletions, and revisions to the Management Practices Catalogue.

* Identifying additional categories of nonpoint source pollution that have not been adequately addressed in the list of management practices.

* Suggesting research or demonstration projects on unproven or new management practices that appear to have potential for protecting water quality.

* Periodically reviewing the state list of management practices to verify the status of each practice. This review should be based on recently published literature and new or previously unknown research or demonstration projects.

H. Conditions For Updating The Catalogue

Any agency, organization, or group may propose an addition, deletion, or revision to a Management Practices Catalogue, provided that the revision responds to one or more of the following conditions:

* Creation of a new roadway and right-of-way maintenance management practice by an agency, university, or recognized group.

* Modification of an existing management practice, either in its design requirements or operation and maintenance.

* Emerging research data which indicates a change in management practice effectiveness and/or pollutants controlled.

* Revisions in state or national water quality policy that necessitate a higher level of waterbody protection, resulting in higher management practice performance standards. Policy revisions would result in additions or deletions of management practices or changes to existing summary sheets.

I. How You Can Propose An Update Of The Catalogue

1. Submit proposed updates, in writing, by December 31 of each year to the New York Nonpoint Source Coordinating Committee, NYSDEC, Bureau of Water Quality Management, 50 Wolf Road, Room 326, Albany, New York 12233-3508.

2. The Committee will review the proposed updates at their next regularly scheduled quarterly meeting. A sub-committee may be formed to study the proposed update and to request input from groups not represented on the Committee.

3. The sub-committee will review the proposed updates and determine if they meet conditions above. In consultation with other interested groups, the sub-committee will make a recommendation to the Committee by May 1 of the following year.

4. When the proposed update is approved, the Committee will distribute copies of the additions or revisions, as approved, to all of its members and other holders of the set of Management Practices Catalogues.

TABLE I.
ROADWAY AND RIGHT-OF-WAY MAINTENANCE MANAGEMENT PRACTICES BY CATEGORY AND LIFESPAN

MANAGEMENT PRACTICE	MANAGEMENT PRACTICE CATEGORY			LIFESPAN
	OPERATIONAL	VEGETATIVE	STRUCTURAL	
Deicing Material Mixing and Handling	●			Temporary
Abrasive and Deicing Material Application and Clean-up	●			Temporary
Salt Storage System: Drainage			●	Permanent
Salt Storage System: Foundation/Floor			●	Permanent
Salt Storage System: Shelter/Cover			●	Permanent
Salt Storage System: Site Selection			●	Permanent
Herbicide Management:	●			Temporary
- Read and Follow the Label Directions	●			Temporary
- Proper Equipment Calibration	●			Temporary
- Proper Timing of Herbicide Application	●			Temporary
- Selective Aerial Application	●			Temporary
- Selective Herbicide Application in Sensitive Areas	●			Temporary
Proper Mechanical Control of Vegetation	●	●		Temporary/3-6 Years
Proper Road Ditch Maintenance	●	●		Temporary/5 years
Catch Basin Cleaning	●			Temporary
Control of Bridge Paint Residuals	●		●	Temporary
Dust Control	●			Temporary
Street Sweeping/RoadClean-up	●			Temporary
Restoration of Disturbed Areas Within the R-O-W	●	●	●	Permanent
Maintenance of Vegetative Cover	●	●		Temporary
Filter Strip		●		Permanent
Proper Species Selection for Vegetative Cover		●		Temporary/Permanent

TABLE II.
ROADWAY AND RIGHT-OF-WAY MAINTENANCE MANAGEMENT PRACTICES AND NPS POLLUTANTS CONTROLLED

MANAGEMENT PRACTICE	SAND/SEDIMENT	HERBICIDES	SALT	NUTRIENT	THERMAL STRESS	O_2 DEMANDING SUBSTANCES	METALS
Deicing Material Mixing and Handling	●		●				
Abrasive and Deicing Material Application and Clean-up	●		●				
Salt Storage System: Drainage	●		●				
Salt Storage System: Foundation/Floor	●		●				
Salt Storage System: Shelter/Cover	●		●				
Salt Storage System: Site Selection	●		●				
Herbicide Management:							
- Read and follow the Label Directions		●					
- Proper Equipment Calibration		●					
- Proper Timing of Herbicide Application		●					
- Selective Aerial Application		●					
- Selective Herbicide Application in Sensitive Areas		●					
Proper Mechanical Control of Vegetation	●						
Proper Road Ditch Maintenance	●			●			●
Catch Basin Cleaning	●			●			
Control of Bridge Paint Residuals							●
Dust Control	●						
Street Sweeping/Road Clean-up	●			●		●	●
Restoration of Disturbed Areas Within the R-O-W	●			●	●		
Maintenance of Vegetative Cover	●			●	●		
Filter Strip	●			●	●	●	●
Proper Species Selection for Vegetative Cover	●	●					

II. ROADWAY AND RIGHT-OF-WAY MAINTENANCE MANAGEMENT PRACTICES

ROADWAY AND RIGHT-OF-WAY MAINTENANCE MANAGEMENT PRACTICES

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PRACTICE	PAGE NO.	DATE
Deicing Chemicals and Abrasives Management		
Abrasive and Deicing Material Application and Clean-up	1	June 1994
Deicing Material Mixing and Handling	3	June 1994
Salt Storage System: Drainage	5	June 1994
Salt Storage System: Foundation/Floor	7	June 1994
Salt Storage System: Shelter/Cover	9	June 1994
Salt Storage System: Site Location Selection	11	June 1994
Maintenance		
Catch Basin Cleaning	13	June 1994
Control of Bridge Paint Residuals	15	June 1994
Dust Control	17	June 1994
Filter Strip	19	June 1994
Maintenance of Vegetative Cover	21	June 1994
Proper Road Ditch Maintenance	23	June 1994
Proper Species Selection for Vegetative Cover	25	June 1994
Restoration of Disturbed Areas Within the R-O-W	27	June 1994
Street Sweeping/Road Clean-up	29	June 1994
Vegetation Control		
Herbicide Management	31	June 1994
Proper Equipment Calibrations	33	June 1994
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Read and Follow the Label Directions	37	June 1994
Selective Aerial Application	39	June 1994
Selective Herbicide Application in Sensitive Areas	41	June 1994
Proper Mechanical Control of Vegetation	43	June 1994

ROADWAY AND RIGHT-OF-WAY MAINTENANCE MANAGEMENT PRACTICES CATALOGUE

FOR

NONPOINT SOURCE POLLUTION PREVENTION

AND

WATER QUALITY PROTECTION

IN

NEW YORK STATE

PREPARED BY:

Roadway and Right-of-Way Maintenance Management Practices Sub-committee of the New York State Nonpoint Source Management Practices Task Force

Summary Sheets Developed By:

NYS Department of Environmental Conservation
Division of Water
Bureau of Water Quality Management

June 1994

MANAGEMENT PRACTICE SUMMARY SHEET

ABRASIVE AND DEICING MATERIAL APPLICATION AND CLEANUP

DEFINITION	Proper calibration of equipment, spreading and clean-up of abrasive and deicing material based on the storm conditions to avoid excessive accumulation of the material.
WATER QUALITY PURPOSE	To minimize the transport of abrasive and deicing materials to water bodies and to reduce the risk of deposition of these materials in surface waters.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Sand, salt, calcium chloride, or other deicing agents.
WHERE USED	Different classes of highways, local roads, side streets, parking lots (i.e., anywhere deicing agents are used).
PRACTICE DESCRIPTION	Application rate, ratio of salt/abrasive mixture, and frequency of treatment for different highway priority classes, traffic and storm conditions should be sensibly determined based on weather forecasts, storm type and changes of temperature during and following the storm. Accurate calibration of equipment can assure that the rate of deicing agents spread provides the rate intended. Equipment should be checked periodically for adjustment and proper functioning such as spinner speed or drop location. Timing of application is crucial and is highly effective in reducing the salt applied on the road. Where low temperature and traffic volume indicate that the application of abrasive is appropriate, clean-up plans should exist in certain critical areas to reduce the water quality impacts. Such actions can include: street sweeping and pick up of sand from roads and shoulders in a timely manner, removal of excess sand from intersections, ramps, gutters and paved ditches, and clean-up of catch basins near the end of snow season.
PRACTICE EFFECTIVENESS	*Putting the deicing agents when and where they will do the most good is effective in reducing the impact of excessive deicing material to water bodies. *Picking-up and trapping abrasive materials after a thaw is effective in reducing sand transport and deposition in surface water.
IMPACT ON SURFACE WATER	Beneficial. Controlling the amount of abrasive/deicing agents, trapping sediment and cleaning up the deposited sediment reduces water quality impacts.

IMPACT ON GROUNDWATER

Beneficial. Proper calibration and controlling the application rate and frequency minimizes the groundwater quality impacts due to road salt application. Abrasive will not result in any adverse impacts on ground water.

ADVANTAGES

*A controlled sand/salt application reduces the waste of material therefore reduces the cost. *Using less salt will reduce the damage to the roads and corrosion of vehicles and bridges.

DISADVANTAGES

*Calibration may require more time for maintenance and decision making. *It may be necessary to upgrade equipment. *Cleanup of road shoulders and catch basins requires extensive use of equipment and manpower.

PRACTICE LIFESPAN

Temporary.

COST

The cost of labor and equipment for sand clean-up is an additional cost to routine ice-fighting operation expenses. Calibration application rate may add to the cost but there are savings associated with using less salt or abrasives.

OPERATION AND MAINTENANCE

In the clean-up process removing accumulated abrasives should be removed manually or by sweepers, not by washing equipment which flushes the material to runoff conveyance systems. Calibration of equipment should be checked periodically. If equipment and manpower are limited, at least sensitive areas should be identified and targeted for cleanup.

MISCELLANEOUS COMMENTS

Observation of significant sedimentation in the sediment traps or adjacent streams may indicate the necessity for increasing the number or the size of catch basins or for some design change to trap sediment on the road shoulder.

REFERENCES

NYS Department of Transportation. Equipment Operator Snow and Ice Manual. Highway Maintenance Division. Albany, NY. December 1992.

NYS Department of Transportation. Highway Maintenance Guidelines. Snow and Ice Control. Albany, NY. Revision October 1993.

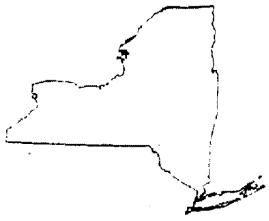
NYS Department of Transportation. Highway Maintenance Division. Equipment Operator Snow & Ice Manual. Albany, NY. December 1993.

St. Lawrence County Environmental Management Council. Road Salt. A Help Or A Hazard? Canton, NY. December, 1982.

Salt Institute. The Snow Fighter's Handbook. A Practical Guide for Snow and Ice Control. Alexandria, VA. 1982.

The Legislature - State of New York. Use of Salt for Snow Removal. Albany, New York, Program Audit. July 1991.

Virginia Department of Highways and Transportation. Standard and Specification 2.07. Highway Deicing Compound Control. 1979.



MANAGEMENT PRACTICE SUMMARY SHEET

DEICING MATERIAL MIXING AND HANDLING

DEFINITION:

Taking precautions during mixing and transportation of bulk quantities of deicing chemicals to prevent the transport of salt residue and brine from mixing areas, salt delivery trucks or maintenance vehicles.

