

ROADSIDE MAINTENANCE

10.01 GENERAL

This manual is intended for internal guidance only and is not intended to create a legal or moral duty. Supervisors have discretion, based upon their expertise and the particular circumstances, to deviate from this manual and to conduct additional research or receive input from experts in other areas, as needed.

10.01.01 Area Included In Roadside

From the standpoint of maintenance, the roadside includes all of the highway right-of-way except that portion used for the shoulders and the traveled way. Rest areas established and maintained by the Division of Highways for use by the traveling public are included in the roadside. The median strip on a dual highway and the Interstate System interchange areas also makes up a part of the roadside.

10.01.02 Items of Roadside Maintenance

The routine maintenance of the roadside is the responsibility of the County Maintenance Superintendent or Interstate/APD Crew Supervisor as the case may be. They will receive advice and direction from the District pertaining to particular items and situations. Some items involved in the routine maintenance of the roadside are as follows:

1. Removal of litter and dead animals
2. Mowing and clearing
3. Chemical control of weeds, brush, and grass from specified areas
4. Control of erosion on slopes of cuts and fills
5. Care of trees and shrubs
6. Rest areas
7. Removal of obstructions within right of way limits
8. Guardrails
9. Right of way fences

In addition to maintenance of the roadside within the right of way limits, the Division of Highways is charged with the control of outdoor advertising and salvage yards within view of our highways. The Right of Way Division has responsibility for licensing and monitoring outdoor advertising and salvage yards. All inquiries on these subjects should be referred to the Right of Way Division.

10.01.03 Location of Right-of-Way Line

Highway construction projects often require the placing of a 6" (150mm) square concrete monument in the right of way corners or at the centerline control point which will provide for the establishing of the right of way line at any desired location. If monuments were not set, it is possible to obtain the right of way width

from plans. In addition, if there is any question regarding right of way width, the District Right of Way agent can be contacted for assistance.

The question often arises as to the widths of right of way owned by the Division on Highways for which the Division has no paper title. This problem is divided into two categories: (a) those roads established prior to 1933; and (b) those roads established since 1933. In each instance we are concerned only with those roads where the Division has no deed, order of the County Court, or other document designating its title or the extent of the width of right of way owned.

(a) Highways Established Prior to 1933

During the period prior to 1921, all roads were county roads and were divided into Class "A" county roads and Class "B" county roads. From 1921 to 1933 the roads were divided into "State Roads" and "County District Roads." For purposes of determining the width of right of way, Class "A" Roads and State Roads are grouped together, and Class "B" Roads and County District Roads are grouped together.

The rule in such cases is that in the absence of documentary evidence to the contrary (meaning a deed or an order of the County Court or other legal paper denoting the width of right of way), that for roads established prior to 1933, which were either Class "A" County Roads or State Roads, the right of way is 40' (12m) in width, measured 20' (6m) on either side of the center line of the traveled portion exclusive of slopes, cuts, and fills. In the case of Class "B" County Roads or County District Roads, the right of way is 30' (9m) in width, measured 15' (4.5m) on either side of the center line of the traveled portion, exclusive of slopes, cuts, and fills.

The West Virginia cases so holding are: *County Court vs. Coal Co.*, 103 WV 386; *State Road Commission vs. Coogle*, 108 WV 287; *Childers vs. State Road Commission* 124 WV 233; and *Hark vs. Lumber Company*, 127 WV 586.

(b) Highways Established Since 1933

By Chapter 40, Acts of the Legislature, 1933, First Extraordinary Session, the State Road System, consisting of primary and secondary roads, was established and placed under the jurisdiction of the State Road Commissioner. Those roads which had previously been classified as State Roads became primary roads while those roads which were previously a part of the County-District road system became secondary roads. By that same Chapter 40, however, the statutes which gave rise to the 40' (12m) and 30' (9m) right of way presumptions noted above were repealed. With regard to a primary or secondary road constructed or established subsequent to May 16, 1933 (the effective date of said Chapter 40), it is not known whether the Court would still apply the same presumptions as to minimum right of way widths.

It is believed that plans for roads constructed by the Road Commission subsequent to 1933 will be available in virtually all cases where a question might arise and in the absence of any other documentary evidence the right of way widths

shown on the plans should be accepted. If a case should arise in which plans or other documentary evidence could be obtained; for example, the case of an existing road or street which has been taken into the State Road System, consideration should be given to the provision of Chapter 17, Article 1, Section 3 of the Official Code of West Virginia, 1931, as amended. By that section, if a road as therein defined has been used by the public for a period of ten years or more and public monies or labor have been expended thereon, it shall be conclusively presumed to have been established. In such case a property owner may not compel the Division to make payment for the land appropriated for the road. *Dunn vs. Griffith, 139 WV 894* established the rule that where part of a tract of land has been appropriated for use as a public road, any claim for damages to the residual of the land must be asserted by the owner within two years after the road has been opened to public use. The time from which the ten-year and two-year periods of limitation begin are legal questions which can only be resolved upon the basis of all the facts in any given case (see *County Court vs. Coal Co., supra; Stephenson vs. Cavendish, 134, WV 361, Dunn vs. Griffith, supra; State ex rel Ashworth vs. State Road Commission, 138 S. E. 2d 471*).

In addition to the presumption noted above, Code, 17-1-3, further provides as follows:

“The words or terms 'road', 'public road,' or 'highway' shall be deemed to include, but shall not be limited to, the right of way, roadbed and all necessary culverts, sluices, drains, ditches, waterways, embankments, slopes, retaining walls, bridges, tunnels and viaducts necessary for the maintenance of travel, In the absence of any other mark or record, the center of the traveled way shall be taken as the center of the road and the right of way shall be designated there from an equal distance on each side, but a road may be constructed on any part of the located right of way when it is deemed advisable so to do.”

When the above quoted statutory provisions are carried into effect care should be exercised to ensure compliance with Code 17-4-7, as amended, which requires the Commissioner to promptly file with the Clerk of the County Court of each County all changes in titles to rights of way, maps, plats, surveys and all discontinuance of State Roads within the County.

10.02 SCHEDULING ROUTINE MAINTENANCE

10.02.01 Spring

10.02.01.01 Cleaning, Mowing, Clearing, and Spraying

1. General cleanup of litter on right of way.
2. Develop and implement schedule for mowing operations.
3. Perform dormant stem brush spraying.
4. Apply spring applications of grass growth regulators.

5. Fertilize and re-seed as required.
6. Removal of hazardous trees and tree limbs.
7. Perform brush cutting and stump spraying operations.
8. Prepare plots and plant wildflowers.
9. Perform dead animal/debris removal as required.

10.02.01.02 Rest Areas and Information Centers

1. Perform inspections as required.
2. Spring cleanup and continued routine maintenance.
3. Open designated rest areas.

10.02.01.03 Erosion Control

1. Perform routine inspection of slopes for erosion.
2. Make repairs to critical areas.
3. Develop and implement program to correct major erosion problems.
4. Perform routine maintenance on slopes.

10.02.01.04 Guardrail and Right of Way Fence

1. Perform routine inspection and repair of guardrail.
2. Perform routine inspection and repair of right of way fence.
3. Plan use of herbicides to control weeds and brush in right of way fence and guardrail.

10.02.01.05 Removal of Obstructions

1. Perform ongoing inspection of right of way to identify any obstructions.
2. Take appropriate action to remove obstructions.

10.02.02 Summer

10.02.02.01 Cleaning, Mowing, Clearing, and Spraying

1. General cleanup of litter on right of way.
2. Continue mowing operations as required.
3. Removal of hazardous trees and tree limbs.
4. Perform brush cutting and stump spraying operations.
5. Perform dead animal/debris removal as required.
6. Develop and implement foliar brush spray program.

10.02.02.02 Rest Areas and Information Centers

1. Perform inspections as required.
2. Perform routine maintenance.

10.02.02.03 Erosion Control

1. Perform routine inspection of slopes for erosion.
2. Perform routine maintenance of slopes.
3. Continue programmed repairs to correct major erosion problems.

10.02.02.04 Guardrail and Right of Way Fence

1. Continue routine inspection and repair of guardrail.
2. Continue routine inspection and repair of right of way fence.

10.02.02.05 Removal of Obstructions

1. Perform ongoing inspection of right of way to identify any obstructions.
2. Take appropriate action to remove obstructions.

10.02.03 Fall

10.02.03.01 Cleaning, Mowing, Clearing, and Spraying

1. General cleanup of litter on right of way.
2. Complete mowing operations.
3. Removal of hazardous trees and tree limbs.
4. Perform brush cutting and stump spraying operations.
5. Perform dead animal/debris removal as required.
6. Continue foliar brush spray program.
7. Prepare plots and plant wildflowers.

10.02.03.02 Rest Areas and Information Centers

1. Perform inspections as required.
2. Perform routine maintenance.
3. Close designated rest areas.

10.02.03.03 Erosion Control

1. Perform routine inspection of slopes for erosion.
2. Perform routine maintenance of slopes.
3. Complete programmed repairs of slope erosion.

10.02.03.04 Guardrail and Right of Way Fence

1. Continue routine inspection and repair of guardrail.
2. Continue routine inspection and repair of right of way fence.

10.02.03.05 Removal of Obstructions

1. Perform ongoing inspection of right of way to identify any obstructions.
2. Take appropriate action to remove obstructions.

