Section L - APPENDICES

March 2003

47.0 COMPARATIVE COSTS OF IMPLEMENTING

EROSION AND SEDIMENT CONTROL PRACTICES

The cost information presented here is primarily intended to assist individuals responsible for developing and executing erosion and sediment control plans in District of Columbia. Hopefully, this will allow comparison of control options so that the most cost effective measures may be implemented. In developing cost effective erosion and sediment control plans, it is necessary for the designer to consider several factors in the selection and positioning of control measures. Consideration should first be directed towards minimizing grading and excavation by utilizing existing topography and drainage patterns in site selection for the control. Offsite drainage which enters the project area should also be examined to prevent overtaxing the sediment control measures, resulting in "blowouts" and increased maintenance costs. Project duration is also an important consideration at the design stage of sediment control.

The timing of vegetative stabilization is also an important consideration in developing effective erosion and sediment control strategies at the lowest cost. If a site is stabilized at the earliest possible time, it may not be necessary to construct as many of the more expensive controls such as sediment traps or basins. For example, if temporary swales were seeded and mulched immediately after construction, the vegetation would trap much of the sediment resulting from subsequent development. This would reduce the need for a series of expensive sediment traps or a large sediment basin.

This cost information is not recommended for use in comparing contractor bids as the project costs may vary from our estimates because of site specific conditions. Because of this potential for cost variability it was necessary to make several assumptions:

1. Project locations were reasonably accessible and within standard transportation distances.

2. The sites were relatively open; i.e., not broken up with trees, rock outcroppings or buildings.

3. Slopes were not severe.

It is difficult to develop cost estimates for erosion and sediment control practices because of the many variables which influence the cost for each project. Labor, availability and proximity of materials, equipment and mobilization costs vary and are influenced by project duration and magnitude.

Rather than attempting to separate costs on the basis of labor, equipment, materials, profit and overhead, the estimates were based on the total cost to developers. This approach was chosen because contractor bids include these factors plus costs for maintenance and eventual removal (if necessary) of the control measure. A simple summation of materials,

construction costs for installation, and contractor profit might therefore substantially underestimate the true cost of a particular practice.

STRUCTURAL PRACTICE COSTS

Temporary Structures:

Cost estimates for temporary sediment control practices include maintenance and eventual removal of the structure. The construction bids are therefore dependent on the anticipated duration of the project. For example, the projected costs for a stabilized construction entrance will be much higher for a lengthy project where this control will have to be periodically repaired or replaced.

All structural cost estimates include labor, materials, excavation and shaping. When vegetative stabilization is required the costs are noted separately. The vegetative stabilization costs for structural practices are higher than for large open tracts because of the relatively small areas involved.

A. Road Stabilization

1.0 Stabilized Construction Entrance (SCE)

Stabilized construction entrance costs were developed for a standard 50 ft. structure, with 2 inch stone and an underlying layer of filter cloth. The cost range reflects anticipated maintenance, based on the duration of the project and projected weather conditions. Longer projects or those conducted during periods of higher rainfall will be in the upper end of the range as the stone may have to be replaced several times.

	Range:	$1,500 - $4,500
	Average:	$2,000

2.0 Stabilized Construction Entrance with Wash Rack

SCE	Range:	$1,500 - $4,500
	Average:	$2,000
Wash Rack	Range:	$750 - $1,250
	Average:	$1,000

3.0 Construction Road Stabilization

Construction road stabilization 6” in depth:

Range:	$6.00 - $10.00 per sq. yd.
Average:	$7.00 per square yd

B. Sediment Barriers

4.0 Straw Bale Dike

Range: $3.00 - $6.00 / l.f.
Average: $4.00 / 1.f.

5.0 Silt Fence

Range: $3.00 - $7.00 / l.f.
Average: $4.25 / 1.f.

6.0 Super Silt Fence

Range: $13.00 - $17.00 / l.f.
Average: $14.00 / l.f.

7.0 Storm Drain Inlet Protection

Strom drain inlet protection construction costs for practices A-D are as follows.

A. Standard Inlet Protection

Range: $125 - $200
Average: $160

B. At Grade Inlet Protection

Range: $35 - $75
Average: $50

C. Curb Inlet Protection

Range: $120 - $160
Average: $150

D. Median Inlet Protection

Range: $125 - $200
Average: $160

8.0 Inlet Filter Bag

Inlet filter bag installation, maintenance, and disposal costs are estimated to be $50-$125.

9.0 Culvert Inlet Protection

Installation of structure is too site specific to offer accurate cost figures.