WATER QUALITY PURPOSE:

Prevent the deicing agent, salt residues and brine solutions from entering surface water or groundwater.

SOURCE CATEGORY:

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED:

Salt and other deicing agents.

WHERE USED:

Highway maintenance facilities where deicing agents are stored.

PRACTICE DESCRIPTION:

In mixing, handling, and transportation of salt and other deicing agents a number of precautions should be observed to minimize the possibility of release or discharge of pollutants:

* All mixing, handling and loading of chemicals should be performed in covered areas or where stormwater and brine controls are in effect.
* When practical, salt should be delivered only in fair weather. Wind and rain can spread the salt to unprotected areas or create brine runoff.
* When practical, salt and sand mixing should be conducted as late as possible in the fall to minimize the exposure of the sand/salt pile to fall and early winter rains.
* Trucks, spreaders, and other equipment should be cleaned of loose salt and residue before leaving the loading area.
* The number of times the chemicals are handled should be minimized.

PRACTICE EFFECTIVENESS:

This practice contains precautionary measures which reduce the damage to the environment as well as to equipment from salt. The measures also reduce the loss of salt.

IMPACT ON SURFACE WATER:	Beneficial. Minimizing the salt spilled reduces the possibility of brine runoff.
IMPACT ON GROUNDWATER:	Beneficial. Minimizing the creation of brine solution is beneficial to groundwater.
ADVANTAGES:	*Minimizes the exposure of sand salt pile to precipitation and prevents surface or groundwater contamination. *Reduces the time spent on handling and cost of labor for multiple handling.
DISADVANTAGES:	None.
PRACTICE LIFESPAN:	Temporary.
COST:	The cost of implementing appropriate deicing handling is minimal. The practice should be incorporated in normal, efficient operations to the extent possible.
OPERATION AND MAINTENANCE:	Performing this practice does not require any additional maintenance through out the year.
REFERENCES:	Cornell Cooperative Extension Regional Office. Highway Salt Management Handbook for Local Government Officials. Albany, NY. February 1988.
	Long Island Regional Planning Board. Nonpoint Source Management Handbook. Hauppauge, NY. 1984.
	USEPA. Manual for Deicing Chemicals: Storage and Handling. Cincinnati, Ohio. July 1974.

MANAGEMENT PRACTICE SUMMARY SHEET

SALT STORAGE SYSTEM: Drainage

DEFINITION:	A system used to temporarily store and properly dispose of salt brine solutions collected at salt loading docks, ramps, or other areas associated with a salt storage system where exposure of salt to precipitation is unavoidable.
WATER QUALITY PURPOSE:	Prevent the contamination of surface and groundwater from salt brine solution.
SOURCE CATEGORY:	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED:	Salt.
WHERE USED:	Highway maintenance facilities where salt is stored.
PRACTICE DESCRIPTION:	The first priority in brine control is to prevent its occurrence. An ideal site addresses brine control by conducting all the operation within structures, reducing the need for additional measures. Brine control is an important practice where loading, mixing, and all storage operations do not occur within structures. For facilities with exterior loading/mixing or mixed abrasive storage, this practice emphasizes cleanup of spills and excess salt and return to cover. The runoff from roof and surrounding areas should be diverted away from contaminated mixing site. Salt storage drain pipes and curbing around the perimeter of storage area that direct the brine runoff to catch basins are the basic components of this system. If the brine collected in a catch basin is highly concentrated, it may be pumped into highway maintenance trucks in small quantities for application. The catch basin can be a small paved collecting basin or a plastic lined lagoon. The capacity of brine storage basin should be sufficient to avoid any overflow. At the end of the snow season when salt/sand spreading terminates the brine should continue to be captured for a short while after salt handling activities at the facility are over. During this period of time when there are no trucks spreading salt for deicing the brine must be pumped onto sand stockpiles (if available and allowed to dry).
PRACTICE EFFECTIVENESS:	This practice can be very effective in controlling the brine wash off from the exposed salt. As a component of a salt storage system, drainage measures can have varied effectiveness depending upon the other adopted practices in the design of the system.

IMPACT ON SURFACE WATER:	Beneficial.
IMPACT ON GROUNDWATER:	Beneficial.
ADVANTAGES:	*Minimizes the possibility of salt brine runoff to surface or groundwater.
DISADVANTAGES:	*Overflow of brine from culverts and catch basin can constitute an environmental hazard. *Constructing the drainage system will have additional cost, the larger the system needed the more the additional cost would be. *The designer's goal should be to minimize the areas producing brine runoff.
PRACTICE LIFESPAN:	Permanent.
COST:	Variable.
OPERATION AND MAINTENANCE:	Catch basins and culverts obstructed by ice and snow can cause an environmental hazard during the periods of thaw. The culverts have to be kept clear of debris or ice all the time that the salt storage system is being used. The catch basins have to be maintained and crystallized salt may have to be removed after evaporation of water.
MISCELLANEOUS COMMENTS:	None.
REFERENCES:	Cornell Cooperative Extension Regional Office. Highway Salt Management Handbook for Local Government Officials. Albany, NY. February 1988. USEPA. Manual for Deicing Chemicals: Storage and Handling. Cincinnati, Ohio. July 1974. Westchester County Environmental Management Council. Highway Deicing Storage and Application Methods. White Plains, NY. Spring 1981.

MANAGEMENT PRACTICE SUMMARY SHEET

SALT STORAGE SYSTEM: Foundation/Floor

DEFINITION	Raising the foundation to an elevation higher than surrounding terrain to prevent run-in; paving the storage area's floor; and providing impermeable padding for the mixing area of salt storage system.
WATER QUALITY PURPOSE	Preventing exposure of the salt pile to runoff and reducing the possibility of salt leakage to the groundwater.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Salt and other deicing agents.
WHERE USED	In any permanent or temporary structural or non-structural salt storage, or highway maintenance facility.
PRACTICE DESCRIPTION	This pollution prevention practice is as important as placing the salt under cover and includes different aspects such as topography, pavement material, etc. The elevation of the interior floor slab should be above the exterior yard area. Final grading should be designed to slope away for drainage purposes. All the areas used in loading or unloading should be paved with an impermeable material which is not adversely affected by the salt. Low permeablity asphalt concrete is considered an appropriate impervious material. The use of Portland cement concrete surface on the exterior area or mixing area which is exposed to infiltration of salt solution from rain and alternate cycles of freezing and thawing is not appropriate.. The interior slab is to remain dry and not exposed to the same corrosive cycle but still needs to be impermeable for additional safety. A sub-base consisting of 15", minimum depth, of crushed stone should be laid down first and compacted to an appropriate degree. The base, the material applied on top of the sub-base, should consist of a minimum of 4" of a hot mix asphalt concrete. The floor slab inside the building should have no drains and should pitch toward the entrance doorway using a slope of about 0.5°. It is recommended that the wall and foundation be an integral structure at least to the highest point of salt stockpiling. The two general approaches to the wall design are continuous and buttress. The foundation sill should be above grade to preclude surface runoff from entering the structure.

PRACTICE EFFECTIVENESS	This practice is effective in reducing the possibility of infiltration of brine into the groundwater. An impermeable pad is most needed if the salt is stored outdoors, although whether outside or inside, salt should be on an impervious base.
IMPACT ON SURFACE WATER	Beneficial. In temporary salt storage which brine is inevitable this practice would be beneficial to surface waters.
IMPACT ON GROUNDWATER	Beneficial.
ADVANTAGES	*Reduces the possibility of salt leakage.
DISADVANTAGES	None.
PRACTICE LIFESPAN	Permanent.
COST	Estimated cost for low permeability pad with seepage and runoff control 1,400 ton pile/6,000 square feet pavement - $13,000-$37,000.
OPERATION AND MAINTENANCE	The paved areas should be regularly maintained. The walls, especially at the joints and sill, have to be checked, sealed and repaired on a regular basis.
MISCELLANEOUS COMMENTS	None.
REFERENCES	Cornell Cooperative Extension Regional Office. Highway Salt Management Handbook for Local Government Officials. Albany, NY. February 1988. Long Island Regional Planning Board. Nonpoint Source Management Handbook. Hauppauge, NY. 1984. Salt Institute. The short version of the Salt Storage Handbook. Alexandria, VA. 1986. Source: Results of preliminary research on salt storage for the draft generic Environmental Impact Statement for the Draft Watershed Regulations. NYC Water Supply. Westchester County Environmental Management Council. Highway Deicing Storage and Application Method. White Plains, NY. Spring 1981. USEPA. Manual for Deicing Chemicals: Storage and Handling. Cincinnati, Ohio. July 1974.

MANAGEMENT PRACTICE SUMMARY SHEET

SALT STORAGE SYSTEM: Shelter/Cover

DEFINITION	The use of a structure, shed, shelter, or impermeable cover to protect the salt from direct precipitation.
WATER QUALITY PURPOSE	To protect the salt from direct rain and snow which would result in runoff from salt pile to surface waterbodies or in leaching to the groundwater.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Salt and other deicing agents.
WHERE USED	Highway maintenance facilities where salt is stored.
PRACTICE DESCRIPTION	The salt pile should be kept dry and out of the weather. Such conditions can be provided by using storage structures or an impermeable cover placed above the salt. Because of freezing, tearing or blowing away, an impermeable cover can be used only for temporary purposes. The storage facility should be large enough to hold the design load amount of chemicals required seasonally without overflowing. Provision of a roof overhang, particularly where the door or opening is located, is a proper precaution.
PRACTICE EFFECTIVENESS	Since Salt Storage Systems are composed of different components, system effectiveness varies depending on site characteristics and selected practices. Sheltering is the most important one and can often compensate for the lack of other practices. Properly constructed salt storage sheds can be highly effective in protecting surface and groundwater. There is no study showing the effectiveness of this practice but experience shows that, as a result of leachate from nearby uncovered salt storage piles, some wells in Nassau County have been rendered non-potable.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	Beneficial.
ADVANTAGES	*Keeps the salt out of the weather. *Reduces the possibility of rainfall run-in to the salt pile.

DISADVANTAGES

*Limitations in loading, unloading, or mixing operation because of working in a confined space. This will not be a disadvantage if system is properly designed.

PRACTICE LIFESPAN

Because of the wide range of type of facilities (from temporary cover to wooden arch or concrete storage building) lifespan varies. The temporary measures have very short lifespans. Permanent structures last longer depending on the design and the type of structure. They may last indefinitely if properly maintained.

COST

Depending on the selected structure cost can vary widely. Tarp coverage: 1,400 ton pile/5,400 Ft^2 tarp $.15 - $.40 per Ft^2. Installation approximately $850. Dome: 1,400 ton pile/72 ft. diameter dome: $80,000-$85,000. Three-sided shed: 1,400 ton pile/4,000-4,300 Ft^2 shed $68,000-$88,000.

OPERATION AND MAINTENANCE

Structural systems have to be maintained regularly. Doors, walls, and floors should be repaired because of damages caused by mechanical loaders. Proper maintenance will decrease the possibility of accidental spills.

MISCELLANEOUS COMMENTS

None.

REFERENCES

Cornell Cooperative Extension Regional Office. Highway Salt Management Handbook for Local Government Officials. Albany, NY. February 1988.

