NEW HAMPSHIRE

DRAINAGE GUIDE

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

DURHAM NEW HAMPSHIRE
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NEW HAMPSHIRE DRAINAGE GUIDE

PREFACE

Purpose and Scope --

The purpose of this Drainage Guide is to provide soil conservationists, engineers, and technicians with a ready reference for planning of agricultural drainage of soils in New Hampshire that have a wetness problem, with the exception of organic soils. This guide is based on available research and test data and experience of many SCS personnel.

It is to be emphasized that this is to be used only as a guide and not as a drainage handbook or as a set of standards and specifications.

Information on investigation, survey, design, and construction is given in the Engineering Field Manual for Conservation Practices and National Engineering Handbook, Section 16. Standards and specifications for drainage practices are given in the New Hampshire Technical Guide, Section IV.

Although the guide has been prepared primarily for agricultural drainage, information on soil properties and conditions that affect drainage may be applied to drainage for other land uses. Recommendations on coefficients, depth, and spacing of drains are for agricultural drainage and do not apply to drainage for other land use.

This guide does not eliminate the need for onsite investigation of soil and water conditions on land where drainage is being investigated or planned. It is assumed that an adequate outlet can be obtained for planned drainage.

The economic feasibility of any drainage project is dependent on many factors and must be determined on each project. Although recommendations for drainage of specific soils are given, it does not imply that it is economically feasible to drain a soil for a specific crop. A drainage system must be designed to fit the topography, crops, soils, environment, and meet the objectives of the landowner.

The Soil Conservation Service is not to provide technical assistance for drainage wetlands types 3 through 20, as described in Circular 39 of the Fish and Wildlife Service, U.S. Department of the Interior or any soils on the Hydric Soils List for New Hampshire issued June 20, 1983.

HOW TO USE THIS GUIDE

1. Read Preface, if not done before.

2. From a soils map and legend, determine the soil series and slope class of the area on which drainage improvement is being considered.

3. Determine the drainage group number for the particular soil series from the index on page 5.

4. Refer to the drainage group for general recommendations on drainage for the soil series.

EXPLANATION OF DRAINAGE GROUP CHARTS

Drainage Groups --

Soils have been divided into eight drainage groups. Soils are grouped by parent material, landscape position, and texture. These factors have a direct effect on drainage of the soils.

Slope Class --

The slope or slopes on which the soil series occurs:

Slope Class	Slope Range Percent
A	0 - 3
B	3 - 8
C	8 - 15
D	15 - 25

Drainage Class --

	Drainage Class	Approximate Depth to Seasonal High Water Table
WD	Well drained	4'-6' (subject to flooding)
MWD	Moderately well drained	1'-3'
PD	Poorly drained	0 -1'
VPD	Very poorly drained	0

Surface Drainage --

Recommendations are given for permissiable velocities, depth, spacing, and side slopes of drainage field ditches, mains and laterals for surface water removal, and water table control. This type of drainage is usually limited to A and B slopes.

It is assumed that where depressions and ponding exists, this will be corrected by land smoothing or grading.

Drainage coefficients are determined on the basis of the crop to be grown and protected rather than the soil.

Use the following drainage curves for ditch capacity for the protection of the crop to be grown:

	Drainage Curve
Pasture and Permanent Hay	C
Corn, Alfalfa, Truck Crops	B
High Value Truck Crops	A

Capacity for these curves are found on pages 14-89, 14-90.1 and 14-90.2 of the Engineering Field Manual.

The recommended permissiable velocity for open drains for each soil is given. These velocities are applicable for ditches with drainage areas less than 640 acres. For drainage areas over 640 acres, allowable velocities must be determined by Technical Release No. 25. Recommendations for bedding widths are given in Chapter 14 of the Engineering Field Manual.

Subsurface Drains --

Recommendations are given for depth and spacing for subsurface drain systems and inflow rates for random or interceptor lines. Inflow rates for interceptor lines on sloping land should be increased by 10 percent for slopes 2 to 5 percent, by 20 percent for 5 to 12 percent, and 30 percent for slopes over 12 percent.