10.02.04 Winter

10.02.04.01 Cleaning, Mowing, Clearing, and Spraying

1. General cleanup of litter on right of way.
2. Develop mowing plan for upcoming mowing season.
3. Overhaul mowing and spray equipment.
4. Perform brush cutting and stump spraying operations.
5. Perform dormant stem brush spraying.
6. Perform dead animal/debris removal as required.
7. Removal of hazardous trees and tree limbs.

10.02.04.02 Rest Areas and Information Centers

1. Repair/refurbish facilities.
2. Perform inspections as required.
3. Perform routine maintenance.

10.02.04.03 Erosion Control

1. Perform routine inspection of slopes for erosion.
2. Make repairs to critical areas.

10.02.04.04 Guardrail and Right of Way Fence

1. Continue routine inspection and repair of guardrail.
2. Continue routine inspection and repair of right of way fence.

10.02.04.05 Removal of Obstructions

1. Perform ongoing inspection of right of way to identify any obstructions.
2. Take appropriate action to remove obstructions.

10.03 LITTER REMOVAL

10.03.01 Materials Included

County and Expressway Maintenance forces are responsible for the removal of trash, rubbish, and debris along State highways. This includes, but is not limited to, fallen branches, articles that have fallen off vehicles, rocks, junk, litter, and dead animals.

10.03.02 General Cleanup

A general cleanup of the right of way on every Expressway, Trunkline, Feeder, and major Local Service Roads will be made at least three times each year. These cleanups will be after spring thaw, the middle of summer and in the fall before the snow season. On other Local Service Roads, one general cleanup in each year should be sufficient. It will be conducted in the spring after all Expressway, Trunkline, Feeder, and major Local Service Roads have been cleaned.

10.03.03 Routine Litter Cleanup

A routine weekly trash cleanup will be carried out on each Interstate. The Expressway, Trunkline, and Feeder system and the more heavily traveled Local Service Roads will receive the attention at intervals designated by the District Engineer.

10.03.04 Removal of Dead Animals

The remains of a dead animal will be removed promptly from the road surface and roadside, and either buried or taken to an approved landfill site.

Every County and expressway maintenance vehicle shall be assigned a shovel and a pair of work gloves and will carry them at all times for the removal and disposal of dead animals.

10.04 MOWING AND CLEARING

10.04.01 Purpose

Mowing along the highway is one of the operations important to good maintenance. Mowing helps to maintain proper sight distances, improves the general appearance of the roadside, controls weed growth and eliminates a fire hazard. Properly maintained roadsides also promote better drainage and tend to prevent snow drifting in some areas.

Mowing occasionally may be extended to variable distances in order to create a natural blending of the roadside and adjacent land. The extent of this irregularity of alignment will be governed by the topography of the area. An attempt will be made to plan mowing so as to accentuate the natural appearance.

Correct mowing heights improve the vegetation cover, reduce the hazard of flying objects, and avoid exposing small litter. Unnecessary mowing jeopardizes the safety of mower operators, results in excess expenditures, and encourages erosion of slopes.

10.04.02 Mowing Classification

Meadow Type Mowing: Meadow type mowing will be accomplished by mowing within a height of 16” (400mm) to 6” (150mm). This type of mowing will be accomplished on roadway shoulders, some interchanges, and sweep-out areas.

- 1. Mowing within 12” (300mm) to 4” (100mm) will be performed on medians and interchanges through municipal areas.**
- 2. Mowing within 10” (250mm) to 4” (100mm) will be performed on designated medians and scenic overlooks.**
- 3. Mowing within 4” (100mm) to 2” (50mm) will be performed at rest areas.**

10.04.03 Mowing Limits

Mowing Around Guardrail: Mow to guardrail. Where possible, treatment beyond guardrail will be accomplished with either selective herbicides or by power mowing, depending on terrain.

Mowing Ditchlines: Mow 5’ (1.5m) beyond ditchline if no slope greater than 3:1 exists.

Sight Distance Maintenance: Mowing should be accomplished to maintain maximum practical site distances.

Areas Not To Be Mowed: Beds planted for natural regeneration, beyond guardrail where herbicides have been used, boulder areas, mowable areas where legumes are planted, or any other area without justification.

10.04.04 Guides To Mowing

10.04.04.01 Interstate and Appalachian Project Development (APD) Highway Mowing

Vegetation will be mowed before it reaches a height of 16” (400mm) and will be mowed to a height of not less than 6” (150mm).

Roadsides and Interchanges in Rural Areas: Mow 30’ (9m) from the edge of the pavement or to ditch line, whichever comes first. If a slope of 3:1 or greater is encountered prior to this limit, mow 5’ (1.5m) up slope. If 3:1 or greater fill slope is encountered, mow to the crest of the slope.

Interchanges in Urban Areas: Mow entire area. If slope of 3:1 or greater is encountered, mow 5’ (1.5m) up slope.

Exit Ramps Intersecting Roadways: Where exit ramps intersect with roadways, mowing will be performed in such a manner that maximum practical sight distance in all directions, not to exceed 500' (150m), is maintained. The sight distance should be maintained as determined from the point where the driver can see approaching traffic on the roadway, allowing sufficient reaction time to stop or reduce speed as necessary before entering the roadway.

Medians Curbed or Non-curbed, 60' (18m) Wide or Less, With No Mounds: Mow the entire area.

Medians Curbed or Non-curbed, 60' (18m) Wide or Less, With Mounds that Slope 3:1 or Greater: Mow all flat areas and mow a maximum of 5' (1.5m) up slope behind ditch line.

Medians 60' (18m) Wide or Greater: Mow 30' (9m) from edge of pavement. If a slope of 3:1 or greater is encountered within this limit, mow a maximum of 5' (1.5 m) beyond guardrail except where herbicides are used.

Median With Guardrail: Mow up to 5' (1.5m) beyond guardrail, except where herbicides are used.

10.04.04.02 Expressway, Trunkline, and Feeder Route Mowing

Where mowing is required, it will be performed before the vegetation reaches a height of 16" (400mm) and mowed to a height of not less than 6" (150mm). Normally, a maximum of two swaths each side of roadway will be mowed. In general, the guidelines given for mowing on an Interstate highway apply to the right-of-way on an Expressway, Trunkline, or Feeder routes.

10.04.04.03 Local Service and Delta Route Mowing

On Local Service Routes, a maximum of one 5' (1.5m) swath each side of roadway will be mowed; all other requirements will be the same as those pertaining to Expressway, Trunkline, and Feeder routes.

Mowing Delta routes will be performed a maximum of one time per year, unless the average daily traffic is 100 or greater. If average daily traffic is greater than 100, mowing will be accomplished before vegetation reaches 16" (400mm) and mowed to a height of not less than 6" (150mm).

10.04.04.04 Mowing at Intersections

Improved safety to motorists through better visibility is obtained by mowing at intersections and around curves. Affected areas are to be mowed when the vegetation interferes with visibility. It is important to remove all vegetation and improve sight distance also along highway rights-of-way in the proximity of all railroad grade crossings to assure maximum visibility of the railroad crossbucks and/or signals.

Sight distance mowing includes mowing at entrances to residences and businesses.

Mowing will be done to achieve maximum practical sight distance in all directions not to exceed 500' (150m). The sight distance will be maintained as determined from the point where the driver would be when properly stopped at the intersection.

10.04.04.05 Mowing Around Signs

Vegetation will be cut when it interferes with the visibility of signs and railroad crossbucks or signals. This includes the trimming of trees or brush. Care should be taken to insure that maximum visibility is maintained at all times.

10.04.04.06 Mowing Adjacent to Improved Property

Rights of way adjacent to improved property and where mowing is possible beyond the designated limits, are not to be mowed unless directed by the District Engineer.

10.04.04.07 Mowing at Scenic Overlooks

All scenic overlooks will be mowed before the grass reaches a height of 10" (250mm) to a height of not less than 4" (100mm).

10.04.04.08 Mowing at Rest Areas

All rest areas will be mowed. Lawn type riding mowers or self-propelled hand lawn mowers may be used. Mowing is to be performed before the grass reaches a height of 4" (100mm) and mowed to a height of not less than 2" (50mm).

10.04.05 Types of Mowing Equipment

10.04.05.01 Sickle Bar Type

The sickle type mower is the unit commonly used throughout the State because of its adaptability to rough terrain. The mower is normally mounted on the powered vehicle although separate pull-type units are available. On this type mower, the bar can be raised over obstacles, and it will cut tall weeds and grass. It can be angled to cut on a steep slope or to span a small ditch. There are two disadvantages to the sickle type mower: It is slow, and the cost of maintaining it is high as the knife must be sharpened frequently and replaced often.

10.04.05.02 Flail Type

The flail type mower is either mounted on a vehicle and run by a power take-off unit, or it carries its own power unit and is pulled by means of a drawbar. Such a mower has a high production rate, and the knives can be replaced quickly. It will not throw objects and the vegetation is pulverized into desirable mulch which is evenly spread behind the mower rather than windrowed.

10.04.05.03 Rotary Mowers

10.04.05.03.01 Heavy Duty Rotary

The heavy duty rotary mower is designed to cut weeds, grass and other heavy vegetation on rough terrain. The mower deck may be attached to the power unit (tractor) in several ways, such as direct side or rear mount, draw bar, or adjustable boom. Generally the unit has a swath width of 5 or 6' (1.5 or 1.8m). These units are highly productive; however, the danger of thrown objects does exist.