Long Island Regional Planning Board. Nonpoint Source Management Handbook. Hauppauge, NY. 1984.

NYS Department of Environmental Conservation. Division of Water Technical and Operational Guidance Series (5.1.7) Storage and Use of Highway Salt and Salt/Sand Mixtures. Albany, NY. January 1989.

Results of preliminary research on salt storage for the Draft Generic Environmental Impact Statement for the Draft Watershed Regulations. NYC Water Supply "Snow Disposal and Storage and Use of Winter Highway Maintenance Material".

Westchester County Environmental Management Council. Highway Deicing Storage and Application Method. Westchester, NY. Spring 1981.

MANAGEMENT PRACTICE SUMMARY SHEET

SALT STORAGE SYSTEM: Site Location Selection

DEFINITION

Selection of salt storage site location considering the protection of water resources.

WATER QUALITY PURPOSE

To reduce or eliminate the potential runoff or leaching from a planned salt storage site to surface waters or groundwater.

SOURCE CATEGORY

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED

Salt and other deicing agents.

WHERE USED

Wherever salt storage facilities are constructed.

PRACTICE DESCRIPTION

This practice is considered a pollution prevention practice. It involves a careful evaluation of the site which includes an inventory of environmental resources such as soil type, depth to bedrock and high water table, slope, proximity to water resources, etc. Once an inventory has been conducted, site limitations can be identified and overcome through engineering design.

Site selection, besides satisfying operational requirements, should meet the criteria below:

- Avoid locating a salt storage facility above an aquifer recharge area or highly permeable soils, if feasible.
- Do not locate the storage sites within wellhead protection areas of community water supplies or private wells.
- Establish a reasonable setback distance from streams, lakes, ponds, and wetlands based on elevation, other factors mentioned above, and local zoning. Protected wetlands and water supply reservoirs require larger setback distance.
- Do not locate a storage facility or a salt stockpile in either a regulated floodway or flood plain.

PRACTICE EFFECTIVENESS

Because this practice is performed before constructing a salt storage facility, it is very effective in preventing pollution.

Salt dissolves easily in water, and can be picked up in runoff and transported to nearby waterbody or recharged to the water supply well located under the storage area. A proper selection of the storage site reduces the potential for groundwater contamination.

There is no study showing the effectiveness of this practice, but experience shows that at Nedford, Long Island, 21 shallow wells located down gradient of three improperly sited salt piles were found to be contaminated with chloride.

IMPACT ON SURFACE WATER

Beneficial. However, proper site selection may be of limited value unless salt is properly housed and protected from stormwater runoff.

IMPACT ON GROUNDWATER

Beneficial. However, Proper site selection may be of limited value unless salt is properly housed and protected from leaching.

ADVANTAGES

*Careful evaluation of a site prior to construction prevents selection of poorly suited sites, saving time, money and potential for water quality impairments. *Keeping a minimum distance, in case of accidental runoff or lack of other salt storage management practices reduces the possibility of groundwater contamination.

DISADVANTAGES

*In some cases siting a salt storage facility to avoid water quality problems may not be consistent with operational requirements such as topography or proximity to service area. *Although careful evaluation of the site prior to construction may exclude the preferred location of the salt storage system, the benefits of environmental protection should outweigh the inconvenience of constructing a facility at an alternate location.

PRACTICE LIFESPAN

Permanent.

COST

Varies depending upon the extent of the evaluation of the site and the nature of the resource inventory. Sometimes choosing the best location may result in additional expenses.

OPERATION AND MAINTENANCE

None.

MISCELLANEOUS COMMENTS

None.

REFERENCES

Cornell Cooperative Extension Regional Office. Highway Salt Management Handbook for Local Government Officials. Albany, NY. February 1988.

Long Island Regional Planning Board. Nonpoint Source Management Handbook. Hauppauge, NY. 1984.

NYS Department of Environmental Conservation. Division of Water Technical and Operational Guidance Series (5.1.7) Storage and Use of Highway Salt and Salt/Sand Mixtures. Albany, NY. January 1989.

USEPA. Manual for Deicing Chemicals: Storage and Handling. Cincinnati, Ohio. July 1974.

Westchester County Environmental Management Council. Highway Deicing Storage and Application Method. Westchester, New York. Spring 1981.

MANAGEMENT PRACTICE SUMMARY SHEET

CATCH BASIN CLEANING

DEFINITION:

Cleaning out the catch basins regularly to maintain their sediment trapping ability.

WATER QUALITY PURPOSE:

To prevent the sediment load and oxygen-demanding substances from reaching surface water.

SOURCE CATEGORY:

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED:

Sediment and oxygen-demanding substances.

WHERE USED:

Catch basins in urban or rural storm sewer systems.

PRACTICE DESCRIPTION:

Catch basins, including chambers or sumps installed in a storm sewer to retain the sediment and debris, have to be inspected and cleaned out regularly depending on the local parameters. The basins can be cleaned either manually with a shovel or by machine using a clamshell bucket or specifically designed or modified equipment. These parameters are the sump capacity, quantity of accumulated street solids, antecedent dry period, meteorological conditions, street cleaning methods and practices, surrounding land use, topography, and to some extent, the type of surface soil adjacent to the street.

In absence of cleaning, catch basins may actually make water quality conditions worse. When a sump is 40- 50 percent full, any inflow could have a flushing effect which can generate a sediment loading and a high concentration of pollutants while passing through the catch basin. If the contributing watershed has active construction or other land uses creating high sediment loads, the catch basin should be cleaned more often than in stabilized areas.

PRACTICE EFFECTIVENESS:

Typical catch basins have been estimated to retain up to 57 percent of coarse solids and 17 percent of equivalent BOD. The material which accumulates in catch basins may contain a high concentration of pollutants. The average concentration of pollutants in the liquid entering catch basins during storms is similar to concentration of untreated sewage. Giving the catch basins cleaning a low priority can cause a major disaster. A good example of this is the subway flooding attributed to clogged catch basins that occurred in New York City on July 3, 1969.

IMPACT ON SURFACE WATER:	Beneficial.
IMPACT ON GROUNDWATER:	None.
ADVANTAGES:	*Minimizes the possibility of clogging and overflow of concentrated pollutants. *Reduces the sediment load in case of flushing when it is more than 40 percent full.
DISADVANTAGES:	*Requires an evaluation of the parameters identified to establish a clean out schedule. *More frequent inspection and clean out is required. *Improper disposal of contaminated sediment may cause problem.
PRACTICE LIFESPAN:	Temporary. Seasonal as it is needed.
COST:	Based on information from NYSDOT-Highway Maintenance Division, "Daily Accomplishment and Information System", the cost of cleaning a catch basin in upstate New York is $36.13 and in downstate, due to traffic volume, is $185.00. More costly because of increasing the required frequency of catch basin cleaning.
OPERATION AND MAINTENANCE:	Cleaning the catch basin is a maintenance practice.
MISCELLANEOUS COMMENTS:	If catch basin sump cannot be properly maintained due to excessive sediment loading, this may indicate the need for a larger capacity catch basin and/or land based erosion and sediment controls.
REFERENCES:	Best Management Practices for Minnesota. Protecting Water Quality in Urban Areas. Minnesota, October 1989. Environmental Protection Technology Series. Catch Basin Technology Overview and Assessment. Cincinnati, Ohio. May, 1977. NYS Department of Transportation. Standard Specification: Construction and Material. Albany, NY. January 1990. Southeastern Wisconsin Regional Planning Commission. Costs of Urban Nonpoint Source Water Pollution Control Measures. Waukesha, Wisconsin. June. 1991.

MANAGEMENT PRACTICE SUMMARY SHEET

CONTROL OF BRIDGE PAINT RESIDUALS

DEFINITION

Methods to avoid the transport to waterbodies of paint chips and dust resulting from surface preparation, grinding, sanding, or washing bridges.

WATER QUALITY PURPOSE

To minimize the delivery of toxic metals and other substances contained in paint chips to waterbodies or wetlands.

SOURCE CATEGORY

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED

Toxic metals such as lead, cadmium and mercury.

WHERE USED

On bridges or any structures located over or adjacent to waterbodies or wetlands.

PRACTICE DESCRIPTION

During surface preparation, dust and debris from the removal of paints can contaminate the air, soil, and water surrounding the work sites. The potential hazards are reduced by containing and collecting the debris. There are a variety of techniques such as collectors, containment systems, and vacuum filtration systems to minimize or prevent the debris generated during surface preparation from entering the environment and to facilitate the controlled collection of the debris for disposal. Collectors are the most commonly used practice. A collector should be at least 10 feet greater in width and length on each side of the area on which work is underway to meet water quality requirements.

Meteorological conditions such as wind, rain, or snow should be considered during the operations. The contractor may have to terminate the operation based on the situation and specific design of the selected technique. During operation and clean-up, the perimeter of the site should be inspected for debris. The debris should be collected on a regular basis and not left to accumulate over the course of a job.

To prevent the loose paint and flakes from peeling and flushing into the water body during bridge washing the following should be adhered to: a) bridge structure should be inspected and paint surface should be rated based on DOT's Engineering Instruction and Specification prior to washing, b) bridges with a paint rating under 4 should not be washed, c) the equipment for pressure washing should be operated at a maximum nozzle pressure of approximately 1,000 psi, d) trash and debris should be collected and properly disposed of from the bridge deck prior to washing operation, e) bridge washing should be per-formed when there is adequate stream flow to dilute thermal discharges and debris that may inadvertently fall into the water. However, under no circumstances should in-stream dilution of contaminants be considered a substitute for proper pollution prevention practices.

PRACTICE EFFECTIVENESS

*Control of bridge paint residuals can be highly effective in protecting water quality and aquatic organisms. *Steel Structures Painting Council Guidance categorizes containment systems into five classes, based on the extent to which the containment is sealed and impermeable. All five classes are effective for water quality protection. *The Gowanus Expressway study conducted by Lawler, Matusky & Skelly Engineers shows that the use of a vacuum filtration system was the single most important variable in

reducing the concentrations of all four different types of suspended particles in the nearfield measurement area. *Bridge washing in spring can reduce the impact of deicing agents used during winter and consequently can reduce the rate of flaking and detachment of paint chips.

IMPACT ON SURFACE WATER

Beneficial.

IMPACT ON GROUNDWATER

None.

ADVANTAGES

*This practice can control the amount of paint chips that will reach a waterbody. *Implementing more comprehensive techniques can have air quality and human health benefits by minimizing or eliminating airborne particulates.

DISADVANTAGES

*Some of the available techniques such as Class A Containment or Vacuum filters are very expensive.

PRACTICE LIFESPAN

This is a short-term practice and depends on continuous maintenance for the duration of the operation.

COST

There is some extra cost involved with use of collectors. However, they are much less expensive than the higher classes of containment systems which are extremely expensive.

OPERATION AND MAINTENANCE

If the wind velocity causes the selected structural practice to emit dust or paint chips, the contractor shall immediately cease work and clean-up the debris. All the floating waste material which may have been accidently released to the water and form on the water surface should be contained from moving downstream by the use of floating water booms (straw or screen).

MISCELLANEOUS COMMENTS

Use of the techniques during paint scraping or blasting and bridge washing has to be based on the standard specifications determined for each technique. Structures that span a navigable waterway may be subject to regulation by the U.S. Coast Guard and other involved agencies. Bridges located near prime DEC trout stocking sites should not be washed during periods of maximum angler usage.