C. Dikes & Diversions

10.0 Earth Dike

Earth dike construction with a grade-all is estimated to be approximately $4.00-$7.00 /l.f. Seeding, fertilization and mulching adds $1.00/1.f.

11.0 Temporary Swale

Swale construction is often bid on the basis of cubic yards (cu. yds.) of earth removed. If an estimate in linear feet (l.f.) is desired, the number of cubic yards of earth removed for swale construction may be multiplied by 0.6.

Temporary swale construction is estimated to be $7.00-$10.00 /cu. yd. or $4.00-$7.00 /1.f.

Seeding, fertilization and mulching adds $1.00 /1.f.

12.0 Dikes/Swales

Dike/Swale construction is estimated to be $7.00-$10.00 /l.f.

Seeding, fertilization and mulching adds $1.00 /1.f.

Dike/Swale outlet materials and installation adds $60-$90/c.y.

13.0 Temporary Storm Drain Diversions

See sediment trap, earth dike or swale based on method of temporary storm drain diversion used.

D. Sediment Traps

14 Sediment Traps

Costs are listed by type of trap, and include excavation, materials, shaping and maintenance. Sediment trap volumes are determined by the number of acres of contributory drainage. Each acre of drainage requires a volume of 67 cubic yards (cu. yds) for all types of traps. Excavation shaping and maintenance costs are computed at $6.00-$10.00 /c.y. Seeding, fertilization and mulching adds $1.00 /s.y. to the cost.

14.1 Pipe Outlet Sediment Trap

Pipe outlet sediment traps are limited to 5 acres maximum drainage area. Trap volumes range between 67-335 cubic yards.

Costs are separated as follows:

Excavation of 67- 335 cu. yds. of earth, shaping and maintenance	$550 - $2,700
Construction and installation of riser and barrel	$3,600 - $5,400
Total Cost	$4,150 - $8,100

14.2 Stone Outlet Sediment Trap

Stone outlet sediment traps are designed to drain up to 5 acres. Trap volumes would range between 67- 335 cubic yards (cu. yds.).

Excavation of 67- 335 cu. yds. of earth, shaping and maintenance	$550 - $2,700
Stone Outlet materials and installation	$300 - $420
Total Cost	$850 - $3,120
Optional Dewatering Device	$420 - $ 540

14.3 Rip-Rap Outlet Sediment Trap

Rip-Rap outlet sediment traps may drain up to 10 acres. The range of trap volumes would therefore be 67- 670 cubic yards.

Excavation of 67- 670 cu. yds. of sediment, shaping and maintenance	$550 - $5,350
Stone and filter cloth materials and installation	$480 - $720
Total Cost	$1,030 - $6,070

14.4 Stone Outlet/Rip-Rap Outlet Sediment Trap

Stone Outlet/Rip-Rap Outlet sediment traps may drain up to 10 acres. The range of trap volumes would therefore be 67- 670 cubic yards.

Excavation of 67- 670 cu. yds. of sediment, shaping and maintenance	$550 - $5,350
Stone/Rip Rap and filter cloth materials and installation	$480 - $ 720
Total Cost	$1,030 - $6,070

15.0 Sediment Basin

Sediment basin costs are highly variable because of the wide range of basin volumes, site specific conditions affecting excavation and shaping costs, and variable riser and barrel dimensions. As the drainage area to the basin may be as large as 100 acres the potential excavation is 6700 cubic yards. It is difficult to project costs on the assumption that 67 cubic yards will actually be excavated for each acre of contributory drainage as in many situations existing land formations are utilized during basin construction, which lowers the cost due to reduced excavation and shaping.

Projected costs for a sediment basin draining 30 acres (ac.) are listed below:

Excavation (1340 cu. yds), Shaping and maintenance	$10,700
Construction and installation of riser, anti-vortex device, barrel, anti-seep collars, and emergency spillway	$ 7,800
Total Cost	$18,500

E. Downdrains & Flumes

16.0 Temporary Pipe Slope Drains

Costs for pipe slope drains are calculated on the basis of linear feet (l .f.). The price is influenced by the diameter of the drain pipe.

Range:	$10.00- $20.00 /l.f.
Average:	$14.00 /1.f.

17.0 Paved Flume

Cost for paved flume is based on the number of square yards in the paved flume. . The price is also influenced by the slope of the paved flume.

Paved flume construction is estimated to be $35.00 -$45.00 / s.y.

F. Inlet & Outlet Protection

18.0 Rip-rap Inflow Protection

Construction of rip-rap inflow protection 1' in depth is estimated to be $35.00 - $50.00/s.y.