10.04.05.03.02 Riding and Self-Propelled Lawn Mowers (Rotary)

The riding lawn mower is used to mow at rest areas where lawn type mowing from 4" to 2" (100mm to 50mm) is desirable. The mower is durable and reduces personnel-hour expenditures where large expanses of lawn type mowing are required. The self-propelled lawn mower is a rugged and efficient mower. It is extremely versatile and will cut grass to lawn specifications. This mower may be used to mow at rest areas.

10.04.06 Operational Procedures

10.04.06.01 Programming Equipment

It is the responsibility of the Assistant District Engineer - Maintenance and County Maintenance Superintendent to study the mowing conditions in their area and make recommendations on the type of mechanical equipment required to perform the specific types of mowing operations in an economical and efficient manner.

10.04.06.02 Steps in Efficient Operation

In an effort to improve the mowing operations throughout the State, the following items are to be considered:

1. Operating time
2. Planned route schedule
3. Correct number and types of mowers
4. Clean right of way
5. Mutual aid

10.04.06.03 Operating Time

Increasing the amount of actual operating time on a piece of equipment is of major importance in reducing the cost of carrying out a complete right of way mowing program. The following are considered important factors for an efficient mowing operation and will be accomplished accordingly:

1. Each mowing crew will be prepared for prompt departure from its headquarters daily.

2. All equipment operating daily from a maintenance headquarters will be checked, greased and gassed at the close of each day's operation.
3. For all equipment parked along the right of way overnight, it will be the operator's responsibility to pick up gas and sufficient grease for servicing his/her equipment each morning, and at midday if required.
4. Each operator will be responsible for obtaining the next day's assignment prior to the close of the current day's work.
5. Midday maintenance, such as greasing and replacing blades, will be performed immediately after lunch on a one stop basis.
6. It is the Crew Leader's responsibility to be certain that each operator: knows how to operate the assigned machine properly; is familiar with mowing standards for the type of right of way that is to be mowed prior to being sent to the job; and is properly licensed. The Crew Leader will make frequent checks on all mowing operations throughout each day.
7. The following items will accompany all mowers to the job site:
 - a. Spare blades and mower parts.
 - b. Tools, as necessary, to change blades and make repairs.
 - c. Sufficient fuel, oil, and grease for a full day's operation.
8. Prior to beginning any mowing operation, proper signs will be placed in accordance with the latest edition of the manual, "Traffic Control for Street and Highway Construction and Maintenance Operations". Signs will be removed when the mowing operation is completed.

10.04.06.04 Planned Route Schedule

Mowing should commence as directed by the Assistant District Engineer - Maintenance and continue through the end of September or as otherwise directed.

Each supervisor will be expected to develop an efficient route plan for carrying out the mowing operation in his/her area.

A planned method of operation will be expected to minimize unnecessary doubling back and excessive turning or maneuvering. Proper routing should allow the operator to mow going to and returning from the day's operation. There should be no long distances of unproductive travel.

Where mowers are operated as a group, a definite mowing plan will be necessary to avoid frequent turning and stopping in order to permit mowers to pass and eliminate complicated maneuvering in order to mow small irregular spots. Supervisors will instruct each operator where and how to cut.

County and section maps will be developed and marked with color codes to indicate mowing priorities, special areas and completed work.

All mowing should be preceded by the mower operators familiarizing themselves with the route which they will mow. Hazardous obstacles will be identified and marked with a delineator readily identifiable by the operator while mowing. Route familiarity could prevent serious injury to personnel and damage to equipment.

10.04.06.05 Correct Number and Types of Mowers

It is important to assign the correct number of mowers to each section of highway. If too many mowers are assigned to one section, a leap-frog type of operation will develop, and too much time will be lost while machines deadhead. If there are not enough mowers, an excessive doubling back situation will occur.

10.04.06.06 Cleaning Right of Way Ahead of Mowers

The cleaning of the right of way ahead of mowing operations will minimize breakdowns, reduce danger of personal injury to operators and save time spent by operators picking up foreign objects. A periodic inspection of the right of way will disclose rough and eroding areas which could be corrected or marked to prevent damage to a mower.

10.04.06.07 Mutual Aid

Mutual aid between areas within Counties, and sometimes between Counties, is necessary to accomplish acceptable right of way mowing operations. In the case of one County assisting another, instructions will usually be given by the Assistant District Engineer - Maintenance.

10.04.07 Clearing Right of Way

10.04.07.01 General

While the clearing of the right of way is an operation that will be carried on throughout the entire year, the winter months are usually more suitable for this type of work since extra personnel may be available. Also, the lack of foliage makes work easier, there is less chance of personnel being affected by poisonous plants such as poison ivy and poison sumac, and the danger of snake bites is eliminated.

10.04.07.02 Expressway, Trunkline, Feeder & State Local Service Highway Right-of-Way

Because of the rugged terrain throughout the State, cutting brush to clear the right of way is primarily a job for hand labor. As the brush is cut, it should be stacked just behind the ditchline to allow for efficient disposal. Disposal may be accomplished by the use of brush chippers or by hauling to approved waste areas. When brush chippers are used the chips may be distributed over the cut area or used as mulch around plantings.

The practice of burning brush should be eliminated because of the fire hazard involved, the unsightly appearance of the ground at burned spots, and the reduction in fertility of the soil at the burn site. If, however, brush is burned on the right of way, all Federal and State regulations in regard to burning will be followed.

10.04.07.03 Interstate and Other Limited or Controlled Access Roads

The maintenance of the right of way on the Interstate System should conform to the specification for landscape plantings. The Interstate is a high speed highway and tree growth should be controlled along the traffic lanes.

The right of way adjacent to the travel lane is divided into zones to describe the type of vegetation that is permissible in relation to the distance from the edge of pavement.

Zone A: 0 to 20' (6m) from edge of pavement.

This area is planted to sod grasses and usually mowed.

No trees, of either large or small species, are allowed in this zone. Small shrubs of selected species may be allowed.

Zone B: 20 to 30' (6m to 9m) from pavement.

All trees that mature with trunks larger than 4" (100mm) in diameter are cleared from this zone. Small trees are allowed if they are protected by a guardrail or are growing on a bank at least 5' (1.5m) above the road ditch.

Selective thinning may be needed to remove undesirable species.

Zone C: 30 to 40' (9m to 12m) from pavement.

Remove all large shade trees that are safety hazards. Leave small flowering trees and shrubs.

Large growing tree species can remain if they are protected by a guardrail or are growing on a bank at least 5' (1.5m) above the road ditch.

Selective thinning is desirable to develop the best trees and shrubs for their landscape value.

Zone D: 40' (12m) to the right of way limit.

All trees, regardless of size, are permissible in this zone. Use selective thinning to establish a good stand of hardwood trees and desirable conifers, small flowering trees, and shrubs.

10.05 HERBICIDES

10.05.01 Purpose of Herbicides

An herbicide is a chemical that is used to control unwanted plants. The use of herbicides is an economical and effective method of controlling unwanted vegetation and is a critical part of any comprehensive vegetation management program within roadside maintenance. A comprehensive vegetation management program consists of eliminating or controlling vegetation through mowing, brush control (mechanical and hand cutting) and the use of herbicides for controlling weeds and brush. The objectives of a vegetation management program are to improve safety by increasing visibility for motorists and residents adjacent to the right of way, to preserve the road surface by improving drainage and eliminating shade, to comply with State and Federal Regulations, to maintain good public relations by creating an aesthetically pleasing roadside appearance and to accomplish these goals in an efficient, cost effective and environmentally safe manner.

10.05.02 Responsibility

Each District is responsible for its herbicide program within the policy and guidelines as set forth by the Commissioner. This includes providing competent, qualified and certified personnel to manage and conduct the herbicide program within the District. The Maintenance Division is responsible for conducting certified public applicator training programs, making recommendations regarding the herbicide program and acting in a staff capacity to provide assistance in conducting an efficient, effective and safe statewide herbicide program.

10.05.03 Classification of Herbicides

Herbicides are classified generally by their effect on plants, time of application, method of application and more specifically by the mode of action, the number of species they control (termed selectivity) and their persistence (termed residual effect.)

10.05.03.01 Effect on Plants:

Translocated Herbicides: These herbicides, also called systemics, are absorbed by the plant through the leaves, stems or roots and move throughout the plant. Their mode of action may be through growth regulation, inhibition of photosynthesis or inhibition of cell growth. These herbicides may be non-selective (affecting all vegetation) or selective (affecting only grasses or broad leaved plants). They may be non-residual (becoming inactive by contact with soil) or residual (with effectiveness lasting a year or more). All herbicides used by the Division of Highways are systemic.

Soil sterilants are systemic herbicides that control vegetation by attacking the root systems or preventing seed germination. They are non-selective, pre-emergent and have a residual effect.

Contact Herbicides: These herbicides are non-selective, affecting all vegetation. They are not absorbed and affect only the plants they come in contact with. They have no residual effect.

10.05.03.02 Method of Application:

Broadcast: The even application of liquid spray, granular particles or pellets over an area. This is the primary method used by the Division of Highways.