REFERENCES

Environmental Science & Engineering Consultants, Lawler, Matusky & Skelly Engineers. Draft Plan for Engineering Control Recommendation for Blast Cleaning Operations. Pearl River, NY. Feb. 1993.

NYS Department of Environmental Conservation. Division of Water Technical and Operational Guidance Series (5.1.5) Bridge Scraping and Painting. April 1987.

NYS Department of Transportation. Draft Engineering Instruction. Albany, NY. February 1994.

NYS Department of Transportation. Revised Maintenance Bridge Cleaning Specification (Draft). Albany, NY. January 1994.

Steel Structures Painting Council. Guide for Containing Debris Generated During Paint Removal Operations. Pittsburgh, PA. March 1992.

MANAGEMENT PRACTICE SUMMARY SHEET

DUST CONTROL

DEFINITION	Methods controlling the movement of airborne pollutants and particulate matter from unpaved roads.
WATER QUALITY PURPOSE	To minimize the generation of dust and its delivery to waterbodies.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Sediment and related airborne pollutants.
WHERE USED	On unpaved roads, access roads and/or points, mining roads, and unpaved parking lots.
PRACTICE DESCRIPTION	Dust control includes a variety of measures which reduce the detachment and/or transport of airborne sediments. Approved dust suppressant materials may be applied to the unpaved areas at controlled rates. Application rates of approved materials should be based on manufacturer's label. Treatment rate for calcium chloride, one of the most common dust palliatives, is 0.5 to 1.0 lb. per square yard. Typically, a road is treated 2 to 3 times a year. However, the rate and frequency of application of any kind of dust suppressant is based on conditions set by soil type, topography, accessibility of water, air temperature, and volume of traffic. Management practices having dust control benefits such as: *Mulching*, *Construction Road Stabilization* and *Stabilized Construction Entrance* from the Construction Catalogue can be used.
PRACTICE EFFECTIVENESS	Effectiveness of controls is dependent upon the specific measure used. Time of application and meteorological condition should be considered to minimize the impact and increase the efficiency. When stormy weather is forecasted, dust control application should be avoided. Dust suppressants are effective on mineral soils if applied at the proper rates and frequency. Construction traffic limits the effectiveness of dust suppressants.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	None.
ADVANTAGES	*Certain dust control measures may also control the erosion of soil by water. *Improves traffic safety. *Reduces health hazards associated with dust. *Can reduce abrasive damages to vehicles and buildings.
DISADVANTAGES	*Dust suppressants can cause health problems if in contact with eyes, skin or respiratory tract. *Calcium chloride is a salt and can kill vegetation.
PRACTICE LIFESPAN	Normally short-term.

COST

Varies.

OPERATION AND MAINTENANCE

Storage structures for dust suppressants should be water-tight. Other helpful management practices for this purpose are salt storage system practices. Spreader trucks and hand spray equipment need to be properly calibrated. Labeled instructions on dust suppressant materials need to be followed. On-site traffic control should be coordinated with all dust control measures.

MISCELLANEOUS COMMENTS

Use of waste oil for dust control is prohibited. The use or storage of brine, ligninsulfonate, and asphalt material could have detrimental effects on water quality. The 1991 New York State Department of Transportation Approved Materials List includes water, calcium chloride, and an acrylic polymer as dust control materials. These materials have been reviewed by New York State Department of Environmental Conservation for environmental compatibility.

REFERENCES

Dutchess County Soil and Water Conservation District. Dutchess County Soil Erosion and Sediment Control Guidebook. Millbrook, NY. June 1989.

Empire State Chapter Soil and Water Conservation Society. New York Guidelines for Urban Erosion and Sediment Control. Syracuse, NY. October 1991. **(Management Practice Design Standard and Specification)**

Maryland Water Resources Administration. USDA-Soil Conservation Service. State Soil Conservation Committee. Maryland Standards and Specification for Soil Erosion and Sediment Control. Annapolis, MD. 1983.

NYS Department of Environmental Conservation. Erosion and Sediment Control Guidelines for New Development. Division of Water. Technical and Operational Guidance Series. Albany, NY. April 1991.

NYS Department of Environmental Conservation and NYS Department of Transportation. Dust Palliatives Memorandum of Understanding. Amended: May 1991.

NYS Department of Transportation. Standard Specifications. January 1990. **(Management Practice Design Standard and Specification)**

State of Washington. Department of Ecology. Stormwater Manual for the Puget Sound Basin (Public Review Draft). Olympia, WA. June 1991.

US Department of Interior. Bureau of Mines. An Environmental Evaluation of Dust Depressants: Calcium Chloride Ligninsulfonates. June 1982.

USDA. Soil Conservation Service. National Engineering Handbook. Washington, DC. October 1986.

MANAGEMENT PRACTICE SUMMARY SHEET

FILTER STRIP

DEFINITION	A strip of perennial grasses, legumes, or shrubs and trees established or maintained across the slope and managed for pollutant removal by overland flow.
WATER QUALITY PURPOSE	To reduce velocity and increase infiltration of runoff water so that sediment, nutrients and organic matter can be retained, and utilized by the vegetation.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Sediment, nutrients, thermal stress, organics, and some heavy metals.
WHERE USED	Riparian zones, road corridors and in conjunction with other management practices that convey surface runoff and control erosion.
PRACTICE DESCRIPTION	Filter strips are seeded to grasses, legumes, or a mixture of both. Occasionally existing stands of trees, or shrubs can be left undisturbed for their filtering ability. New plantings of shrubs as filter strips require temporary cover to be effective. Designed filter strip widths vary with land slope, type of vegetative cover, watershed area, soil suitability and type of pollutant to be filtered. Filter strips reduce the delivery of pollutants from runoff water by filtration, deposition, infiltration, absorption, adsorption, decomposition and volatilization.
PRACTICE EFFECTIVENESS	Filter strips are most effective in conjunction with erosion-reducing management practices. Pollutant removal effectiveness is directly related to filter strip width. Filter strips are very effective for sediment and sediment-bound pollutant removal. Research on construction sites for erosion control has shown that grass strips can remove 85% or more of the sediment from runoff. Filter strips do not remove soluble phosphorus or nitrates effectively, and total phosphorus is not removed as effectively as sediment.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	Slight. Practice may increase infiltration and downward movement of soluble pollutants.
ADVANTAGES	*Filter strips are inexpensive, easy to install and maintain. *Unobtrusive. *Benefits for wildlife. *Filter strips reduce surface runoff volumes. *Filter strips adjacent to watercourses can provide shade which benefits aquatic life.
DISADVANTAGES	*Filter strips do not reduce pollutant generation. *Filter strips are less effective in hilly areas, in areas receiving concentrated flows, during larger runoff-producing storms, and during colder winter months. *Filter strips lose effectiveness when significant sediment accumulates in the filter.

PRACTICE LIFESPAN

Long term, if properly maintained.

COST

Relatively inexpensive for herbaceous filter strips. Slightly higher costs for trees and shrubs.

OPERATION AND MAINTENANCE

Removal of trapped sediment every year, or after larger runoff-producing storms. Vegetation should be mowed each year. Vehicle traffic should be restricted.

MISCELLANEOUS COMMENTS

Selection of appropriate plant materials and filter strip widths should be guided by references cited. Nutrients applied during vegetation establishment should be guided by soil test results. Forested filter strips may have greater pollutant removal capability than grassed filter strips. However, because vegetative cover in forested filter strips is not as great as grassed filter strips, they may need to be longer to achieve optimum removal.

REFERENCES

Dutchess County Soil and Water Conservation District. Dutchess County Soil Erosion and Sediment Control Guidebook. Millbrook, NY. June 1989.

Federal Highway Administration. Management Practices for Mitigation of Highway Stormwater Runoff Pollution. Vol. II. McLean, VA. 1985. **(Management Practice Design Standard and Specification)**

Irondequoit Bay Coordinating Committee. Best Management Practices for Stormwater Runoff Management. May 1985.

Long Island Regional Planning Board. Evaluation of Land Use Impacts on Environmental Quality in Urban and Semi-rural Streams Tributary to Great South Bay, Long Island, NY. Hauppauge, NY. March 1990.

Metropolitan Washington Council of Governments. Controlling Urban Runoff. 1987.

NYS Department of Environmental Conservation. Longabucco, P., Controlling Agricultural Nonpoint Source Water Pollution in New York State: A Guide to the Selection of Best Management Practices to Improve and Protect Water Quality. Albany, NY. 1991.

NYS Department of Environmental Conservation. Morton, W. Stream Corridor Management: A Basic Reference Manual. Albany, NY. January 1986.

USDA. Soil Conservation Service. Effects of Conservation Practices on Water Quantity and Quality. October 1988.

USDA. Soil Conservation Service. Guide to Conservation Plantings on Critical Areas for New York. Syracuse, NY. June 1991.

USDA. Soil Conservation Service. National Handbook of Conservation Practices. Filter Strips. Syracuse, NY. 1982. **(Management Practice Design Standard and Specification)**

MANAGEMENT PRACTICE SUMMARY SHEET

MAINTENANCE OF VEGETATIVE COVER

DEFINITION	Maintenance and inspection of vegetative cover in critical areas on a regular basis and re-establishment of vegetation in exposed soils.
WATER QUALITY PURPOSE	To stabilize the soil and prevent sediment transfer to water bodies.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Sediment.
WHERE USED	Roadbanks and shoulders, utility right-of-way corridors, streambanks at utility or highway crossings, critically eroding areas and steep slopes.
PRACTICE DESCRIPTION	Vegetative cover of right-of-way, particularly in critically eroding areas, should be inspected periodically and maintained as needed. To assure adequate vegetative cover, soil fertiity may have to be maintained. Soil testing prior to fertilizer application is recommended. Fertilizer application in close proximity to waterbodies should be restricted, limited, or in a new stand of grass, be incorporated into the soil. Nitrogen fertilizer on a new seedbed or a new stand of grass can be applied annually. Where legumes are included in the planting, nitrogen applications are not recommended. Vegetative covers need to be inspected for soil exposure on a regular basis and, when necessary, be reseeded as soon as possible. Regrading, control of surface runoff when necessary, preparation of seed bed, application of fertilizer and lime, mulching, silt fence, staked hay bales and jute mesh may be required as part of the reseeding operation. Seeded areas should be protected for one year to allow development of a dense sod. If roadbanks are not seeded within 24 hours after earth work is completed or have rill or gully erosion, they should be sacrificed or regraded prior to seeding. Timing is a crucial factor. Good results for cool season mixtures are attained from seeding or planting established in spring before May 20 or in late summer between August 15 and October 15. Warm season mixtures should be planted on droughty, sandy or gravelly sites as early in the spring as possible and prior to May 1. Planting techniques may include drilling, tracking (on draughty sites and slopes), hydroseeding (best for steep slopes), broadcasting, sprigging, and sodding.
PRACTICE EFFECTIVENESS	Revegetation of disturbed areas is an effective practice in preventing soil erosion. A study of roadside slopes at two sites shows that where there was no plant cover the soil eroded to an average depth of 2-3 cm over 7 months. In contrast, sites with hydroseeding had a net accumulation of soil material.
IMPACT ON SURFACE WATER	Beneficial.