19.0 Gabion Inflow Protection

Construction of gabion inflow protection 9" in depth is estimated to be $45.00 – $55.00 /s.y.

20.0 Stone Check Dams

Construction of stone check dams is estimated to be $60.00 -$90.00 /c.y.

21.0 Stone Outlet Structures

Placement of 2" to 3" stone is estimated to be $60.00 - $90.00 / c.y.

2" x 10" x 12' baffle board is estimated to be $55.00 - $75.00

22.0 Rock Outlet Protection

Construction of rock outlet protection is estimated to be $60.00 - $90.00 /c.y.

G. Dewatering Strategy

23.0 Removable Pumping Station

Construction of removable pumping station is estimated to be from $45.00 - $85.00 /v.l.f.

Installation, operation, and removal of a pump system are additional costs that are dependent upon the quantity of water to be pumped and the head required.

24.0 Sump Pit

Construction of removable pumping station is estimated to be from $30.00 - $70.00 /v.l.f.

Installation, operation, and removal of the pump system are additional cost that are dependent upon the quantity of water to be pumped and the head required.

25.0 Pumped Water Filter Bag

Pumped water filter bag are estimated to be from $100.00 – $200.00 ea

26.0 Sediment Tank

Sediment tanks are estimated to be from $200.00 – $350.00 ea

27.0 Dewatering Basin

Straw Bale cost:	$4.00 /l.f.
Silt Fence cost:	$4.25 /l.f.
Rip-rap cost:	$70.00 /c.y.
Aggregate cost:	$60.00 /c.y.

H. Waterways & Stream Protection

28.1 Pump-Around Practice

Installation of structure is too site specific to offer accurate cost figures.

28.2 Culvert Pipe W/ Access Road

Installation of structure is too site specific to offer accurate cost figures.

28.3 Diversion Pipe

Installation of structure is too site specific to offer accurate cost figures.

28.4 Sandbag/Stone Diversion

Installation of structure is too site specific to offer accurate cost figures.

28.5 Fabric-Based Channel Diversion

Installation of structure is too site specific to offer accurate cost figures.

29.1 Riprap

Rigid engineering technique for bank stabilization - $78 per linear ft

29.2 Imbricated riprap

Rigid engineering technique for bank stabilization - $90 per linear ft

2.3 Gabions

Rigid engineering technique for bank stabilization - $90 per linear ft

29.4 Live Stakes

Rigid engineering technique for bank stabilization - $1 to $4 per stake

29.5 Live Fascines

Woody vegetative system for bank stabilization - $5.50-$22 per linear ft

29.6 Natural Fiber Rolls

Natural fiber and vegetative system for bank stabilization (installed)-$61 per running foot

29.7 Brush Layering

Woody vegetative system for bank stabilization - Cut: $9 to $14.50 per linear ft
Fill: $13 to $28 per linear ft

29.8 Brush Mattresses

Woody vegetative system for bank stabilization - $33.50 per square ft

29.9 Live Crib Wall

Woody vegetative system for bank stabilization of the front face - $11 - $28 per square ft

29.10 Root Wads

Woody vegetative system with simple structures for limited bank stabilization and aquatic habitat enhancement wad - $168-$1,121 per root

29.11 Toe Protection

Installation of structure is too site specific to offer accurate cost figures.

30.1 Boulder Placement

Improvement/creation of aquatic habitat - $583 per ten boulders

30.2 Log Vanes

Rigid engineering techniques for bank stability and creation of flow Diversity - $406 per single wing vane

30.3 Rock Vanes

Rigid engineering techniques for bank stability and creation of flow Diversity - $406 per single wing vane

30.4 J-Hook Vanes

Installation of structure is too site specific to offer accurate cost figures.

30.5 Stream Deflectors

Rigid engineering techniques for creation of aquatic habitat - $406 per single wing deflector

30.6 Log & Rock Check Dams

Rigid engineering techniques for creation of aquatic habitat and channel grade control - $395 per log dam

30.7 Weirs

Rigid engineering techniques for creation of aquatic habitat and channel grade control - $1,212 per structure

30.8 Cross Vanes

Rigid engineering techniques for creation of aquatic habitat and channel grade control - $1,212 per structure

30.9 Step Pools

Installation of structure is too site specific to offer accurate cost figures.

31.1 Utility Stream Crossing

Installation of structure is too site specific to offer accurate cost figures.

31.2 Multi-Cell Culverts

Installation of structure is too site specific to offer accurate cost figures.

31.3 Culvert Baffles

Installation of structure is too site specific to offer accurate cost figures.

31.4 Small Bridge Installation

Installation of structure is too site specific to offer accurate cost figures.