For coefficients of subsurface systems, refer to page 14-53 of the Engineering Field Manual.

Spacing recommendations are only a guide and on site determination and Chapter 14 of the Engineering Field Manual should be used for actual spacing.

Filters and Envelopes --

Most of the pipe used for subsurface drains in New Hampshire is made of flexible material and the trenches are dug with backhoes. Therefore, either the bottom of the trench must be shaped to fit the bottom third of the pipe (Figure 1 & 1A), or backfilled to the top of the pipe with sand or sand and gravel envelope to provide support to the pipe (Figure 2). This envelope is often erroneously called a filter. A sand-gravel filter should extend a minimum of 3 inches all around the pipe (Figure 3).

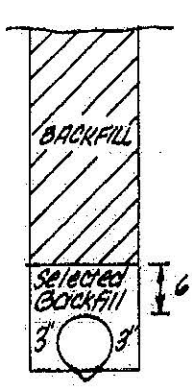


FIGURE 1
90° groove in undisturbed soil

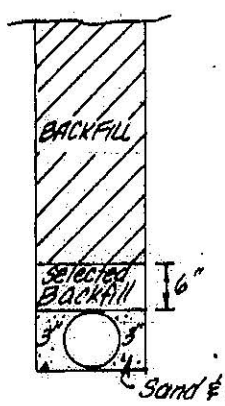


FIGURE 2
Sand & Gravel Envelope

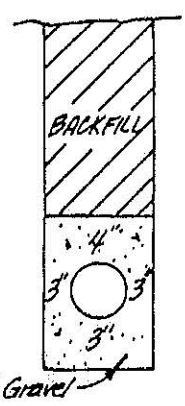
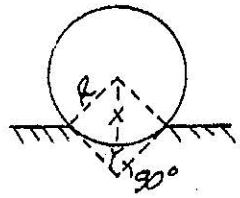


FIGURE 3
Sand & Gravel Filter



D (in.)	R (in.)	X (in.)	Y (in.)
4	2.0	2.0	0.83
5	2.5	2.5	1.04
6	3.0	3.0	1.24
8	4.0	4.0	1.66

FIGURE 1A
Dimensions for a 90° "V" groove

Whether a filter is required or not is dependent on the partical size distribution, plasticity of the soil, and the size of the perforations in the pipe. Perforations in pipe vary between about 1/8 to 5/8 of an inch in width or diameter. Because of these variables, filter recommendations have been included for those soils that more often than not need one. For other soils, the determination for filter requirement should be made on an individual basis. Refer to page 14-71 of the Engineering Field Manual for guidance.

Besides sand-gravel as a filter, there are several synthetic fabric filters available that work well in fine sandy soils that would not require an envelope. These filters are limited to the use where the silt fraction in the soil around the conduit is less than 40 percent. (No more than 40 percent passing the No. 200 sieve).

DRAINAGE GROUP 3

Soils formed in very fine sand and silt deposits of glaciolacustrine origin.

Soil Series	Slope Class	Drainage Class	SURFACE DRAINAGE: Permis. Vel. ft./sec.	SURFACE DRAINAGE: Drainage Mains & Laterals Drainage Field Ditch: Depth Feet	Spacing Feet	S:S	SUBSURFACE DRAINS: Systems: Depth Feet	Spacing Feet	Random Inflow Rate cfs/1,000 ft.
Nicholville	A&B	MWD	2.0	2.5-3.5	100-125	2:1	2.5-3.5	100-120	0.10 *
Scio	A&B	MWD							
Belgrade	A&B	MWD							
Dartmouth	A&B	MWD							
Binghamville	A&B	PD							
Raynham	A&B	PD							
Roundabout	A&B	SWP&PD							
Pemi	A&B	PD							

* Filter usually needed — DO NOT USE SYNTHETIC FABRIC FILTER.

DRAINAGE GROUP 3A

Soils formed in silt and clay deposits of marine origin.