Band: The application of liquid spray, granular particles or pellets in narrow strips.

Directed: Liquid solution is applied to or near the base of an undesirable plant.

Spot Treatment: Liquid spray, granular particles or pellets are applied to individual plants or clumps of plants.

Basal Bark: Liquid solution is applied to the lower trunk of a woody plant or tree.

Dormant Stem: Liquid solution is applied to the lower trunk of a tree or woody plant during the dormant or non-growing season.

Cut Stump: Liquid solution is applied to stumps immediately after cutting.

10.05.03.03 Timing of Application:

Pre-emergent: The herbicide is applied prior to the emergence of vegetation and controls vegetation by preventing seeds from germinating. Soil sterilants are pre-emergent herbicides.

Post-emergent: The herbicide is applied after the vegetation has emerged and is actively growing.

10.05.04 Adjuvants

Adjuvants are an agent added to herbicide solutions or mixes to increase their effectiveness. Some of the adjuvants commonly used are surfactants, defoamers, drift control agents, penetrants, PH adjusters, dyes and masking agents.

Surfactants: A material added to the mix to reduce the surface tension of the liquid which increases the area of the leaf surface covered by each drop.

Defoamers: An agent used to reduce or prevent foaming or the inclusion of air into the mix.

Drift Control Agents: A material used to prevent off-target damage due to drift or the airborne movement of spray.

Penetrants: An agent to speed up or increase the absorption of herbicide by dissolving the waxy cuticle of the plant.

PH Adjuster: An agent used to adjust the acidity or alkalinity of the mixing water.

Dyes: An agent used to show the spray pattern and coverage of plants.

Masking Agent: A material used to suppress obnoxious odors.

10.05.05 Herbicide Formulations

Herbicides are available in a variety of formulations. The formulation of an herbicide is the active ingredient combined with a carrier, either a liquid or a solid. Formulations are emulsifiable concentrates, dry-flowables, granules, soluble powders, solutions, water dispersible granules and wettable powders.

Emulsifiable Concentrates - Are liquid formulations with the active ingredient (the chemical part of the herbicide) which reacts with vegetation dissolved in one or more petroleum solvents. These formulations contain an emulsifier so the

material will mix readily with water. They are not abrasive and will not plug screens or nozzles. They can freeze, are flammable and can cause rubber hoses, gaskets and pump parts to deteriorate and may damage painted surfaces.

Dry Flowables - Consist of finely ground solid particles. They can be mixed readily with water, do not usually clog nozzles or screens and need only moderate agitation to remain in suspension.

Granules - Are dry, ready-to-use materials and are prepared by mixing the active ingredient with a solid such as clay.

Soluble Powders - Are dry, powdered formulations that dissolve in water to form a solution.

Solutions - Are liquids with the active ingredient dissolved in a carrier. They are normally used without further mixing.

Water Dispersible Granules - Are dry, granular formulations designed to be mixed with water. Upon contact with water the granules disperse and go into suspension.

Wettable Powders - Are dry, powdered formulations and are mixed with water to produce suspension. They must be agitated constantly to avoid settling. They can clog screens and nozzles and are abrasive.

10.05.06 Types of Vegetation

Plants are classified according to their physical characteristics or their life cycle. Recognizing and understanding the differences are important because it determines the most effective herbicides to use and the best time of treatment.

10.05.06.01 Physical Characteristics

Grasses are called "*monocots*" because they have a single seed leaf. They may be either annuals or perennials.

Broadleaves are called "*dicots*" because they have two seed leaves and broad leaves. They may be winter or summer annuals, biennials or perennials.

Woody plants are perennial broadleaf species that develop woody stems. They become dormant in winter and leaf out in spring.

10.05.06.02 Life Cycle Characteristics

Annuals are grass or broadleaf species that complete their life cycle in one year. Summer annuals germinate in the spring, grow and produce flowers through the summer, set seed and die in the fall after the seeds have matured. They are best

controlled in spring when in the seedling stage of growth. Winter annuals are broadleaf plants that germinate in fall, begin their growth over winter and flower in early spring producing seed shortly thereafter. The plants usually die by summer. Winter annuals are best controlled in the seedling stage either in fall or early spring.

Biennials need two years to complete their life cycle. The second year the plant flowers and then dies after the seeds have matured. They are best controlled during the first year of growth.

Perennials live more than two years. Many reproduce by seed but some reproduce by rhizomes, tubers, or root sections. They are best controlled during the seedling stage.

10.05.07 Types of Vegetation Control

10.05.07.01 Herbaceous Weed Control

One type of vegetation needing to be controlled is herbaceous weeds which are non-woody plants.

The types of herbaceous weeds are:

- 1. Annual broadleaf weeds**
 - a. live for one summer only
 - b. reproduce only by seed
 - c. winter annuals emerge in fall
 - d. summer annuals emerge mostly in spring; occasionally throughout the summer
 - e. best treated at seedling stage or pre-emergence
- 2. Biennial broadleaf weeds**
 - a. live for two years
 - b. reproduce only by seed
 - c. flower during second year
 - d. may emerge in cool weather, including fall
 - e. best treated in seedling stage or pre-emergence
- 3. Perennial broadleaf weeds**
 - a. live for three or more years
 - b. reproduce by seed, spreading roots, sections of root or stem
 - c. best treated at seedling stage or pre-emergence
 - d. otherwise best treated when in bud stage or immediately after flowering
 - e. a systemic herbicide that reaches the root system must be used

4. Annual grasses
 - a. may emerge throughout the entire growing season
 - b. live for one summer only
 - c. are undesirable in turf because they turn brown and die
 - d. in established turf best herbicide is pre-emergence
 - e. post-emergence herbicides injure desirable perennial grasses

5. Perennial grasses
 - a. live for three or more years
 - b. herbicide must be systemic that kills roots

The reasons for controlling herbaceous weeds are to avoid competition with more desirable vegetation such as perennials in turf, aesthetics, visibility around curves and intersections, eliminate noxious or problem weeds and/or where bare ground is desired.

10.05.07.02 Bare Ground Control

Several reasons exist to keep the ground bare of all vegetation. Among these are eliminating the need for mowing around objects such as sign posts, keeping guardrails visible and aesthetically pleasing, and preventing damage to the shoulder and pavement by improving drainage and preventing roots from growing in cracks.

Bare ground control is done primarily in the spring. It should be started as soon as possible after the soil has thawed using a pre-emergent herbicide. Once vegetation sprouts and begins growing, a post-emergent herbicide should be added to the mix.

Herbicides used to provide bare ground control are usually non-selective and pre-emergent, with residual activity. The primary application method used is broadcast spray.

10.05.07.03 Brush Control

Brush refers to any unwanted woody vegetation such as shrubs, bushes and trees as compared to weeds and grasses. Controlling brush is necessary to prevent its encroaching on the rights of way, and is usually more difficult than weed control because the root systems are perennial and more extensive and will continue to grow from stumps or roots unless these are killed. Brush is much cheaper and easier to control at earlier stages of growth. Selective herbicides are generally used to avoid creating bare ground with consequent erosion.

The primary application method used is broadcast spray. Other methods that can be used, depending on conditions and time of year, are dormant stem, basal bark and cut stump.

Brush control by broadcast spray is usually done from late summer until fall and becomes ineffective when the leaves begin to turn color.

10.05.07.04 Plant Growth Regulators (PGR)

One other type of vegetation control is to regulate periods of growth and dormancy and the rate of plant growth. The primary benefit and use for PGR is to retard the growth rate of grass in turf in order to reduce the number of mowing cycles.

The time of application, correct rates, and properly calibrated equipment are essential to achieve good results. A broadleaf herbicide should be mixed with the PGR to control broadleaf weeds. Some herbicides will control broadleaf weeds and also act as a PGR.

10.05.08 Safety

10.05.08.01 Herbicide Toxicity

Practically all chemicals are toxic to humans, animals, and the environment at high enough concentrations and dosages. If properly handled, herbicides will not cause injury except to the plants for which they are intended. **READ THE LABEL** is the first and most important procedure to follow when using and handling herbicides. The instructions on the label are to be followed exactly as stated. Potential injury by careless exposure to herbicides may be caused by three routes of entry to the human body:

1. through the skin (dermal)
2. into the lungs (inhalation)
3. through the mouth (oral)

The label of each herbicide will contain all information needed to handle that herbicide safely including the application rate, clothing to be worn, proper equipment, first aid instructions and antidotes. The toxicity or degree to which a substance causes harm when exposure occurs is measured in milligrams of the chemical per kilogram of body weight to provide a lethal dosage to 50% of the test animals. This is termed “LD-50” or “Lethal Dose for 50% of test animals”. Herbicides are given one of three signal words denoting the specific LD-50 rating:

1. **Danger-Poison (highly toxic)**
2. **Warning (moderately toxic)**
3. **Caution (minimally toxic)**

The higher the LD-50 number, the less toxic the herbicide. Minimizing or eliminating exposure is the sure and best method for preventing potential harm to humans from herbicides.