32.0 Lined Waterway

Because of varying channel widths it is impossible to present excavation and lining costs in linear feet. Cost estimates are therefore listed in cubic yards (cu. yds.) for excavation and shaping and square yards (sq. yds) for linings. Vegetative stabilization costs are computed in the same manner as for permanent diversions.

Excavation and shaping	$7.00- $10.00 /cu. yd.
Rip-Rap lining (1 foot thickness)	$35 - $50 /sq. yd.
Gabions	$60 - $90 /cu. yd.
Filter cloth	$1.00 - $1.50 /sq. yd.

33.0 Grassed Waterway

Cost for grassed waterway excavation, shaping and vegetative stabilization are computed in the same manner as for permanent diversions. If the waterway is to have a stone center $10.00 - $12.00 per linear foot is added to the cost.

Approximate costs for grassed waterways are estimated on the basis of linear feet (l.f.). Several vegetative stabilization options are listed; the choice would be dependent on the anticipated drainage velocity.

Excavation and shaping	$7.00-$10.00 /l.f.
Sodding and stapling	$2.75 /sq. yd.
Sodding with jute or excelsior nettings as protective cover	$5.50 /sq. yd.
Seeding and straw mulching	$1.00 /sq. yd.
Seeding, with excelsior type mattings as protective cover	$3.00 /sq. yd.
Stone center for waterway	$12.00 /l.f.

34.0 Temporary Access Waterway Crossings

Installation of structures is too site specific to offer accurate cost figures.

35.0 Individual Practices

Installation of structures is too site specific to offer accurate cost figures.

36.0 Turbidity Curtain

Installation of structure is too site specific to offer accurate cost figures.

I. Site Preparation

37.0 Land grading / roughening

Installation of structure is too site specific to offer accurate cost figures.

38.0 Topsoiling

The costs of topsoiling are strongly influenced by topsoil availability, the distance it must be transported and the time and effort required to apply the topsoil. Estimates for this practice are presented here as square yards (sq. yds.) to a depth of 4 inches. If it is desired to convert these figures to cubic yards (cu. yds.), the values may be multiplied by 9.

Range:	$2.00- $3.00 /sq. yd.
Average:	$2.25 /sq. yd.

39.0 Blankets and Matting

Range:	$1.25- $2.00 /sq. yd.
Average:	$1.50 /sq. yd.

40.0 Subsurface Drains

6” CMP underdrain	$11.00 /l.f.
8” CMP underdrain	$12.00 /l.f.
6” PVC underdrain	$18.00 /l.f.
8” PVC underdrain	$24.00 /l.f.
6” perforated CMP	$9.00 /l.f.
8” perforated CMP	$10.00 /l.f.
4” perforated PVC pipe	$12.00 /l.f.
8” perforated PVC pipe	$24.00 /l.f.
12” perforated PVC pipe	$36.00 /l.f.

41.0 Brickbats

Brickbat installation 3” – 4” in depth:

Range: $4.00 - $8.00 /s.y.
Average: $6.00 /s.y.

J. Vegetative Stabilization

42.0 Vegetative Practice Costs

Vegetative stabilization is perhaps the most variable of the erosion and sediment control practices because of the many potential combinations of sod, seed, lime, fertilizer, mulch, and equipment types. Because of this potential for variability, cost ranges were developed for each practice which included differences in materials, application rates, labor costs, and regional price structures. A description of those factors which would influence the final cost (to developers) is included for each practice.

The surface area to be stabilized with vegetation has a significant impact on the final cost. For this reason cost ranges were prepared for areas less than 2 acres, 2-5 acres, and greater than 5 acres. In developing each estimate, it was assumed that the project sites were reasonably accessible and open, without steep slopes and properly cleared and graded.

Seeding

Seeding costs have been divided into two main categories; hydroseeding and conventional. Conventional seeding includes the traditional broadcast and drill methods. The cost estimates were obtained from contractors who guaranteed establishment of the desired vegetation and provided at least one post-germination watering. Seedbed preparation, fertilization, mulching and mulch anchoring costs were also incorporated. Some contractors fertilized again after vegetation establishment. The cost estimates also reflect the wide range of seed mixtures typically used in Maryland.

Hydroseeding:

Hydroseeding costs are influenced by the type of mulch and the mulch anchoring method used. Straw mulch used with asphalt tacking agents would place the cost in the higher end of the values listed. If the straw is anchored with a mulch anchoring tool instead of asphalt, the cost is reduced. Fiber mulches tend to be the least expensive.