			SURFACE DRAINAGE *				SUBSURFACE DRAINS **		
			Drainage Mains & Laterals Drainage Field Ditch				Systems		
Soil Series	Slope Class	Drainage Class	Permis. Vel. ft./sec.	Depth Feet	Spacing Feet	S:S	Depth Feet	Spacing Feet	Random Inflow Rate cfs/1,000 ft.
Buxton	A&B	MWD	3.0	1.5-2.5	100	2:1	2.5-3.5	60- 80	0.08 ***
Boxford	A&B	MWD							
Scantic	A&B	PD	3.0	1.5-2.5	100	2:1	2.5-3.5	40- 60	0.05 ***
Scitico	A&B	PD							
Biddeford	A	VPD							
Maybid	A	VPD							

* Land smoothing and grading are common and effective drainage practices on these soils.
** Subsurface drains are seldom economically feasible because of required close spacing.
*** Filter usually needed — DO NOT USE SYNTHETIC FABRIC FILTER.

DRAINAGE GROUP 4

Soils formed in loamy deposits over silt and clay origin.

Soil Series	Slope Class	Drainage Class	SURFACE DRAINAGE: Drainage Mains & Laterals Drainage Field Ditch: Permis. Vel. ft./sec.	Depth Feet	Spacing Feet	S:S	SUBSURFACE DRAINS: Systems: Depth Feet	Spacing Feet	Random Inflow Rate cfs/1,000 ft.
Elmwood	A&B	MWD	2.5	2.5-3	100-120	2:1	2.5-3	80-100	0.10 *
Eldridge	A&B	MWD							
Swanton	A&B	PD	2.5	2-3	100	2:1	2.5-3	60- 80	0.08 *
Squamscott	A&B	PD							

* Filter usually needed — DO NOT USE SYNTHETIC FABRIC FILTER.

DRAINAGE GROUP 5

Upland soils formed in loamy and sandy glacial till.

Soil Series	Slope Class	Drainage Class	SURFACE DRAINAGE: Permis. Vel. ft./sec.	SURFACE DRAINAGE: Drainage Mains & Laterals Drainage Field Ditch: Depth Feet	SURFACE DRAINAGE: Drainage Mains & Laterals Drainage Field Ditch: Spacing Feet	SURFACE DRAINAGE: Drainage Mains & Laterals Drainage Field Ditch: S:S	SUBSURFACE DRAINS: Systems: Depth Feet	SUBSURFACE DRAINS: Systems: Spacing Feet	SUBSURFACE DRAINS: Random Inflow Rate cfs/1,000 ft.
Acton	A,B&C	MWD	3.0	2.5-3	150-200	2:1	2.5-3	150-200	0.15 *
Newfields	A,B&C	MWD	3.0	2.5-3	100-150	2:1	2.5-3	100-125	0.12 *
Dixmont	A,B&C	MWD	3.0	2.5-3	100-150	2:1	2.5-3	100-125	0.12 *
Sutton	A,B&C	MWD	3.0	2.5-3	100-150	2:1	2.5-3	100-125	0.12 *
Sunapee	A,B&C	MWD	3.0	2.5-3	100-150	2:1	2.5-3	100-125	0.12 *
Waumbek	A,B&C	MWD	3.0	2.5-3	150-200	2:1	2.5-3	150-200	0.20 *
Lyme	A&B	PD	3.0	2.5-3	100-150	2:1	2.5-3	100-125	0.12 *
Leicester and Leicester Variants	A&B	PD	3.0	2.5-3	100-150	2:1	2.5-3	100-125	0.12 *

* Filter usually needed.

DRAINAGE GROUP 6

Upland soils formed in loamy glacial till with very firm pan below 1.5-2.5 ft. depth.