IMPACT ON GROUNDWATER	None to beneficial.
ADVANTAGES	*Maintenance on a regular basis and revegetation can reduce the possibility of soil loss and sedimentation. *A good selection of species can restrict the invasion of woody species. *Improves aesthetics.
DISADVANTAGES	*Site preparation for re-seeding will increase maintenance costs. *Inaccessibility of the site increases the cost of vegetation establishment.
PRACTICE LIFESPAN	Long lifespan.
COST	Varies. Ranges from several hundred dollars per acre, when practice is limited to mowing, trimming, and pruning, to up to $1,000 per acre for hydroseeding critically eroding areas.
OPERATION AND MAINTENANCE	Varies. Follow-up inspection is appropriate after the first and if necessary, after second growing season (3 to 9 months and 21 months after planting). If the surface runoff on the site is controlled properly, an established vegetative cover may only require periodic mowing and trimming. Grazing should be prohibited in newly seeded areas.
MISCELLANEOUS COMMENTS	Significant erosion in vegetated areas can be an indication that vegetative cover may not be an adequate measure for stabilizing the area. Other management and/or structural practices may be required for controlling the erosion effects of surface runoff. Besides vegetation establishment and management other practices such as streambank and shoreline protection, diversion, structural slope protection, and sediment control mats, or rip-rap based on the hydrologic pattern and site characteristics can be employed.
REFERENCES	Empire State Chapter. Soil and Water Conservation Society. New York Guidelines for Urban Erosion and Sediment Control. Syracuse, NY. October 1991 Federal Energy Regulatory Commission. Erosion Control. Revegetation and Maintenance Plan. Washington. DC. June 1992. NYS Department of Transportation. Standard Specifications: Construction and Materials. Albany, NY. January 1990. **(Management Practice Design Standard and Specification)** U.S. Environmental Protection Agency. Guidance Specifying Management Measures for Sources of NPS Pollution in Coastal Waters. Washington, DC. January 1993. USDA-Soil Conservation Service. A Guide to Conservation Plantings on Critical Areas for New York. Syracuse, NY. June 1991.

MANAGEMENT PRACTICE SUMMARY SHEET

PROPER ROAD DITCH MAINTENANCE

DEFINITION

Techniques for providing stable conditions on roadside ditches during routine sediment removal, clean-up, and ditch reshaping operations.

WATER QUALITY PURPOSE

To minimize the generation of sediment and its delivery to waterbodies during maintenance operations.

SOURCE CATEGORY

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED

Sediment and attached contaminants such as lead, zinc, copper.

WHERE USED

In vegetated or unvegetated road side ditches and swales.

PRACTICE DESCRIPTION

The intent of this practice is to assure proper drainage function of the ditch while minimizing soil exposure and erosion.

The following are recommended components of a comprehensive ditch maintenance program:

a. The plan must consider proximity to receiving waterbodies and potential for channel and bank erosion. Appropriate practices such as additional stabilization measures for erosion control and material and devices such as geotextile fabric, sediment mats, and rip-rap should be used when necessary.

b. Steep slopes and embankments above ditches should not be striped of vegetation since this may result in severe erosion unless proper sediment and erosion control is employed.

c. Ditch must be configured to handle peak storm flows without experiencing significant scour or channel failure.

d. Vegetative Management Practices and/or seeding for channel and bank stabilization should be applied immediately after any soil disturbance.

e. If erosion and sedimentation cannot be controlled on-site, then on-line sediment traps and structural BMPs may be installed in the drainage system.

f. Maintenance should occur under seasonally dry conditions whenever possible (late summer or early fall is best).

PRACTICE EFFECTIVENESS

Vegetated ditches are an effective mitigation measure for removing pollutants from highway runoff. Mar et al. (1982) found that channeling highway runoff in Washington State through 100 ft. of grass removed 60-80 percent of the lead, zinc and copper contaminants. Wang et al.

(1982) concluded that 200 to 250 ft. of grassed waterway removed the majority of metals from the runoff.

IMPACT ON SURFACE WATER

Beneficial. A properly maintained vegetated waterway can reduce runoff velocity and enhance settling of suspended solids.

IMPACT ON GROUNDWATER

None to beneficial.

ADVANTAGES

*The sediment and vegetation removed contains pollutants filtered and adsorbed from the highway runoff. *The removal prevents these pollutants from being re-suspended or transported by later storm events.

DISADVANTAGES

*Striping the ditch of its protective vegetative cover increases flow velocity, may cause erosion and decreases the removal of pollutants. *Irrigation of newly seeded areas also may be required

PRACTICE LIFESPAN

Life span varies depending on the soil type, slope, rainfall intensity, ditch size, and vegetative cover. A reasonable inspection period can be once a year.

COST

Grass waterways are relatively inexpensive to construct and maintain. The frequency of maintenance operation in case of damages as a result of heavy storms may require additional expenses.

OPERATION AND MAINTENANCE

All structures should be inspected periodically and after major storm events for erosion, debris jams, and condition of vegetative cover. Routine clearing can minimize clogging, flooding, gullying and washout. Culverts and ditches must be left free of debris that can restrict water flow. Mowing can control the vegetation growth and reduce the necessity of an overall stripping the ditch and vegetation removal. In diverting from unpaved roads, sediment-laden runoff should not be diverted to protected waterbodies without proper treatment.

MISCELLANEOUS COMMENTS

Refer to **Construction Catalogue** for additional stabilization BMPs. The ditch maintenance plan should address disposal of sediments removed from ditches.

REFERENCES

Federal Highway Administration. Management Practices for Mitigation of Highway Stormwater Runoff Pollution. McLean, Virginia. June 1985.

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NYS Department of Transportation. Standard Specifications. January 1990.

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State of Virginia Water Control Board. Best Management Practices Handbook, Urban. 1979.

U.S. Environmental Protection Agency. Guidance Specifying Management Measures for Sources of NPS Pollution in Coastal Waters. Washington. DC. January 1993.

MANAGEMENT PRACTICE SUMMARY SHEET

PROPER SPECIES SELECTION FOR ESTABLISHING VEGETATIVE COVER

DEFINITION	Selection of appropriate vegetative species to stabilize the soil and minimize the need for maintenance.
WATER QUALITY PURPOSE	To minimize the generation of sediment and reduce the need for herbicide.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Sediment, herbicides
WHERE USED	Roadway right-of-way, utility right-of-way, buffer strips, critical areas.
PRACTICE DESCRIPTION	The selection of plant materials is an important step in establishing a vegetative cover in critical areas, buffer strips, grassed waterways, and rights of way. Besides soil stabilization and stormwater runoff control criteria, species selection should consider ease of maintenance and site suitability. Species selection varies based on local climate, shade conditions, soil drainage, adaptability of the species to the site, and intended use of the area. Adequate sight distance for highway safety requires low growing plants and turf, otherwise the vegetative cover has to be maintained mechanically or with herbicides more frequently. Selection can be guided by references cited. Planting trees and shrubs with deep root systems directly over or near water, gas, oil, and sewer lines or buried telephone and power cables should be avoided. Therefore, woody plant suppression is a secondary goal of many right-of-way plantings. The most successful plants are flatpea and crownvetch in well drained soil and canarygrass in poorly drained soils. If the vegetative canopy creates 50% shade cover or more, crownvetch may not grow vigorously. Flatpea remains vigorous with a minimum of 3-4 hours of direct daily sunlight.
PRACTICE EFFECTIVENESS	The effectiveness of this practice depends largely on selecting plant species which are best suited to specific site conditions and intended use of the right-of-way. A proper selection is effective in soil stabilization and ease of maintenance.
IMPACT ON SURFACE WATER	Beneficial. Implementing this practice reduces the possibility of soil exposure and sediment delivery to waterbody.

IMPACT ON GROUNDWATER	Beneficial. Implementing this practice reduces the need for using herbicides and the possibility of leaching to the groundwater.
ADVANTAGES	*Proper species selection can reduce maintenance requirements and related costs and minimize the use of mechanical control. *Suitable species require less pesticide application. *Proper selection of species can restrict the invasion of woody species. *Improves aesthetics.
DISADVANTAGES	*Highway safety issues requiring adequate sight distance and utility right-of-way corridors requiring low growing herbaceous plants narrows the range of appropriate species.
PRACTICE LIFESPAN	Long lifespan.
COST	A proper selection of vegetation should not create extra costs.
OPERATION AND MAINTENANCE	None.
MISCELLANEOUS COMMENTS	Consulting with Soil & Water Conservation District, Cornell Cooperative Extension, Soil Conservation Service, or local garden stores can be helpful in making the best selection.
REFERENCES	Empire State Chapter. Soil and Water Conservation Society. New York Guidelines for Urban Erosion and Sediment Control. Syracuse, NY. October 1991.
	NYS Department of Transportation. Standard Specifications: Construction and materials. Albany, NY. January 1990. **(Management Practice Design Standard and Specification)**
	U.S. Environmental Protection Agency. Guidance Specifying Management measures for Sources of NPS Pollution in Coastal Waters. Washington, DC. January 1993.
	USDA-Soil Conservation Service. A Guide to Conservation Plantings on Critical Areas for New York . Syracuse, NY. June 1991.

MANAGEMENT PRACTICE SUMMARY SHEET

RESTORATION OF DISTURBED AREAS WITHIN THE ROW

DEFINITION

Restoration of the disturbed area to its original condition of slope, soil compaction, ground cover, and hydrologic pattern or to stable condition through appropriate practices.

WATER QUALITY PURPOSE

To control surface water runoff and prevent soil erosion and sediment transport to waterbodies.

SOURCE CATEGORY

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED

Sediment.

WHERE USED

Roadway right-of-way and utility right-of-way corridors where trenching and backfilling or cuts and fills are required.

PRACTICE DESCRIPTION

Restoration is usually the final stage of construction but may also apply to soil disturbance during repair or reconstruction of utility facilities. Any soil disturbance during ROW activities should be followed by restoration of the area.

Slopes should be returned to the original contours or an erosion-resistant grade (no steeper than one vertical on one and one-half horizontal in cut and fills). Seeding and other erosion control measures should be installed within 15 days after construction operations cease. If the season does not allow for vegetative growth, interim stabilization methods should be installed to control erosion temporarily until vegetation is successfully established. Soil compaction rates should be sufficient to prevent seed/mulch and sediment washoff. Over-compaction should be avoided, since it may hinder vegetative growth or result in excessive runoff and consequent erosion. Topsoil should be restored to the original depth to help with a better vegetative establishment. For temporary stream relocations or stream crossings the stream channel should be returned to its original hydrology and hydraulic conditions at the end of the project.

Slope breakers, sediment barriers, silt fence, staked hay/straw bales, rip-rap, grade stabilization structure, diversion, trench breakers, mulching, matting, hydroseeding, or other structural or operational practices can be utilized to stabilize the soil permanently or temporarily. The need and spacing of each of the above practices can be determined on a project-specific basis and used as needed, especially in areas adjacent to waterbodies and wetlands. Fertilization is often necessary because trenching and backfilling result in the removal and burial of fertile topsoil. All the debris should be removed from the site at the end of the project.