Hydroseeding costs are as follows:

	Cost Per Acre		
	Less than 2Ac.	2-5Ac.	Greater than 5Ac.
Temporary			
Range:	$1,250- $2,100	$1,050- $1,850	$875- $1,550
Average:	$1,625	$1,375	$1,225

Permanent			
Range:	$1,975- $2,650	$1,625- $2,425	$1,250- $2,100
Average:	$2,375	$2,100	$1,750

Conventional Seeding:

The type of mulch and method of anchoring influences the cost of conventional seeding in the same manner as for hydroseeding.

Conventional Seeding costs are as follows:

	Cost Per Acre		
	Less than 2Ac.	2-5Ac.	Greater than 5Ac.
Temporary			
Range:	$1,250- $2,100	$1,050- $1,850	$875- $1,550
Average:	$1,750	$1,440	$1,200
Permanent			
Range:	$1,750- $2,650	$1,450- $2,375	$1,250- $2,100
Average:	$2,150	$1,975	$1,750

Permanent seeding requiring anchoring with blankets or nettings (e.g., Excelsior blanket, jute or synthetic nettings):

As this practice is generally employed in highly erodible locations of relatively small areal extent, the cost estimates are presented in square yards (sq. yds.). The costs include seeding, blanket or netting material, and installation labor. It is assumed that any grading or shaping has already been completed.

Range:	$1.50 - $3.50 /sq. yd.
Average:	$2.25 /sq. yd.

Straw Mulching

Although the various seeding methods previously described include the cost of mulching, straw mulch is in certain situations applied and anchored as a soil stabilizer without seed. This can occur when a recently graded site is to be left unattended after the normal seeding season has passed, or when extra soil protection is desired. The cost estimates are for applying straw mulch at a rate of 1.5- 2.0 tons per acre, and anchoring with a mulch anchoring tool. Anchoring the straw with asphalt adds approximately $325- $485/acre to the cost.

Flat Area Average:	$450/Acre
Sloped Area Average:	$650/Acre

Sodding

Sodding costs are primarily dictated by the type of sod which is to be placed. Field sod is at the lower end of the range, blended bluegrass varieties are the most expensive, and certified Ky - 31 tall fescue falls in the middle of the range. The price ranges include site preparation (exclusive of clearing and rough grading) liming, fertilization and one or two post installation waterings. Costs are calculated on a square yard (sq. yd.) basis.

Range:	$2.50- $6.50 /sq. yd.
Average:	$3.50 /sq. yd.

Fertilization of Buffer Areas

In some situations it is desirable to enhance the growth of existing vegetation along the perimeter of a project by fertilization. This improved stand of vegetation then acts to reduce runoff velocities and trap sediment which may not have been retained by other on site control practices.

Caution must be exercised with this practice to avoid applying fertilizer during the hot-dry summer season and "burning" the vegetation.

Buffer fertilization costs are $500- $675 /acre.

K. Other Practices

43.0 Tree Protection

Tree Protection is too site specific to offer accurate cost figures.

44.0 Dust Control

Dust control is too site specific to offer accurate cost figures.

45.0 New Products and Procedures

NA

46.0 Polyacrylamide

The material cost of PAM ranges from $1.25 per pound to $5.00 per pound per acre. The cost of application is not available at this time.

48.0 EXAMPLE SEED SPECIFICATIONS

A. The seed mixtures and specifications shall meet the minimum requirements as specified below.

1. Furnish the kinds and amounts of seed as indicated below to be seeded in all areas designated.

   (List mixtures and amounts of each species here).

2. The minimum requirements for grass and legume seed used in the vegetative work are as follows:

   a. All seed must meet the requirements of the Maryland State or DPW-DDOT specifications.

   b. All seed shall be subject to re-testing by a recognized seed laboratory.

   c. All seed used shall have been tested within the six(6) months immediately preceding the date of sowing such material on this job.

   d. Inoculant - The inoculant for treating legume seed in the seed mixtures shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the species. Inoculants shall not be used later than the date indicated on the container. Add fresh inoculant as directed on package. Use four times the recommended rate when hydroseeding. VERY IMPORTANT - Keep inoculant as cool as possible until used. Temperatures above 75-80 degrees F. weaken bacteria and make inoculant less effective.

Quality of Seed*

	Minimum Seed Purity (%)	Minimum Germination (%)
LEGUMES		
Birdsfoot trefoil	98	80
Crownvetch	95	65
Lespedeza, Korean	97	85
Lespedeza, Sericea	98	85
Sweetclover	98	85
GRASSES		
Bluegrass, Canada	80	80
Bluegrass, Kentucky	80	85
Fescue, red	97	80
Fescue, tall 'Ky-31'	97	85
Lovegrass, weeping, Boer, Lehmann's	95	87
Redtop	90	85
Reed canarygrass	96	80
Ryegrass, Italian	98	85
OTHER ANNUALS		
Barley	98	90
Millet	99	80
Oats	98	80
Sudangrass (non hybrids)	98	80

*Seed containing prohibited or restricted noxious weeds should not be accepted.