10.05.08.02 Mixing, Applying, Storing, Transporting, and Disposition of Herbicides Safely

Practicing safety in handling herbicides cannot be overemphasized or overdone due to the potential harm that can result to humans, animals, and the environment from accidents or misuse. When mixing herbicides, always use the safety equipment specified on the label. All measuring or mixing equipment should be thoroughly washed after each use and stored with the herbicides in a locked and secure area. Any spills must be completely cleaned up, using an absorbent material if needed. When applying herbicides use the proper equipment in good condition, be sure proper safety equipment is on hand and being worn, and that proper spraying precautions are used.

Always store herbicides in their original containers. Do not transfer or store herbicides in unmarked containers not intended for herbicides, such as soft drink bottles, jars, milk cartons, etc. Keep herbicides in a locked, secure facility set aside and conspicuously posted for that purpose. Do not store safety equipment with herbicides. Check the containers frequently for leaks. Should a leak occur, transfer the herbicide to a marked container meant to hold that herbicide, clean up any spills and dispose of the leaking container properly. Keep an updated inventory of all stored herbicides. As a safety precaution, the name and phone number of the nearest hospital and poison control center should be posted in a prominent location in the storage facility.

When transporting herbicides, do not place them in the cab or passenger compartment. Never leave the vehicle unattended with herbicide containers exposed. Always have the labels and MSDS (Material Safety Data Sheets) in the vehicle for the herbicides being used or transported.

When disposing of herbicide containers, follow the instructions on the label, including proper safety equipment and clothing. Empty containers should be triple rinsed, using the rinse water for mixing, and recycled if possible. If recycling is not possible, the containers should be punctured and then burned or buried in a landfill according to Federal, State and local laws. The applicator must learn and keep current with these laws and regulations regarding not only herbicide disposal but all herbicide use, and must strictly adhere to them.

10.05.09 Herbicide Application Procedures

10.05.09.01 Spraying Procedures

The most efficient method of applying herbicides for vegetation control is by use of vehicle-mounted power spraying equipment. This is the method used for practically all of the Division of Highways' herbicide applications.

In order to achieve desired results:

1. The sprayer must be calibrated
2. Identify target vegetation
3. The herbicide(s) most effective and cost efficient for the target vegetation must be used
4. The application rate must be correct
5. Use the proper adjuvants
6. The spray head must have the proper nozzles to give adequate coverage and be regulated to provide the desired swath width and spray pattern

In order to avoid potential hazards:

1. Do not spray when wind is gusting or greater than 10 mph (16km/hr.)
2. Do not apply herbicides where runoff can enter water supplies such as wells, ponds, flowing ditches or streams
3. Do not spray foliar applied herbicides while it is raining or if rain is anticipated that day; however, root absorbed herbicides require rain after application
4. Do not spray non-selective or bare ground herbicides on land that is undergoing or has a great potential for erosion
5. Do not spray where landowners have submitted a no-spray agreement
6. Do not spray beyond the right of way
7. Do not use herbicides, such as phenoxyes, near susceptible crops
8. Do not spray herbicides where grazing livestock can eat treated vegetation
9. *When in doubt, do not spray*

10.05.09.02 Effect of Climate On Spraying

Climate has an important effect on herbicides through influencing the types of vegetation that exist in an area and because weather plays a critical part in the decision making process and success of herbicides. Three weather factors: temperature, moisture and rainfall, and wind must be considered when spraying in order to achieve desired results and avoid some potential hazards.

10.05.09.03 Temperature

Most herbicides are more effective at temperatures of 70°F (21°C) and above. Cooler weather slows down the rate of absorption of the herbicide(s) and the plants metabolism. Consequently the effects of the herbicide(s) will be slower. Higher temperatures not only cause herbicides to work more quickly, they also cause herbicides to break down more quickly, shortening the residual effect. Due to the effect of temperature on plant growth, this is particularly important in the use of PGR's where proper timing depends on the stage of growth. Using the calendar to apply PGR's may cause an error in timing large enough to cause unacceptable damage to turf, or less than desirable results. When temperature is important, the label will give the temperature range for application.

10.05.09.04 Moisture and Rainfall

Adequate moisture is important to the success of the herbicide program for several reasons. Plant growth depends on a sufficient amount of moisture to translocate nutrients through the plant's vascular system. Systemic herbicides are translocated throughout the plant by this same process. Drought causes the translocation process to slow down; therefore, systemic herbicides are slower acting and less effective. Drought also causes plants to produce a protective, thick waxy coating on their leaf and stem surfaces, which provides a barrier against the absorption of herbicides by the plant.

The use of a surfactant helps the herbicide penetrate this waxy barrier. Foliar applied herbicides require at least eight hours of rain free weather following application to allow the plant to absorb the herbicide(s).

Soil applied herbicides require rain within three weeks of application to reach the roots of plants otherwise control may be lost. Too much rain, however, may leach soil applied herbicides beyond the roots.

10.05.09.05 Wind

Wind is a major factor to be considered when applying herbicides because of the hazardous potential for drift. Drift is defined as the movement of spray particles or vapor through the air into areas not intended for treatment. Drift occurs in two ways: particle drift and vapor drift.

Particle drift is moisture droplets being carried by moving air. Particle drift can be minimized or eliminated by:

1. creating large size droplet spray
2. keeping delivery pressure as low as possible and still achieve adequate coverage
3. keeping nozzles low to the ground or close to target vegetation

Vapor drift occurs from volatilization (evaporation) of the herbicide with the resulting fumes carried out of the target area by air currents. Vapor drift can be minimized or eliminated by:

1. using non-volatile herbicides
2. spraying only when temperatures are low enough that little or no volatilization occurs

Note: Ester formulations of herbicides are more volatile than amine formulations.

To summarize, the potential for drift can be minimized or eliminated by:

1. using large nozzles and low pressure

2. using adjuvants to increase droplet size
3. keeping nozzles low or close to target vegetation
4. not spraying in windy conditions
5. using non-volatile herbicides
6. not spraying at high temperatures when using volatile herbicides

10.05.09.06 Other Application Procedures

Due to its efficiency and cost effectiveness for treating large area, the primary application method used by the Division of Highways is broadcast spray. Existing conditions may require other treatment methods.

Dormant stem treatment is used on woody species in their dormant stage or after the foliage has dropped. This method requires wetting the lower 6 – 12” (150 - 300mm) of the stem or trunk. The advantages are:

1. sensitive crops and ornamentals are not present
2. utilizes personnel in non-spray season
3. volatilization is not a hazard
4. selective in that only treated plants are affected
5. large size trees and vegetation can be controlled

Basal bark treatment can be used at any time of the year. This method requires wetting the entire circumference of 12 - 24 in. (300 - 600mm) of the stem or trunk. The advantages are:

1. selective in that only treated plants are affected
2. potentially less hazardous to nearby crops and ornamentals than broadcast spray
3. large size trees and vegetation can be treated easier than with broadcast spray

Cut surface or cut stump treatment is a method used to treat stems or stumps individually after cutting or mowing and can be done any time of year. The advantages are:

1. prevents regrowth or resprouting
2. utilizes personnel in non-spray season

This treatment should not be used:

1. when stumps are covered with snow or ice
2. when snow is falling
3. when raining
4. when the ground is snow covered

Directed and spot treatments may be used with granular or liquid herbicides to control specific plants or areas such as multiflora rose or the areas around buildings or signposts.

10.05.10 Equipment

The primary spray equipment used is a unit consisting of a truck with a tank, pump, and sprayer. The units may also be equipped with an injection system to avoid tank mixing or mixing the herbicides with the water in the tank. A monitoring system is used to regulate the application of herbicides and to provide the operator with information. Other types of equipment used are for hand application, such as backpack sprayer and handguns.

10.05.10.01 Tanks

Tanks are used to hold the carrier, herbicides, or the spray solution and may be constructed of fiberglass, plastic, aluminum, mild steel or stainless steel. They should have an agitator, especially if used to hold herbicides or spray solutions, and should have filters and screens to prevent damage to pumps, valves, and nozzles.

10.05.10.02 Pumps

To deliver pressure to the spray head, two basic types of pumps are used: the piston pump and the centrifugal pump. Piston pumps are capable of high pressures but are limited to low volumes and operate by means of a piston or pistons forcing the solution through hoses to the spray head. Centrifugal pumps operate by means of an impeller rotating at a relatively high rpm forcing the solution through hoses to the spray head. They are capable of high output volumes but are limited in pressure. Regardless of the type of pump used, the system must be equipped with a pressure regulator and bypass to maintain a uniform pressure and flow. It should also have pressure gauges so that the correct spraying pressure can be determined and properly adjusted. The most important location to regulate and maintain a constant and correct pressure is at the spray head, because this affects the coverage and droplet size or drift potential.

10.05.10.03 Injector Systems

Injector systems are used to hold and mix the herbicide(s) into the carrier (water). The herbicide(s) are stored in separate tanks and the main holding tank contains only water. Some adjuvants may need to be mixed with the water in the holding tank.

10.05.10.04 Monitoring Systems

Monitoring systems have been developed that will control the application process precisely. Some are computerized and can be programmed to deliver a specified application rate for the herbicide(s) and provide a wealth of information to the operator including rate, acres (hectares) covered, amount of herbicide used,

amount of herbicide(s) remaining in tank. Monitoring systems will maintain a constant rate per acre (hectare) as the vehicle speed changes.