PRACTICE EFFECTIVENESS

Restoration is effective in controlling erosion. Studies show that each one of the methods for soil stabilization can be reasonably effective in reducing soil loss. The result from a study on different types of mulching on a site with a uniform 20% slope shows that soil loss was reduced from 40 ton/acre in a no-mulch condition to 11 T/A by using

60T/A stone or to 5.5 T/A by using 7 T/A woodchips (Hynson, et al., 1982).

IMPACT ON SURFACE WATER

Beneficial. Restoration of ROW contributes to water quality by controlling erosion and sediment transport.

IMPACT ON GROUNDWATER

None.

ADVANTAGES

*Establishment of vegetation provides favorable wildlife habitat.
*Proper soil compaction in both topsoil and subsoil where ROW crosses agricultural sites provides appropriate seedbed for cultivation.

DISADVANTAGES

*Some of the structural practices require technical expertise for design and installation and following standard specifications.

PRACTICE LIFESPAN

Permanent.

COST

Cost will vary depending on the stabilization practice selected.

OPERATION AND MAINTENANCE

Follow-up inspections shall be made after the first and second growing season (normally 3 to 9 months and 15 to 21 months) after planting to determine the success of revegetation. Revegetation can be considered successful if non-nuisance vegetation is similar in density to adjacent undisturbed land. Some areas may need to be protected from grazing until plants are well established.

MISCELLANEOUS COMMENTS

A selection of management or structural practices can be made from the Construction Management Practices Catalogue or references cited on this practice.

REFERENCES

Empire State Chapter. Soil and Water Conservation Society. New York Guidelines for Urban Erosion and Sediment Control. Syracuse, NY. October 1991.

Federal Energy Regulatory Commission. Erosion Control, Revegetation, and Maintenance Plan. Washington, D.C. June 1992.

Federal Energy Regulatory Commission. Wetland and Waterbody Construction and Mitigation Procedures. Washington, D.C. September 1992.

NYS Department of Environmental Conservation. Erosion and Sediment Control Guidelines for New Development. Division of Water Technical and Operations Guidance Series (5.1.10). Albany, NY. April 1991

NYS Department of Environmental Conservation. Division of Water. Management Practices Catalogue. Construction Catalogue. Albany, NY. November 1992.

NYS Department of Transportation. Construction Guidelines for Temporary Erosion Controls. Albany, NY. July 1987.

NYS Department of Transportation. Standard Specifications Construction and Materials (General Provisions). Albany, NY. January 1990.

U.S. Environmental Protection Agency. Guidance Specifying Management Measures for Sources of NPS Pollution in Coastal Waters. Washington, D.C. January 1993.

MANAGEMENT PRACTICE SUMMARY SHEET

HERBICIDE MANAGEMENT

DEFINITION	An integrated systems approach to managing the selection, handling, mixing, use, placement, storage and disposal of herbicides used on hardwood species, woody vines, suckers and any undesirable vegetation in roadway and utility right-of-ways.
WATER QUALITY PURPOSE	To reduce or prevent herbicide contamination of surface and groundwater resources.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Herbicides, including defoliants, desiccants and plant regulators.
WHERE USED	Roadway, railroads, and utility right-of-way corridors.
PRACTICE DESCRIPTION	The system is composed of several management practices that incorporate informed decision-making, risk assessment, source controls, pollution prevention, and improved application efficiency. The linear nature of ROW corridors requires adopting various management measures for specific situations to minimize water quality impacts. A well-designed herbicide management program controls potential losses of chemicals from target vegetation, by reducing risks associated with the herbicide application. This approach can be made by proper selection of application methods (including basal, stem-foliar, or cut-stump treatment), herbicide formulation, timing, equipment calibration, equipment condition, handling, site-specific evaluation, weather conditions and following the label directions.
PRACTICE EFFECTIVENESS	Practices that incorporate informed decision-making, source controls, and management practices associated with herbicide use are very effective in reducing potential runoff or transport of herbicides. Best control may be achieved in conjunction with erosion control and surface water control.
IMPACTS ON SURFACE WATER	Beneficial. Herbicide management practices eliminate or reduce the availability of herbicides as a potential pollutant; however, to achieve maximum control, they must be combined with management practices that control erosion and reduce surface runoff volumes.
IMPACT ON GROUNDWATER	Beneficial. Herbicide management practices eliminate or reduce the availability of herbicides for leaching; however, to achieve the maximum control they must be combined with management practices that reduce infiltration.

ADVANTAGES	*Herbicide management reduces the potential for herbicide loss due to reduced availability. *Improved herbicide management may reduce the amount of herbicide used in right-of-way management, thereby reducing herbicide costs. *Improved application efficiency will result in reduced drift and volatilization losses. *Proper timing of herbicide application to avoid adverse temperatures, winds and significant runoff events will reduce the potential for herbicide loss due to reduced availability.
DISADVANTAGES	*Some herbicide management practices are expensive. *Weather may render some herbicide management practices invalid.
PRACTICE LIFESPAN	Varies. However, herbicide practices have a temporary lifespan.
COST	Varies with management practice selected.
OPERATION AND MAINTENANCE	Specific to management practice selected.
MISCELLANEOUS COMMENTS	All franchised electric and gas utilities in New York State are required to have a systemwide management plan which is reviewed and approved by the Public Service Commission.
REFERENCES	Cornell Cooperative Extension. Cornell University. Department of Floriculture and Ornamental Horticulture. Hummel, Norman. Lawn Care Without Herbicides. Ithaca, NY. November 1990. **(Management Practice Design Standard and Specification)** Cornell Cooperative Extension. Cornell Recommends for: Floriculture/Cultural, Forest Crops/Pest Control, Turfgrass, Vertebrates. Ithaca, NY (Current Year). **(Management Practice Design Standard and Specification)** Cornell Cooperative Extension. Miscellaneous Bulletin 74. Guide to Safe Herbicide Management Around the Home (Current Year). Ithaca, NY. **(Management Practice Design Standard and Specification)** Cornell Cooperative Extension. Cornell University. Dept. of Soil, Crop and Atmospheric Sciences. Extension Series No. 1. van Es, Harold and Nancy M. Trautmann. Herbicide Management for Water Quality: Principles and Practices. Ithaca, NY. October 1990. **(Management Practice Design Standard and Specification)** Cornell Cooperative Extension. Herbicide Applicator Training Manual. Second Edition. Ithaca, NY. (See individual Category Manuals) 1990. **(Management Practice Design Standard and Specification)**

MANAGEMENT PRACTICE SUMMARY SHEET

STREET SWEEPING / ROAD CLEANUP

DEFINITION

Use of a mechanical broom sweeper, motorized vacuum sweeper, loaders, or hand tools to clean impervious surfaces.

WATER QUALITY PURPOSE

To remove pollutant loads from impervious surfaces before they are washed into stormwater conveyance systems.

SOURCE CATEGORY

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED

Debris, organic matter, nutrients, sediments, abrasives, pathogens, some trace metals and aesthetics.

WHERE USED

On roads, streets, parking lots and other impervious surfaces in residential, suburban, industrial and commercial areas from Spring through late Fall.

PRACTICE DESCRIPTION

Street sweepers are designed to dislodge debris and dirt from the street surface, transport it onto a moving conveyor, and deposit it into a storage hopper. The most common type of street sweeper is a mechanical sweeper, which uses a rotating gutter broom to transport particles from the gutter area into the path of a large cylindrical broom which rotates to carry the material onto a conveyor belt. Water is sprayed on the collected material to control resuspension of the fine particles. A second type of street sweeper is a vacuum sweeper, which uses gutter and main pickup brooms for dislodging and transporting pavement and street debris and dirt into the path of a vacuum intake, which carries the debris into the hopper. The collected dirt is sprayed with water and settles out in the hopper. The material collected by street sweepers is taken to a disposal site such as a landfill.

In cities where sand is heavily applied during the winter, it is necessary in spring cleanup to remove the accumulated sand. The method commonly utilized involves front end loaders and trucks or hand crews which are followed by front end loaders to move sediment from the street surface to trucks. Shoveling is useful in removing accumulated materials from sites not accessible by mechanical cleanup methods. Cases where shoveling is appropriate include removing accumulated solids and sludges in ditches, cleaning out sumps and removing contaminated snow.

PRACTICE EFFECTIVENESS

The effectiveness of street sweeping depends on the type and condition of the street pavements; on parking, traffic and litter conditions;, and on the management and operation of the program. Frequent cleaning of streets and pavement can result in a 20% reduction of total suspended solids, up to 10% reduction in chemical oxygen demand and 5% to 35% reduction in lead. Intensive cleaning of streets and pavements can result in up to 50% reduction of fecal coliform and a 15% reduction of total coliform; however, seasonal differences may occur. Overall, the practice is limited in pollutant load reductions.

IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	None.
ADVANTAGES	*Improves street aesthetics. *Removes urban floatables from the pollutant load. *Prevents clogging of downstream stormwater inlets. *Sand removal prevents the sediment from being washed off into waterbodies.
DISADVANTAGES	*Street sweeping effectiveness is limited due to variability of operator skill, performance of equipment and frequency of street cleaning. *Practice is labor-intensive and requires significant capital investment.
PRACTICE LIFESPAN	Street sweepers typically have a useful life of 8 to 14 years. The practice of sweeping or vacuuming streets has a lifespan of about three days.
COST	Estimated costs are high. In 1988, the City of Milwaukee swept 86,000 curb-miles for about $25 per curb mile.
OPERATION AND MAINTENANCE	Perform operation and maintenance on equipment according to manufacturer's directions. After snow melts, increase frequency of sweeping and sand removal. An important part of this practice involves educating the equipment operator about methods to optimize pollutant removal, including optimum sweeper speed, brush adjustment and rotation rate, sweeping pattern, and interim storage and disposal methods.
MISCELLANEOUS COMMENTS	Flushing method in street cleanup is not recommended. This method does not remove the pollutants but flushes it to the drainage system and can have adverse water quality impacts. An important part of a successful sweeping program involves establishing and enforcing regulations for litter control and trash and refuse storage, in addition to establishing a public education campaign designed to promote a reduction of curbside trash.
REFERENCES	Long Island Regional Planning Board. Koppelman, Lee, et al. The Long Island Segment of the Nationwide Urban Runoff Program. Hauppauge, NY. December 1982. Southeastern Wisconsin Regional Planning Commission. Costs of Urban Nonpoint Source Water Pollution Control Measures. Waukesha, Wisconsin. June 1991. USEPA. Office of Water. Guidance Specifying Management Measures for Sources of Nonpoint Source Water Pollution in Coastal Waters. Chapter 4: "Management Measures for Urban Areas" and "Site-specific Industrial Stormwater BMPs". Washington, DC. January 1993. USEPA. Office of Research and Monitoring. Water Pollution Aspects of Street Surface Contamination. Washington, DC. November 1972.