Prohibited noxious weeds - Johnsongrass or Johnsongrass crosses, Canada thistle, and quackgrass.

Restricted noxious weeds - Wild garlic and wild onion, bermudagrass, annual bluegrass, corn cockle, dodder and bindweed.

Seed should not contain in excess of 2.50 percent of weed seeds; none is desirable.

To calculate percent pure live seed, multiply germination times purity and divide by 100.

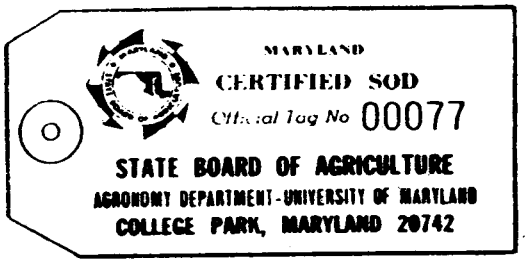
Example: 'Ky-31' tall fescue with a germination of 85 percent and a purity of 97 percent. 97 x 85 = 8245. 82.45 - 100 = 82.45 percent pure live seed.

49.0 EXPLANATION OF CLASS OF TURFGRASS SOD

1. State "Certified Sod"

"Certified" turfgrass sod is superior sod grown from "Certified" seed. It is inspected and certified by the State Certifying Agency to insure genetic purity, overall high quality and freedom from noxious weeds as well as excessive amounts of other crop and weed plants at the time of harvest. It may be composed of a mixture of two or more varieties or species. The sod must meet published state standards and bear an official Maryland, Virginia, or other state "Certified Sod" label on the bill of lading. The purchaser should require such labels when sod is delivered.

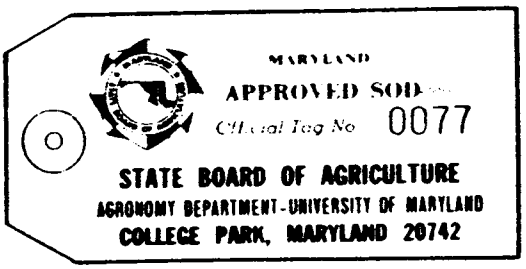
Specimen "Certified" Labels for Maryland and Virginia

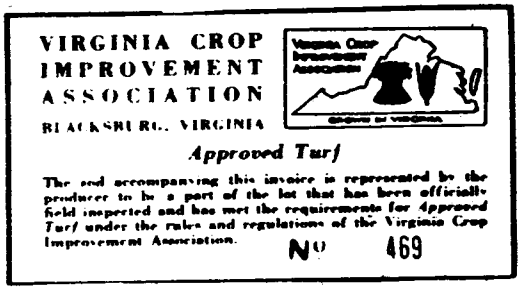


2. State "Approved Sod"

"Approved" turfgrass sod is inspected and approved by the State Certifying Agency to insure overall high quality and freedom from noxious weeds and excessive amounts of other crop and weed plants at the time of harvest. It may be composed of a mixture of two or more varieties or species. The sod must meet published state standards and bear an official Maryland or Virginia "Approved Sod" label on the bill of lading. The purchaser should require such labels when sod is delivered.

Specimen "Approved" Label for Maryland and Virginia





3. Other Sod

The architect should provide detailed quality specifications for all sod other than State "Certified" or "Approved" classes. Such specifications should include species and/or varieties and the following quality standards: weed content, other crop contaminants, thatch, diseases, insects, mowing height, uniformity and overall quality. These quality standards are automatically covered in the State "Certified" and "Approved" classes. If assistance is needed in developing quality standards for other sod, contact the County Extension Agent in the County where the work is to be performed.

Reference: MD-VA Pub. #1, Guidelines Specifications, Soil Preparation and Sodding. Cooperative Extension Service, University of Maryland and Virginia Polytechnic Institute. December 1969.

50.0 EXPLANATION OF COMPOSITION OF TURFGRASS SOD

The following mixtures of species and varieties are eligible for the State "Certified" and State “Approved” classes of sod in the District of Columbia.