10.05.10.05 Spray Heads and Nozzles

A number of different spray heads with various types of nozzles exist. Some of the nozzle types available are flat-fan, off-center (o.c.), boomless and whirling disc. Each type gives a different pattern and coverage on vegetation. The nozzles may be made from different materials such as aluminum, brass, plastic, stainless steel or tungsten carbide. Differences in cost and corrosion or wear resistance are the advantages/disadvantages of each type of material.

10.05.10.06 Calibration

The best equipment or spraying system is virtually useless unless it is properly calibrated. Properly calibrated equipment will provide the most efficient, economical and safe operation.

There are four factors which determine the amount of solution delivered to a given area and which are used to calibrate the equipment. These factors are:

1. spray width or swath
2. nozzle size
3. pressure at nozzle
4. vehicle speed

The basic calibration formula derived from the four factors and used is:

$$\text{gallons per acre} = \frac{495 \times \text{gallons per minute}}{\text{miles per hour} \times \text{spray width (feet)}}$$

Metric:

$$\text{liters per hectare} = \frac{594 \times \text{liters per minute}}{\text{kilometers per hour} \times \text{spray width (meters)}}$$

Note: 495 is a constant factor (594 for metric formula)

The operations manual for the equipment or system used should be consulted for more detailed/specific information regarding how the system operates and is calibrated.

10.05.11 Maintaining Records

The maintenance of accurate records is important due to:

1. Federal, State or local laws requirements

2. protects applicator against allegations of misuse or illegal use
3. protects the Division of Highways against lawsuits, payment for damage to crops, trees, ornamentals, etc.

These records should contain the following data:

1. date and time of application
2. type of equipment used
3. herbicide(s) used
4. formulation
5. mixing information (how many pounds per gallon of water/kilograms per liter of water)
6. rate of application (gallons of mix per acre/liters of mix per hectare)
7. total area treated
8. location (route number, mile post or distance from nearest intersection, distance treated)
9. target vegetation
10. weather conditions at time of application
11. name of applicator
12. miscellaneous comments

These records should be maintained at the District Headquarters.

10.05.12 Certified Public Applicators

Competent, qualified and trained personnel are essential to conducting an efficient, effective and safe vegetation management program. A certified public applicator is someone who has demonstrated that he/she has the training and knowledge to pass the examination given by the Department of Agriculture. It is required by State law that the herbicide program be supervised and directed by a Certified Public Applicator. State law requires at least one member of the spray crew to be either a certified applicator or a technician.

10.05.13 Public Relations

As employees of the Division of Highways, we are indirectly employed by the taxpayers. It is our legal and moral responsibility to comply with existing laws and regulations and to establish and maintain good public relations by cultivating the goodwill of motorists and citizens. One of the ways this can be accomplished is to provide a well cared for roadside that presents an aesthetically pleasing appearance. The use of herbicides is essential in accomplishing this goal. Frequent negative accounts in the news media of the potential hazards associated with herbicides, the public's concern and awareness toward herbicides use, and the highly visible herbicide application makes good relations a difficult and tenuous task. This task can be made much easier by adopting the following posture:

1. Always be courteous to the public.

2. Listen attentively to concerns expressed by the public so they will know that you are genuinely understanding and interested in their situation.
3. Be prepared to respond to expressed concerns with accurate information concerning the type of herbicides you are applying.
4. If you are unable to answer their questions offer to obtain the information for them.
5. You should record information such as: name, date, time, location and details of request.
6. Forward requests to your supervisor for proper response.
7. The supervisor should promptly reply to requests for information.
8. Keep records of inquiries by the public and the responses given.

10.05.14 Summary

Although the information and procedures given in the herbicide section is helpful and should be followed by applicators, it is not intended to be a detailed and complete “how-to” guide for conducting an herbicide program. It is intended to be a general overview of the herbicide program, more valuable for the information provided to all maintenance employees than specifically for applicators. Specific information may be found in manuals written for roadside vegetation control and pertinent equipment manuals.

10.06 EROSION CONTROL OF SLOPES

10.06.01 Erosion Causes

The intensity of rainfall, the type of soil, the steepness of the slope and the length of the slope, all affect the amount and severity of erosion. On highways, the runoff from the above road cut causes serious erosion problems.

We can modify or control all factors except the rainfall characteristics and soil type. If conditions justify, we can modify the soil condition by various means such as the addition of cover soil.

10.06.02 Slope Design

A major project for the control of slope erosion is usually required only at the location at which a problem has existed for some time and where a sizable amount of maintenance money has already been expended. In such a case, a permanent solution to the problem is the only way to make corrections. On some projects it will be necessary for the Roadway Design Division to prepare plans.

In general, earth slopes should be sufficiently flat to promote the growth of vegetation and to provide ease in maintenance. Normally, slope work will be limited to the width of the right of way. Sometimes it is economically justified to obtain easements to extend the slope beyond the right of way. Where right of way is available, the slopes should follow standards shown in Figure 10-1. Where a rock ledge is overlain with earth, the rock will be the toe of the earth slope.

10.06.03 Slope Length

On long soil slopes, those exceeding over 50' (15.2m), it may be advisable to use temporary diversions across the slope until the seeding is established.

All runoff water should be diverted from the top of the slope until a good sod is established. This runoff water should be diverted to a natural drainage course where it can be safely carried to the main waterway system (see Figure 10-2).

10.06.04 Establishing a Vegetative Cover

Any type of soil in a roadway cut or fill needs a good sod cover to protect it from erosion.

The soil should be limed and fertilized as shown by experience, or soil tests performed and the appropriate seed mixture applied and mulched. Seeding methods will be governed by the size of the job, equipment available, and the time of year the operation is undertaken.

10.06.05 Repair of Major Erosion Damage

Major erosion damage such as a large gully or cavity may make it necessary to haul in fill material to replace the soil which has washed away. Rock, broken concrete or other heavy material should be placed in the eroded area to prevent recurrence. Fill material of this type needs thorough packing and a good covering of soil before any seeding or sodding is attempted as described in Section 10.06.04.

10.07 MAINTENANCE OF TREES AND SHRUBS

10.07.01 General

Trees and shrubs growing or planted along the highway right of way increase the beauty and the scenic enjoyment of the traveler; however, they may be a safety hazard when growing too close to the traffic lane. Selected trees are planted along newly constructed highways for beauty and shade in certain rest and recreation areas. Shrubs are sometimes used in the median areas of dual highways as a safety measure to reduce the blinding effect of oncoming headlights.

It is the responsibility of maintenance personnel to make routine checks on all trees within the right of way to identify and remove trees that present a potential hazard to motorists. Such hazards can be due to dead trees and trees leaning toward or over the traveled way, to trees or shrubs that restrict sight distance at a curve or intersection, or to trees that are too close to the traveled way. Trees that do not present a hazard to motorists will not be removed without approval from the Assistant District Engineer - Maintenance.

10.07.02 Tree Removal

When a tree becomes a safety hazard, immediate steps should be taken for removal.

It is sometimes necessary to remove a tree by topping it first. Only experienced workers, using all safety precautions, will be permitted to climb trees.

If a tree or tree branches which must be removed is located in the proximity of a utility line, it is necessary to advise a representative of the company of the hazard to their utility line. In most cases, removing the tree or branches is the responsibility of the utility company. In any case, the utility company will usually prefer to perform the work. In the event the utility company does not accept the responsibility, it is necessary to have one of their representatives present when the work is being performed. When the utility representative is present, the work may proceed, provided the proper equipment and experienced personnel are at the site and the tree, or branches, can be removed with complete safety to traffic and all persons in the area.

All tree stumps will be cut to ground level or removed. If the roots are to be left, an application of stump spray is required to minimize resprouting. Every hole left from the removal of a stump will be backfilled with suitable material, thoroughly tamped and the spot seeded to obliterate the scar.

10.07.03 Trimming Trees

Trees within the right of way may be trimmed or pruned for any of the following reasons: to promote safety; to preserve the life of the tree; to improve the appearance of the roadside; to provide sight distance or to allow an unobstructed view of a scenic location. Trees may also require trimming to provide clearance for vehicular traffic or pedestrians. The removal of dead limbs is of primary importance. All trees will be carefully inspected, especially in the spring when new foliage is developing, to locate all dead branches which should be removed promptly if they constitute a safety hazard.

When a tree on private property overhangs the roadway and needs trimming, an agreement must be made with the owner of the property before the tree can be removed; however, any portion of the tree overhanging the right of way may be removed at any time the need arises. If removal is necessary and agreement cannot be reached, the matter will be reported to the proper authority for appropriate action before any work is done. In case of imminent danger to the traveling public, immediate corrective action should be taken.

A tree may be trimmed at any time of year except when the sap flow is at the maximum. Sketches of proper methods of trimming trees and treating wounds are shown in Figure 10-3. Suitable tree paint will be applied to cuts over 1" (25mm) in diameter, to wounds, and to old unhealed cuts.

Branches must be removed to allow a 14' (4.3m) clearance over the roadway.

The owner of abutting property will have first option on wood resulting from the trimming or removal of a tree. If the owner desires to have the wood, it will be piled on his/her property, preferably out of sight from the roadway. Otherwise, it will be disposed of, with all brush, as conditions dictate. Small limbs and brush may be disposed of by use of a brush chipper. Under no circumstances will trimmed branches be piled and burned.