MANAGEMENT PRACTICE SUMMARY SHEET

HERBICIDE MANAGEMENT: Proper Equipment Calibration

DEFINITION	Proper equipment calibration involves measuring the output of herbicide application equipment under controlled conditions to facilitate adjustment of equipment components.
WATER QUALITY PURPOSE	To ensure herbicide application equipment is uniformly applying the correct amount of material, and that herbicides do not contaminate surface or groundwater resources.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Herbicides, including defoliants, desiccants and plant regulators.
WHERE USED	Roadway, railroads, and utility right-of-way corridors. In all instances when herbicides will be applied by equipment.
PRACTICE DESCRIPTION	Calibration involves determining the correct herbicide rate, checking and adjusting boom height, nozzle spacing, nozzle discharge angle, nozzle flow rate, nozzle spray pattern, operating speed and pressure. Calibration ensures that herbicide application machinery is uniformly applying the correct amount of material over a given area. Calibration is performed for liquid and granular herbicides applied by equipment. Herbicide delivery can change with equipment wear, gauge error, nozzle error, wheel slippage, speedometer error, and friction loss. Calibration is a critical factor in the operation and maintenance of herbicide application equipment and should be performed regularly. Proper equipment calibration results in correct herbicide application and reduces the availability of herbicides as a nonpoint source pollutant.
PRACTICE EFFECTIVENESS	The effectiveness of any herbicide depends upon the proper application and placement of the chemical. Proper equipment calibration, performed on a regular basis, can reduce or eliminate the errors, increasing the effectiveness of herbicide application and reducing or eliminating the availability of herbicides as a nonpoint source pollutant.
IMPACT ON SURFACE WATER	Beneficial. Proper equipment calibration will greatly reduce or eliminate the availability of herbicides as a nonpoint source pollutant.
IMPACT ON GROUNDWATER	Beneficial. Proper equipment calibration will greatly reduce or eliminate the availability of herbicides as a nonpoint source pollutant.

ADVANTAGES	*Equipment calibration increases herbicide application effectiveness. *Proper calibration saves pesticide materials and reduces application costs. *Calibration identifies faulty equipment components, which helps with regular O&M of equipment.
DISADVANTAGES	None.
PRACTICE LIFESPAN	Temporary. In ROW applications, equipment may be transported over rough terrain which could cause spray calibration to come out of adjustment. For this reason, calibration should be performed prior to each herbicide application.
COST	No out-of-pocket cost for calibration. Does require "time" from herbicide applicator.
OPERATION AND MAINTENANCE	Follow according to equipment manufacturer's directions. Typically prior to each herbicide application.
MISCELLANEOUS COMMENTS	Herbicide Application Training Manual, Second Edition, discusses calibration procedures for different types of sprayers.
REFERENCES	Cornell Cooperative Extension. Cornell University. Department of Floriculture and Ornamental Horticulture. Hummel, Norman. Lawn Care Without Herbicides. Ithaca, NY. November 1990. **(Management Practice Design Standard and Specification)**
	Cornell Cooperative Extension. Cornell University. Department of Soil, Crop and Atmospheric Sciences. Extension Series No. 1. van Es, Harold and Nancy M. Trautmann. Herbicide Management for Water Quality: Principles and Practices. Ithaca, NY. October 1990. **(Management Practice Design Standard and Specification)**
	Cornell Cooperative Extension. How to Apply Herbicides Accurately. Ithaca, NY. **(Management Practice Design Standard and Specification)**
	Cornell Cooperative Extension. Miscellaneous Bulletin 74. Guide to Safe Herbicide Management Around the Home. Ithaca, NY (Current Year). **(Management Practice Design Standard and Specification)**
	Cornell Cooperative Extension. Herbicide Applicator Training Manual. Second Edition. Ithaca, NY. 1990. **(Management Practice Design Standard and Specification)**

MANAGEMENT PRACTICE SUMMARY SHEET

HERBICIDE MANAGEMENT: Proper Timing of Herbicide Application

DEFINITION	Timing herbicide applications with consideration for vegetative density, stage growth, irrigation and rainfall.
WATER QUALITY PURPOSE	To apply herbicides when they are most effective for vegetative control and pose the least risk of contaminating groundwater and surface waterbodies.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Herbicides, including defoliants, desiccants and plant regulators.
WHERE USED	Roadway, railroads, and utility R-O-W, wherever unwanted vegetation has grown.
PRACTICE DESCRIPTION	Proper timing of any herbicide application involves: •the use of field monitoring to detect vegetative growth so that herbicide applications can be targeted to times of need, and unnecessary applications are avoided; •the use of weather forecasting to detect rain and wind speed, so that herbicide applications can be avoided during adverse weather.
PRACTICE EFFECTIVENESS	Proper timing of herbicide applications, can prevent or reduce the availability of herbicides as a nonpoint source pollutant to surface and groundwaters.
IMPACT ON SURFACE WATER	Beneficial. Proper timing of herbicide applications reduces losses by most transport routes.
IMPACT ON GROUNDWATER	Beneficial. Proper timing of herbicide applications reduces the potential of herbicide leaching losses.
ADVANTAGES	*Fewer herbicide applications are required if they are carefully timed, resulting in lower herbicide costs. *Proper timing of applications results in more effective control of the target vegetation, eliminating over-application, thereby lowering herbicide and application costs.
DISADVANTAGES	*Proper timing of herbicide application requires the development of a higher level of management skill from the herbicide applicator, and this skill may take additional time to acquire.
PRACTICE LIFESPAN	Temporary. Proper timing of application principles must be followed prior to each herbicide application.

COST

No out-of-pocket cost for proper timing of herbicide application. Does require "time" from herbicide applicator.

OPERATION AND MAINTENANCE

Requires continuation of field monitoring program.

MISCELLANEOUS COMMENTS

None.

REFERENCES

Cornell Cooperative Extension. Cornell Recommends for: Field Crops, Livestock/Poultry, Stored Grains, Floriculture/Cultural, Forest Crops/Pest Control, Turfgrass, Vertebrates, Tree-Fruit, Grapes, Small Fruit, Vegetable/Potato. Ithaca, NY (Current Year). **(Management Practice Design Standard and Specification)**

Cornell Cooperative Extension. Cornell University. Dept. of Soil, Crop and Atmospheric Sciences. Extension Series No. 1. van Es, Harold and Nancy M. Trautmann. Herbicide Management for Water Quality: Principles and Practices. Ithaca, NY. October 1990. **(Management Practice Design Standard and Specification)**

Cornell Cooperative Extension. How to Apply Herbicides Accurately. Ithaca, NY. **(Management Practice Design Standard and Specification)**

Cornell Cooperative Extension. Miscellaneous Bulletin 74. Guide to Safe Pest Management Around the Home. Ithaca, NY (Current Year). **(Management Practice Design Standard and Specification)**

Cornell Cooperative Extension. Herbicide Applicator Training Manual. Second Edition. Ithaca, NY. (See individual Category Manuals) 1990. **(Management Practice Design Standard and Specification)**

NWQEP. Best Management Practices for Agricultural Nonpoint Source Control: IV. Herbicides. Biology and Ag. Engineering Department. North Carolina State University. Raleigh, NC. September 1984. **(Management Practice Design Standard and Specification)**

NYS Department of Environmental Conservation. Longabucco, P., Controlling Agricultural Nonpoint Source Water Pollution in New York State: A Guide to the Selection of Best Management Practices to Improve and Protect Water Quality. Albany, NY. 1991.

MANAGEMENT PRACTICE SUMMARY SHEET

HERBICIDE MANAGEMENT: Read and Follow the Label Directions

DEFINITION	Reading and following herbicide label directions.
WATER QUALITY PURPOSE	To reduce errors made in herbicide selection, use and disposal; to reduce or eliminate the potential loss of herbicides from roadway and right-of-way operations to surface and groundwater.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Herbicides.
WHERE USED	Roadway, railroad and utility right-of-way corridors, as neessary, to control undesirable vegetation.
PRACTICE DESCRIPTION	Reading and following the herbicide label directions is a preventative management practice to be used by all herbicide applicators prior to making chemical herbicide management decisions. The label includes critical information for worker and applicator safety, public health, and environmental protection. The label's use instructions, approved by USEPA, have been carefully developed after many years of study and testing. Reading the label will determine whether the herbicide is needed for controlling specific plant species, and if it can be safely used; ratio and precautions for mixing, application, storage and proper disposal of the herbicide, rinsate and container. Using a herbicide in any manner other than specified on the label is against the law. By reading and following the label directions, applicators can reduce the risk of herbicide contamination of surface and groundwater.
PRACTICE EFFECTIVENESS	When applicators read and follow label directions, they gain improved herbicide knowledge which can lead to less herbicide use and reduced threat to surface and groundwater resources from herbicide contamination.
IMPACT ON SURFACE WATER	Beneficial. Reading and following the label directions provides protection for surface waterbodies.
IMPACT ON GROUNDWATER	Beneficial. Reading and following the label directions provides protection for groundwater.
ADVANTAGES	*When the label directions are carefully followed, herbicide losses to waterbodies will be minimized.
DISADVANTAGES	*Labels may not include specific New York State restrictions for herbicide use.

PRACTICE LIFESPAN	Temporary. Must be done before each herbicide use.
COST	None.
OPERATION AND MAINTENANCE	As indicated on the herbicide label.
MISCELLANEOUS COMMENTS	A Material Safety Data Sheet (MSDS) is available from the manufacturer for each registered herbicide. Because the MSDS contains additional information which may not be included on the label, applicators should read and retain copies of the MSDS for herbicides they use regularly. *Application rate should be identified based on an accurate calculation of the area and mixing ratio.
REFERENCES	Cornell Cooperative Extension. Cornell Field Crops and Soils Handbook. Second Edition. Ithaca, NY. 1987. **(Management Practice Design Standard and Specification)**
	Cornell Cooperative Extension. Cornell Recommends for: Field Crops, Livestock/Poultry, Stored Grains, Floriculture/Cultural, Forest Crops/Pest Control, Turfgrass, Vertebrates, Tree-Fruit, Grapes, Small Fruit, Vegetable/Potato. Ithaca, NY (Current Year). **(Management Practice Design Standard and Specification)**
	Cornell Cooperative Extension. Pesticide Applicator Training Manual. Second Edition. Ithaca, NY. (See individual Category Manuals) 1990. **(Management Practice Design Standard and Specification)**
	NYS Department of Environmental Conservation. Longabucco, P. Controlling Agricultural Nonpoint Source Water Pollution in New York State: A Guide to the Selection of Best Management Practices to Improve and Protect Water Quality. Albany, NY. 1991.
	NWQEP. Best Management Practices for Agricultural Nonpoint Source Control: IV. Pesticides. Biology and Ag. Engineering Department, North Carolina State University. Raleigh, NC. September 1984.
	USDA. Soil Conservation Service. National Handbook of Conservation Practices-Pest Management. Syracuse, NY. December 1990.

MANAGEMENT PRACTICE SUMMARY SHEET

HERBICIDE MANAGEMENT: Selective Aerial Application

DEFINITION:

Careful selection of target areas and application method for the aerial application of herbicides where other methods of vegetation control are not practical and on-site specific considerations and post management needs require this approach.

WATER QUALITY PURPOSE:

To prevent herbicide drifts and runoff from utility rights-of-way and subsequent contamination of waterbody.

SOURCE CATEGORY:

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED:

Herbicides, including, defoliants, desiccants and plant regulators.

WHERE USED:

Roadway, railroads, and utility right of way corridors, wherever undesirable vegetation has grown.