NO. 1 SUNNY TURF AREAS

a. Kentucky Bluegrass
20-60% Certified 'Merion'
20-40% Certified 'Kenblue' (Ky. origin) or 'South Dakota Certified'
0-40% Certified 'Fylking', Certified 'Pennstar' or Certified 'Adelphi'

b. 'Turcote' bermudagrass 2/

NO. 2 GENERAL PURPOSE TURF AREAS (Droughty or Shaded Areas)

a. Kentucky Bluegrass
20-60% Certified 'Merion'
20-40% Certified 'Kenblue' (Ky. origin) or ‘South Dakota Certified'
0-40% Certified 'Fylking', Certified 'Pennstar' or Certified 'Adelphi'

Red Fescue 1/
10-50% Certified 'Pennlawn' or Certified ‘Jamestown’

b. 'Turcote' bermudagrass 2/
100% (Not in shade)

NO. 3 MULTI-USE TURF AREAS (Athletic Fields, Lawns, Parks, Playgrounds)

a. Tall Fescue
90-100% Certified 'Kentucky 31'

Kentucky Bluegrass
0-10% Certified 'Kenblue' (Ky. origin), 'South Dakota Certified', or Certified 'Marion'

b. 'Tufcote' bermudagrass 2/
100% (Not in shade)

1/ If the lawn is under heavy shade, use the higher percentage of red fescue.
2/ Sod is expensive. Use of stolons is more practical.

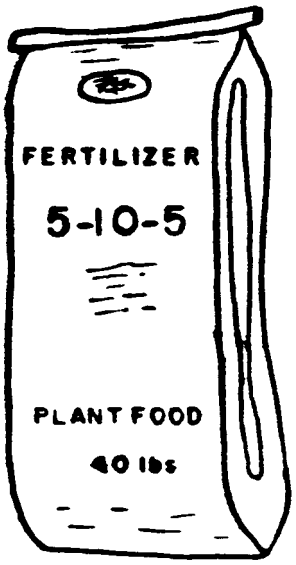
51.0 HOW TO READ FERTILIZER LABELS

FERTILIZER GRADE

5 - 10 - 5

MEANS

5%	10%	5%
NITROGEN	PHOSPHORUS	POTASH
N	P_2O_5	K_2O



OR

2 lbs	4 lbs	2 lbs
N/bag	P_2O_5/bag	K_2O/bag

52.0 MAINTAINING VEGETATION

Vegetation must be properly maintained if it is to provide effective erosion control on a continuing basis. Proper maintenance also ensures a healthy stand of vegetation that can withstand extreme climatic conditions and pest, weed, or disease infestation better than poorly maintained vegetation. Without adequate maintenance, the vegetative cover will gradually lose its ability to reduce runoff, and may eventually have to be replaced.

Soil and climatic conditions, specific plant requirements, and intended use of the area determine the maintenance requirements that must be met regularly. Such requirements may include mowing, fertilizing, liming, watering, pruning, fire control, weed and pest control, or reseeding. Any maintenance activities that are necessary must be performed regularly and promptly. Maintenance of vegetated areas may also require prompt removal of debris, and protection from unintended uses or traffic. An effective preventive maintenance program anticipates requirements and accomplishes work when it can be done with the least effort and expense.

The type of vegetation and the intended land use determine how frequently the various maintenance practices will be necessary.

Pest and disease control requirement s are usually more intensive on improved areas. Most insects, such as grubs, crickets, chinch bugs, grasshoppers, army worms, beetles and ants, feed on grass roots, stems and leaves and may cause considerable damage in a short space of time if not controlled. Rodents, such as field mice, ground squirrels, gophers, and moles, may damage vegetation and create hazards by burrowing and throwing up mounds on earthen structures. Insects and rodents should be kept under reasonable control.

Disease of herbaceous and woody plants are usually of minor importance where adapted species have been used and reasonably good management practiced. Trees that have been destroyed by disease or seriously damaged by insects should be removed. Removal of these diseased trees is essential if the disease or insect infestation is likely to spread to other plants.

Dry vegetation constitutes a fire hazard. The taller the vegetation, the greater the hazard. Herbaceoos vegetation on improved grounds may be less subject to serious fire, since it is kept well mowed and probably well watered. Tree and shrub areas on improved ground also undergo fairly intensive management. Debris, such as fallen trees and branches, is usually removed without undue delay and later is occasionally cleared away. These practices reduce fire hazards considerably. On unimproved grounds, vegetation is usually allowed to grow tall. Mowing and removing residue on occasion may help prevent fires in such areas.