10.07.04 Spraying Trees and Shrubs

Trees and shrubs are sprayed to prevent damage by insects and to aid in controlling disease. If, at any time during the year, damage from insects or disease to trees and shrubs within the right of way is noted, the Assistant District Engineer - Maintenance will be informed.

The same equipment used for chemical control of weeds, brush and grass is used for spraying trees and shrubs. Care must be taken to assure the removal of any weed or brush killing chemical from the tank, lines, and nozzles before the equipment is used for spraying material for the control of insects or disease. *Repeated rinsing of the tank and flushing of the lines and nozzles with hot water and detergent is absolutely necessary.*

10.07.05 Maintenance of New Plantings on Interstate and Other Highways

All new plantings of trees, shrubs and other plants along the right of way will require special maintenance at least during the first three years after planting. The contractor may be responsible for new plantings for one full growing season after planting.

Maintenance of these new plantings include watering, weed control, pruning and disease or insect control as needed. Watering will be necessary during drought periods. This will require that a water tank be available, as needed. Weed control may be necessary under certain conditions in beds and around small plants, but usually the mowing operation will be sufficient around the larger trees.

Pruning will consist of removing any dead or damaged limbs, any unusually irregular growth or where root development does not seem to be in balance with the new plant's needs.

The stakes on newly planted trees will be removed by the maintenance crew one year after completion of the contract and then only upon proper authorization.

10.08 INTERSTATE REST AREAS

10.08.01 General Requirements

It is the general policy of the Division to establish rest areas on the Interstate Highway System which shall be maintained in a safe, attractive, clean, sanitary, and operable manner at all times.

Maintenance and operation of rest areas on the Interstate Highway System is performed by contract and is the administrative responsibility of the Interstate Maintenance Crew Supervisor.

The public is very observant and critical of the care that rest area facilities receive. To preserve a good image for the Division, it is essential that a high standard of maintenance be provided at all times.

10.08.02 Inspections

Inspections of rest areas will be performed at a minimum frequency of three times weekly by a Division of Highways' representative assigned by the District Engineer. These inspections shall be unscheduled and conducted both day and night.

10.09 REMOVAL OF OBSTRUCTIONS

10.09.01 General

The Division of Highways is empowered by law to remove or have removed any obstruction which may be placed or which falls within the right of way limits of a State highway. In fact, the Division is held responsible for the removal of any such obstruction.

An obstruction is any unauthorized installation or object within the right of way limits which affects the easy, safe and convenient use of a public highway for public travel.

Typical obstructions are: fences, abandoned vehicles, signs, unauthorized or improperly constructed approaches, utility poles, privately owned materials or equipment stored on the right of way, water diverted or channeled to the highway, or unauthorized landscaping. Any object constructed or placed on the right of way without an approved encroachment permit as detailed in this Manual is considered an obstruction.

10.09.02 Responsibility of County Maintenance Superintendent

The County Maintenance Superintendent is expected to have a thorough knowledge of all roads within the county, and is responsible for the elimination of obstructions. A property owner may begin construction of a commercial or private approach, construction of a building or the erection of a fence without determining the exact location of the right of way line. In most instances there is no intention of

deliberately encroaching upon the highway right of way. The encroachment is merely the result of lack of information. If an encroachment is called to the attention of the property owner in the early stages of its installation, the property owner will usually appreciate being told and will remove the obstruction with little or no hard feelings toward the Division of Highways. If the encroachment is not reported early and immediate corrective action taken, the problem may become more complicated.

10.09.03 Removal Procedure

When an obstruction is to be removed from the highway right of way, the procedure will be as follows:

1. The County Maintenance Superintendent will notify the owner or the person responsible for the obstruction, in writing, that he or she is violating the law by placing, or causing to be placed, the obstruction within the highway right of way limits, and that immediate steps must be taken to remove the obstruction and to repair any damage that may have been caused by its existence.
2. If the obstruction is not promptly removed by the responsible party, the County Maintenance Superintendent must notify the District in writing. This notification must describe the circumstances, and furnish a full description and detailed location with the name and address of all responsible parties. The District will then provide written notification to the responsible party, with a copy to the County Maintenance Superintendent, that the obstruction must be removed. In case the obstruction is not removed within ten days after the County Maintenance Superintendent receives a copy of the notification, either the County Maintenance Superintendent or the Assistant District Engineer - Maintenance will ask the Sheriff of the County to serve a regular ten-day "Notice for removal of obstructions" upon the responsible party.
3. If the obstruction has not been removed at the expiration of the time specified in the ten-day notice, the County Maintenance Superintendent will become responsible for having the obstruction removed and making any necessary repairs to the right of way. A reimbursable authorization should be obtained to record expenditures associated with removal and restoration. Upon completion of the work the responsible parties should be invoiced for the cost of corrective action.
4. Before legal action for the removal of an obstruction is instituted, the County Maintenance Superintendent must make sure that the exact right of way limits at the specific location have been established.

10.10 MAINTENANCE OF GUARDRAIL

10.10.01 General

It is a proven fact that a guardrail enhances safety and eliminates, to a large extent, the mental hazard of driving on a mountain road. The improper installation of guardrail, however, can create a traffic hazard. For this reason reviews of the installation should be made prior to replacing damaged sections of guardrail. Some guardrail may be unnecessary while in other cases fixing or removing the hazard may be more beneficial than replacing the guardrail. Proper routine maintenance should always be performed on existing guardrail.

10.10.02 Types

At the present there are six types of guardrail in common use throughout the State. These types are shown in Figure 10-4. They are known as beam, plate, wire cable, wire mesh, stone wall, and earth mound. In an attempt to provide the best protection with the least amount of expenditure and to present a uniform standard throughout the State, it is the policy of the Division to use the beam type on all new installations. Short sections which have been damaged should be replaced and updated to approved standards when possible. Salvaged rail from construction projects may often be reused by maintenance forces on other roads.

10.10.03 Location for Different Types

10.10.03.01 Beam Guardrail

Beam type guardrail is the strongest type of metal guard and is used on all Interstate and major highways. Beam guardrail is of great assistance to drivers as a guide around a sharp curve since it is readily visible throughout its entire length and the delineation characteristics are quite good. Damaged sections should be replaced with beam guardrail, if possible. End treatments are a very crucial part of beam guardrail; they provide the guardrail with anchorage and support. These end treatments can also be the most dangerous part of the guardrail to vehicles. For this reason, damaged end treatments should be replaced and updated to approved standards.

10.10.03.02 Plate Guardrail

Plate type guardrail has the same delineation advantage as the beam type. Plate guardrail is not as strong and does not give the neat appearance of beam type.

10.10.03.03 Wire Cable Guardrail

Wire cable guardrail used in West Virginia consists of two cables. Because of its lack of visibility from the vehicle operator's standpoint, it affords very little assistance in guiding drivers around a sharp curve.

0.10.03.04 Wire Mesh Guardrail

Wire mesh guardrail is the type for which proper maintenance is most difficult. Where rail of this type is presently located on a sharp curve, it will be kept well painted to improve its delineation characteristics.

10.10.03.05 Stone Wall Guardrail

At one time, stone wall guardrail was constructed at any point where guardrail was needed. Today this type is only constructed under special conditions at a location where aesthetics is the primary factor and an abundance of loose stone is readily available, as along a particularly scenic highway or at an overlook. Since this type is more or less permanent, it requires very little maintenance. When a wall is located on a curve, a 12” (300mm) strip of white reflectorized paint along the top of the face of the wall should be maintained to provide better delineation. Drains must be provided through the bottom of the wall at frequent intervals to carry off surface water and eliminate erosion of the highway shoulder. Also, where a stone wall is used, the highway shoulder should be wider to allow for storage of snow, which cannot be pushed over the wall easily.

10.10.03.06 Earth Mound Guardrail

An earth mound guardrail, like the stone wall type, has been used at any location where guardrail was needed. Since it has a wider base, a greater width of graded roadbed is required. To permit drainage, 6” (150mm) drain pipes are installed and must be maintained through the base of the mound at short intervals. The highway shoulder should be wide enough to allow for the storage of snow.

When an earth mound is located around a curve, large one-person stones are partially embedded at short intervals and painted with white reflectorized paint, or short wooden or metal stakes with reflectors are placed along the top. These aids to delineation must be properly maintained.

10.10.04 Guardrail Maintenance Procedures

10.10.04.01 Guardrail Alignment

The alignment of guardrail, regardless of type, is of the utmost importance for both safety and appearance. Normally, guardrail is installed parallel to the centerline of the road, except for flaring at end treatments. It is generally placed at the outside edge of the shoulder. Guardrail should not be too close to the edge of pavement; being too close can limit sight distance and reduce the effective roadway width. Maintaining the parallel position around the outside of curves allows drivers to utilize the guardrail as a guide when driving in inclement weather conditions. Guardrail that is not parallel to the roadway centerline increases the contact angle, resulting in more extensive damage to both the vehicle and the guardrail.

True horizontal and vertical alignment of a beam, plate, cable, or mesh guardrail is necessary in order that the rail element may be subjected to the proper tension without placing an undue strain on certain posts. Earth used in backfilling should be thoroughly tamped to hold posts at proper line and grade. Tilted posts should be jacked into line and settled posts should be raised to the proper grade by jacking. Soil at or around tilted or settled posts should be restored to proper grade and slope to ensure proper performance of the guardrail.