PRACTICE DESCRIPTION:

Aerial application of herbicides by airplane or helicopter should be carried out so as to minimize water quality impacts. In working with aerial applicators, the followings items should be considered:

* Aerial Application should be undertaken only when implementation of other control methods such as mechanical or biological control or ground spraying targeted vegetation is impractical. A site restricted by any of the following factors might be selected for aerial application: when density of vegetation makes the cost of cutting prohibitive; excessive width and height of undesirable brush on the right of way, site not accessible to ground equipment.

* Aim aerial application at the target vegetation. Proper calibration, selection of equipment and application system can maximize accurate placement on the target vegetation. Use of equipment which can handle thickened herbicide or deliver large uniform droplets, or other improved technologies are effective in accurate targeting.

* Prevent drift by considering the wind speed. Drifting from targeted areas to unintended areas can happen depending on wind speed and direction. Use of drift control agents is effective in minimizing the drift. Wind limits are set based on mixture used, application equipment, height of drop and proximity of sensitive areas next to the ROW.

* Identify the area to be treated and any crucial areas to avoid. Keep the maps simple and easy to read during flight, with boundary landmarks clearly identified. Inspect the site and review the map with your pilot and carefully identify nearby ponds, creeks, streams, wetlands, sinkholes.

* Sites located in environmentally sensitive areas should not be selected for aerial application. Dependent upon specific site conditions, and label directions, aerial application on shut-off zones shall be established so as to minimize potential impacts on water resources.

* Establish whose responsibility it is to make decisions based on the weather changes. Professional pilots are expert at interpreting the effects of changes and can make the go/no-go weather decisions to avoid conditions which can cause damaging drift problems.

PRACTICE EFFECTIVENESS: This practice can be relatively effective where hardship does not allow using any other methods of vegetation control. Following the above guidelines will reduce the impact of herbicide on water resources.

IMPACT ON SURFACE WATER: Beneficial.

IMPACT ON GROUNDWATER: Beneficial.

ADVANTAGES: *Reduces the drift and herbicide loss. Where aerial application is unavoidable, this practice provides more protection to waterbodies or other sensitive areas.

DISADVANTAGES: *In spite of selective application, there remains a risk of drift of herbicide to non target areas.

PRACTICE LIFESPAN: Temporary.

COST: Consideration of guidelines may require more sensible timing and operation. Implementing other methods will cost more but the water quality benefits should outweigh the extra cost.

OPERATION AND MAINTENANCE: None

REFERENCES:

Cornell Cooperative Extension. Herbicide Applicator Training Manual. Second Edition. Ithaca, NY. August 1991.

Environmental Stewardship Editorial Materials. The Alliance for a Clean Rural Environment. Washington, D.C. 20005. Niagara Mohawk Power Corporation. Transmission Right-of Way Management Program. Syracuse, NY. October 1989.

Niagara Mohawk Power Corporation. Transmission Right-of-Way Management Program. Syracuse, NY. October 1989.

U.S. Department of Commerce. North Carolina State University At Raleigh. Best Management Practices for Agricultural Nonpoint Source Control. Raleigh, NC. September 1984.

MANAGEMENT PRACTICE SUMMARY SHEET

HERBICIDE MANAGEMENT: Selective Herbicide Appication in Sensitive Areas

DEFINITION

Evaluation of site characteristics and adoption of the appropriate techniques and buffer zones to prevent herbicide drift, transport, and leaching to waterbodies.

WATER QUALITY PURPOSE

To prevent contamination of water bodies as a result of herbicide application in environmentally sensitive areas.

SOURCE CATEGORY

Roadway and Right-of-Way Maintenance.

POLLUTANTS CONTROLLED

Herbicides.

WHERE USED

Roadway, railroad and utility right-of-way corridors crossing or adjacent to streams, lakes, ponds, springs, sink holes, groundwater well head protection areas, and wetlands.

PRACTICE DESCRIPTION

Because of the linear nature of highway and utility ROW, it is likely that the rights-of-way sometimes cross or are in close proximity to environmentally sensitive areas. In areas adjacent to wetlands, surface waters and well head areas, herbicide applicators should adopt various management measures applicable to protect waterbodies. Set back distances and buffer zone widths vary depending on herbicide application method, herbicide formulation and ROW environmental characteristics such as: hydrology, topography, soil type, weather conditions, and vegetation density. All the above variables should be considered so as to prevent the possibility of herbicide drift, leaching, wash-off, and mobility through soil.

Sensitive areas and relative potentials for loss and leaching of herbicides should be identified by on-site inspection, field inventory, or using up-to-date maps before starting herbicide application. Foliar or broadcast application should be terminated if the wind speed is higher than 10 mph or more than the limits specified on the label. Droplet size can be controlled by additives or equipment adjustment to reduce the drift loss. Depending on the proximity to water bodies aerial application may have to be switched to ground application. If the combination of factors such as slope, soil, and ground cover causes high runoff volume, the application method or the herbicide formulation should be changed or other alternatives should be chosen. Blanket treatment (spraying all vegetation at high-pressure with relatively large quantity of herbicide) typically done by a sprayer mounted on a truck driving along the ROW, is not appropriate in such areas. Low-volume application by backpack-mounted applicators and selectively spraying unwanted vegetation can be done at a safe proximity. However, leaving "no-treatment" buffers is good practice in areas adjacent to sensitive water resources.

PRACTICE EFFECTIVENESS

A comparison of alternative methods, formulation, and timing of application shows that ground vs. aerial application, controlled droplet applicators, computer controlled equipment, drift shielded ground sprayers, direct nozzles, soil-incorporated vs. surface-applied, granules vs. dust formulation, oil emulsions, and spraying only on calm days are effective techniques for reducing drift loss. Airborne drift loss is typically 4-5 times greater with aerial application than with high-clearance ground sprayers, and low-clearance ground sprayers are even more effective. Ultra low volume equipment and formulation and restricting application before precipitation are effective in reducing runoff losses.

IMPACT ON SURFACE WATER	Beneficial. An integrated decision making process before applying herbicides in sensitive areas and selection of the most appropriate method based on existing conditions and variables will have a beneficial impact on adjacent waterbodies.
IMPACT ON GROUNDWATER	Beneficial. Limiting the use of herbicide in areas susceptible to infiltration will reduce the threat for groundwater contamination.
ADVANTAGES	*Considering a set-back distance based on the adopted practices can prevent herbicide transfer to surface waters. *This practice will provide flexibility based on the site situation in sensitive areas. *Low-volume spraying is cost-effective if brush density is light. *Selective application, which eliminates tall maturing vegetation and encourages low-growing plants to live, chokes out reinvasion of undesirable species.
DISADVANTAGES	*Evaluating the site situation requires gathering information and studying variables that can have water quality impact. *This evaluation requires technical expertise and time for planning and decision making.
PRACTICE LIFESPAN	Temporary.
COST	Depends on the need for changing equipment, collecting information and technical expertise. Some of the methods such as low volume spraying are less expensive.
OPERATION AND MAINTENANCE	Maintain maps of sensitive areas and information of the site characteristics.
MISCELLANEOUS COMMENTS	Management practices from "Agriculture" catalogues such as: "Evaluation of Site Specific Leaching and Surface Loss Potentials" and "Computerized Precision Application" can be used.
REFERENCES	Cornell Cooperative Extension. Pesticide Applicator Training Manual. Second Edition. Ithaca, NY. August 1991. Electrical World. Right-of-Way Maintenance. Low-Volume Spraying Effective for Many. Greg Paula, Associate Editor. September, 1992. Empire State Electric Energy Research Corporation. Herbicide Residue and Mobility Study: Existing Data and Simulation Model Review. Arthur D. Little, Inc. Cambridge, MA. December 1987. NYS Department of Environmental Conservation. Controlling Agricultural Nonpoint Source Water Pollution in New York State. Albany, NY. 1991. Oregon State University. Department of Forest Science. Determination of the Effectiveness of Herbicide Buffer Zones in Protecting Water Quality. L. Norris. Corvallis, Oregon. 1993. U.S. Department of Commerce. North Carolina State Univ. at Raleigh. Best Management Practices for Agricultural Nonpoint Source Control. 4. Pesticides. Raleigh, North Carolina. September 84. USDA. Soil Conservation Service. National Handbook of Conservation Practices-Pest Management. Syracuse, NY. December 1990.

MANAGEMENT PRACTICE SUMMARY SHEET

PROPER MECHANICAL CONTROL OF VEGETATION

DEFINITION	Proper use of mechanical equipment to remove or reduce undesirable vegetation.
WATER QUALITY PURPOSE	To avoid erosion caused by the use of equipment which could disturb soil in sensitive areas.
SOURCE CATEGORY	Roadway and Right-of-Way Maintenance.
POLLUTANTS CONTROLLED	Sediment.
WHERE USED	Roadway right-of-way and utility right-of-way corridors.
PRACTICE DESCRIPTION	This practice is to emphasize the need to select equipment that will minimize impacts to waterbodies. A wide range of mechanical techniques and equipment are available for clearing and maintaining right-of-way areas which if properly employed can reduce water quality impacts. These methods should be selectively chosen to minimize site disturbance and soil erosion. The selection should consider site characteristics such as terrain, slope length, soil condition, and proximity to waterbodies. Water quality impacts from selective vegetative maintenance methods, such as use of chain saws and cutting or trimming trees and other woody vegetation, are minimal. Selective vegetative removal which maximizes protection of low-growing vegetation is preferred over blanket treatment. When all vegetation is removed, high growing plants are usually the first to regrow, compounding the problem with each work cycle. Leaving low-growing vegetation in place allows low-growing plants to choke out tall-plant seeds, preventing them from regrowing. Non-selective vegetative maintenance methods that treat an entire area include methods such as sheardozing, scalping, pushing, brushraking, rootraking, disking and plowing. The use of above practices can cause soil exposure and should be followed with land restoration practices such as mulching, vegetative cover, and structural slope protection. The disturbed soil should be properly seeded, fertilized and stabilized with mulch or an erosion control blanket immediately.
PRACTICE EFFECTIVENESS	Proper selection and use of mechanical equipment can be very effective in reducing soil disturbances and erosion problems.
IMPACT ON SURFACE WATER	Beneficial to slight impact. Proper selection of equipment can minimize soil exposure and erosion.
IMPACT ON GROUNDWATER	None to beneficial.
ADVANTAGES	*Minimizes soil erosion and sedimentation. *Proper mechanical control is an alternative to chemical control.

DISADVANTAGES

*New growth and re-sprouting can lead to a dense cluster of sprouts that is difficult to remove. *Materials cut from right-of-way have to be removed. *Some of the methods that treat individual plants are labor-intensive and more expensive in the short-term.

PRACTICE LIFESPAN

The work cycle is a highly variable parameter, depending primarily on vegetation, terrain, rainfall, soil condition and length of growing season. Transmission lines usually have a 4-6 yr. cycle and distribution lines are trimmed back in a 3-4 yr. cycle.

COST

Depends on the variables associated with clearing and maintenance method. In addition to the cost of labor, differences in terrain, accessibility or extremes in brush density are basic factors in determining the cost. A nationwide survey of utilities by Florida Power Corp indicates the average cost of tree trimming is about $1,000 per mile. Reported costs range from $300 to $1,400 per mile.

OPERATION AND MAINTENANCE

None.

MISCELLANEOUS COMMENTS

Refer to *Restoration of Disturbed Areas* summary sheet and Silviculture Catalogue for more information.

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