53.0 STANDARDS AND SPECIFICATIONS

FOR

MATERIALS SPECIFICATIONS

Table 44 Geotextile Fabrics

DISTRICT OF COLUMBIA APPLICATION CLASS	TYPE OF GEOTEXTILE	GRAB STRENGTH lb D 4632	PUNCTURE STRENGTH lb D 4633	PERMITTIVITY sec^{-1} D 4491	APPARENT OPENING SIZE, max mm D4751	TRAPEZOID TEAR STRENGTH lb D 4533
SD TYPE I	NONWOVEN	160	56	0.50	0.43	55
	WOVEN, MONOFILAMENT	250	90	0.50	0.43	90
TYPE II	NONWOVEN	160	56	0.20	0.25	55
	WOVEN, MONOFILAMENT	250	90	0.20	0.25	90
PE TYPE I	NONWOVEN	200	80	0.70	0.43	80
	WOVEN, MONOFILAMENT	250	90	0.70	0.43	90
TYPE II	NONWOVEN	200	80	0.20	0.25	80
	WOVEN, MONOFILAMENT	250	90	0.20	0.25	90
TYPE III	NONWOVEN	200	80	0.10	0.22	80
	WOVEN, MONOFILAMENT	250	90	0.10	0.22	90
SE	NONWOVEN	200	80	0.20	0.30	80
	WOVEN	250	90	0.20	0.30	90
ST	WOVEN	300*	110	0.05	0.15**	110
F	WOVEN	100	-	0.05	0.60	-
E	NONWOVEN	90	30	0.50	0.30	30

Note 1: All property values are based on minimum average roll values in the weakest principle direction, except for apparent opening size.

Note 2: The ultraviolet stability shall be 50 percent after 500 hours of exposure for all classes, except Class F, which shall be 70 percent (D 4355).

* Minimum 15 percent elongation.

**This is a MINIMUM apparent opening size, not a maximum.

The properties shall be determined in accordance with the following procedures:

-Apparent opening size ASTM D-4751

-Grab tensile strength ASTM D 4632: 4x8" specimen, 1x2" clamps, 12"/min. strain rate in both principal directions of geotextile fabric.

-Puncture Strength ASTM D 4833

The fabric shall be inert to commonly encountered chemicals and hydrocarbons, and will be rot and mildew resistant. It shall be manufactured from fibers consisting of long chain synthetic polymers, and composed of a minimum of 85% by weight of polyolephins, polyesters, or polyamides. The geotextile fabric shall resist deterioration from ultraviolet exposure.

In addition, Classes A through E shall have a 0.01 cm./sec. minimum permeability when tested in accordance with ASTM D-4491, and an apparent minimum elongation of 20 percent (20%) when tested in accordance with the grab tensile strength requirements listed above.

Silt Fence

Class F geotextile fabrics for silt fence shall have a 50 lb./in. minimum tensile strength and a 20 lb./in. minimum tensile modules when tested in accordance with ASTM D-4595. The material shall also have a 0.3 gal./ft.^{2}/min. flow rate and seventy-five percent (75%) minimum filtering efficiency when tested in accordance with ASTM D-5141.

Geotextile fabrics used in the construction of silt fence shall resist deterioration from ultraviolet exposure. The fabric shall contain sufficient amounts of ultraviolet ray inhibitors and stabilizers to provide a minimum of 12 months of expected usable construction life at a temperature range of 0 to 120 degrees F.

Table 45 Stone Size

	SIZE RANGE	D_{50}	D_{100}	AASHTO	WEIGHT
NUMBER 57*	3/8" – 1 ½"	½"	1 ½"	M-43	N/A
NUMBER 1	2" – 3"	2 ½"	3"	M-43	N/A
RIP-RAP**	4" – 7"	5 ½"	7"	N/A	N/A
CLASS I	N/A	9.5"	15"	N/A	150lb max
CLASS II	N/A	16"	24"	N/A	700lb max
CLASS III	N/A	23"	34"	N/A	2000lb max

* This classification is to be used on the inside face of stone outlets and check dams.
** This classification is to be used whenever small rip-rap is required.

Stone For Gabion Baskets

BASKET THICKNESS		**SIZE OF INDIVIDUAL STONES**	
INCHES	**MM**	**INCHES**	**MM**
6	**150**	**3 – 5**	**75 – 125**
9	**225**	**4 – 7**	**100 – 175**
12	**300**	**4 – 7**	**100 – 175**
18	**460**	**4 – 7**	**100 – 175**
36	**910**	**4 – 12**	**100 - 300**

NOTE: Recycled concrete equivalent may be substituted for all stone classifications. Recycled concrete equivalent shall be concrete broken into the sizes meeting the appropriate classification, shall contain no steel reinforcement, and shall have a density of 150 pounds per cubic foot.