10.10.04.02 Beam and Plate

Posts for beam and plate type guardrail must be kept in good vertical and horizontal alignment. All non-galvanized metal parts shall be kept well painted to present a better appearance, provide better delineation, and preserve the material. When the galvanized coating is damaged it may be touched up with aluminum paint.

Beam or plate guardrail cannot be satisfactorily straightened. Extra lengths of each type will be carried in stock at the District storage area at all times, in case repairs become necessary. Some adjustment of plate type guardrail will be required in the spring and fall to provide correct tension at different temperatures. Adjustment of beam type guardrail is not necessary to make allowance for a change of temperature.

10.10.04.03 Cable

Post and galvanized fittings for cable type guardrail will be given the same attention as mentioned for beam or plate guardrail. The cables will be kept under a constant tension, which is just sufficient to hold them taut. It is necessary to loosen them in the fall to allow for cold weather, and to tighten them in the spring to allow for hot weather. The necessary adjustment in the fall can usually be made by first loosening the cable offsets and then slackening the end bolts a few turns. In the spring, if slack is noted in the cable, the offsets will again be loosened and the end bolts will be adjusted to take up the slack. If the end bolts do not permit enough take-up, the procedure will be as follows: The adjusting nut on one end bolt and the wedge-type cable fastener are removed; the proper length of cable is cut; the cable fastener is replaced; and the cable is retightened by adjusting the bolts. The length of the end bolt must never be changed.

All reflectors will be checked to make sure that they are clean and in the proper position.

10.10.04.04 Wire Mesh

Posts and galvanized fittings for wire mesh guardrail will be given the same treatment as described for beam or plate guardrail. The wire mesh will be kept well painted to preserve the steel, to provide better visibility and to present a better appearance. The mesh should be taut at all times. Some adjustment of the mesh is

necessary to allow for temperature changes. Because of the construction of the mesh, however, the adjustment is less than that of wire cable.

10.10.04.05 Stone Wall

Stone wall guardrail is maintained by keeping the wall in good condition, keeping the drains functioning, painting the white strips at the top of the wall on a curve, and keeping reflector units in good condition.

10.10.04.06 Earth Mound

Earth mound guardrail will require maintenance to preserve the shape and size of the mound, to keep the drains functioning and to keep in place the visibility stones or delineators used on top of the mound on curves. Vines and grass will be kept trimmed close to the ground.

10.10.05 Timber Guardrail Posts

10.10.05.01 Treatment

Any timber used for guardrail posts, other than yellow locust, will require a preservative treatment.

10.10.05.02 Guardrail Posts Without Guardrail

Guard posts have been used quite frequently without any type of guardrail element as an economy measure. Due to the hazard that this type of guardrail presents to vehicles it should not be installed. All sections that are now in existence should be replaced, when damaged, with an acceptable form of guardrail.

10.10.06 Guardrail Inspections

Guardrail inspections will be made twice a year by the Maintenance Assistant responsible for each County, either alone or in company with the County Maintenance Superintendent. There will be an inspection in the spring after the snow season is over, and one in the fall prior to the snow season. These inspections will be concerned with alignment, appearance, and general condition. Any sections in need of repairs or maintenance will be noted on a standard Work-Order Form and the work will be scheduled by the County Maintenance Superintendent.

Each year during the winter, before March 15, a guardrail survey will be made by an inspector from the District. A form similar to Figure 10-5 will be completed in triplicate. This original and one copy will be kept at the District, and the other copy will be sent to the County Maintenance Superintendent. From the information included on this form, materials can be ordered and a program of repairs and replacement can be devised.

10.10.07 Guardrail Erection at New Locations

New or reclaimed guardrail will not be erected at new locations except as directed by the Assistant District Engineer - Maintenance. Where guardrail is to be reconstructed, the Assistant District Engineer - Maintenance must approve the type, amount, and the location for the installation. Construction methods and materials used for erection and repairs will be in accordance with the requirements set forth in the Division's Standard Specifications and Design Standards.

10.10.08 Repair of Guardrail

The repair of guardrail damaged as a result of accidents or other causes is an important function of highway maintenance. Prior to the actual repair, damaged guardrail must be separated into one of two categories: Non-Functional or Functional.

10.10.08.01 Damaged Guardrail Categories Defined

Non-Functional Guardrail

Damaged guardrail that no longer substantially serves its original intended purpose. Example:

end sections/treatments – impacted

rail elements/cable - severed or substantially tilted from vertical

Functional Guardrail

Damaged guardrail that is still intact and will sustain another collision with substantially the same result as prior to damage. Example:

minor impact damage - dents, minor tilting, etc.

10.10.09 Policy - Repair of Guardrail

The Division of Highways has established a policy for repair of damaged guardrail. This policy is to be utilized whether the work is completed by State Forces or by Contractor. The guardrail repair policy establishes different priorities and precautions to be taken for different route systems/ADT's. The policy also requires that each damaged site be reviewed and categorized as defined in Section 10.10.08.01.

Repair priorities of damaged guardrail for the defined route systems/ADT's shall be the following:

10.10.09.01 Interstate and Other Expressways

Non-Functional Guardrail: Place appropriate warning devices immediately after being notified; utilize State Forces or emergency mobilization clause of guardrail contract to effect repairs as soon as reasonably possible.

Functional Guardrail: Place appropriate warning devices the next scheduled work day; schedule repairs to be completed within 60 days.

10.10.09.02 National Highway System and Routes with ADT's Greater Than 6000

Non-Functional Guardrail: Place appropriate warning devices when notified or no later than the next scheduled work day; mobilize guardrail contractor or State Forces to effect repairs as soon as practical within a 30 day maximum.

Functional Guardrail: Place appropriate warning devices the next scheduled work day; schedule repairs to be completed within 60 days.

10.10.09.03 Other Routes with ADT's 1000 - 6000

Non-Functional Guardrail: Place appropriate warning devices the next scheduled work day, and schedule repairs by contract as soon as practical -- within 60 days maximum.

Functional Guardrail: Schedule repairs to be completed within 90 days.

10.10.09.04 Routes Less than 1000 ADT

Non-Functional Guardrail: Place appropriate warning devices as site specific conditions dictate; schedule the repairs by contract unless they are minor in nature -- within a 90 day maximum.

Functional Guardrail: Schedule repairs to be completed within 120 days.

10.10.10 Additional Guidelines - Repair of Guardrail

Repairs to guardrail end treatments shall be made in accordance with the current design standards, unless the repair is so minor that it can easily return the end treatment to its original condition.

Partial replacement of a run of guardrail shall return the section to the same specification as originally designed. Complete replacement of a run, including end treatments, shall be to the current specification/standard.

10.11 MAINTENANCE OF RIGHT OF WAY FENCES

10.11.01 General

Right of way fences are constructed at certain locations on the Interstate and APD Highway System for the purpose of promoting safety by controlling access to and from the highway right of way. They are generally erected during construction and become the responsibility of Division of Highways maintenance forces upon the acceptance of the project.

10.11.02 Types of Fence

In rural areas galvanized woven-wire farm fence 3' 11" (1175mm) high is used. In urban areas, zinc or aluminum coated steel chain-link fence 5' (1500mm) in height with a 2" (50mm) mesh is used.

10.11.03 Fence Installation

10.11.03.01 Woven-Wire Farm Fence

When woven-wire farm fence is used, the posts may be of metal or wood. End posts, corner posts and gate posts must be braced properly. Line posts will be spaced not more than 10' (3m) center to center, and the distance from an end post, corner post, gate post, or intermediate braced posts to the first line post will not exceed 10' (3m).

End posts, corner posts, gate posts and intermediate braced posts will be no less than 8' (2.4m) long and will be set at least 3' (900mm) in the ground. Wood posts must be at least 6" (150mm) in diameter at the small end and will be set with the large end down. All wood and metal post shall be installed as shown in the Division of Highways' Standard Details.

Line posts will be at least 7' (2.2m) long and will be set at least 2½' (750mm) in the ground. Metal posts are to be driven plumb and in perfect alignment. Wood posts will be in perfect alignment on the side to which the fence fabric is to be fastened.

10.11.03.02 Steel Chain-Link Fence

End posts, corner posts, gate posts or intermediate braced posts for chain-link fence will be in accordance with Division of Highways' Standard Specifications. Line posts will be 2 ¼" (57mm) H columns.

The length of the end post, corner post, gate post or intermediate braced post will be at least 3' (900mm) greater than the height of the fence, and each such post will be set in a concrete footing not less than 3' (900mm) deep and not less than 12" (300mm) in a diameter. Line posts also will be 3' (900mm) longer than the height of the fence and each shall be set in a concrete footing not less than 3' (900mm) deep and not less than 12" (300mm) in diameter. The spacing of line posts shall not exceed 10' (3m) center to center. All posts and fence shall be installed as shown in the Division of Highways' Standard Details.

10.11.04 Fence Repairs

Right of way fence will be repaired or replaced whenever necessary. Repair work, such as replacing posts, restringing and tightening wire fencing and barbed wire, and securing wire to posts, will be performed as a normal maintenance operation in accordance with the foregoing installation methods. Extensive replacement work will usually be accomplished by contract.

FOOTNOTE

As more fully set forth in Section 01.01.01, nothing in this manual is intended to create a legal or moral duty and has been created for internal guidance only.