Soil Series	Slope Class	Drainage Class	Permis. Vel. ft./sec.	SURFACE DRAINAGE * Drainage Mains & Laterals Depth Feet	Spacing Feet	S:S	SUBSURFACE DRAINS ** Systems Depth Feet	Spacing Feet	Random Inflow Rate cfs/1,000 ft.
Buckett	A,B,C&D	WD	3.5	2-2.5	60-100	2:1	2.5-3	80-100	0.12
Bernardston	A,B,C&D	WD	3.5	2-2.5	60-100	2:1	2.5-3	60-100	0.08 ***
Howland	A,B,C&D	MWD	3.5	1.5-2.5	60-100	2:1	2.5-3	60- 80	0.08 ***
Marlow	A,B,C&D	WD	3.5	2.5-3	60-100	2:1	2.5-3	80-100	0.10
Millis	A,B,C&D	WD	3.5	2.5-3	60-100	2:1	2.5-3	80-100	0.12
Monarda	A,B&C	PD	3.5	1.5-2.5	60-100	2:1	2.5-3	60- 80	0.08 ***
Montauk	A,B,C&D	WD	3.5	2.5-3	60-100	2:1	2.5-3	80-100	0.12
Paxton	A,B,C&D	WD	3.5	2-2.5	60-100	2:1	2.5-3	60- 80	0.10
Peacham	-	VPD	3.5	1-2	60-100	2:1	2.5-3	60- 80	0.08 ***
Peru	A,B,C&D	MWD	3.5	2.5-3	60-100	2:1	2.5-3	80-100	0.10
Pittstown and Pittstown Variant	A,B,C&D	MWD	3.5	2-2.5	60-100	2:1	2.5-3	60-100	0.08 ***
Plaisted	A,B,C&D	WD	3.5	1.5-2.5	60-100	2:1	2.5-3	60- 80	0.08 ***
Ridgebury	A,B&C	PD	3.5	1.5-2.5	60-100	2:1	2.5-3	60- 80	0.10
Pillsbury	A,B&C	PD	3.5	1.5-2.5	60-100	2:1	2.5-3	60- 80	0.10
Scituate	A,B,C&D	MWD	3.5	2.5-3	60-100	2:1	2.5-3	80-100	0.12
Skerry	A,B,C&D	MWD	3.5	2-2.5	60-100	2:1	2.5-3	80-100	0.12
Stissing	A&B	PD	3.5	1.5-2.5	60-100	2:1	2.5-3	60- 80	0.08 ***
Whitman	A	VPD	3.5	1.5-2.5	60-100	2:1	2.5-3	60- 80	0.10
Woodbridge	A,B,C&D	MWD	3.5	2-2.5	60-100	2:1	2.5-3	60- 80	0.10

* Diversions may be applicable for drainage of hay and pasture land on B&C slopes.

** Where slopes are greater than 5%, investigate for artesian water in the pan at 3-5 foot depth. When flexible pipe is used, sand-gravel envelope is usually installed.

*** Filter usually needed — DO NOT USE SYNTHETIC FABRIC FILTER.

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SOIL SERIES	Drainage Group
Acton	5
Au Gres	2
Becket	6
Belgrade	3
Bernardston	6
Binghamville	3
Biddeford	3A
Borohemists[2]	-
Boxford	3A
Buxton	3A
Charles	1A
Chocorua[1]	-
Croghan	2
Dartmouth	3
Deerfield	2
Dixmont	5
Duane	2
Eldridge	4
Elmwood	4
Finch	2
Freshwater Marsh[2]	-
Fryeburg	1A
Grange	2
Greenwood[1]	-
Hadley (Low Bottomland)	1A
Howland	6
Ipswich[2]	-
Kinsman	2
Leicester and Leicester Variant	5
Limerick	1A
Lovewell	1A
Lyme	5

Soil Series	Drainage Group
Madawaska	2
Marlow	6
Matunuck	-
Maybid	3A
Medomak	1A
Millis	6
Mixed Alluvial Land	1
Monarda	6
Moosilauke	2
Montauk	6
Muck and Peat[1]	-
Naumburg	2
Newfields	5
Nicholville	3
Ninigret	2
Occum (Low Bottomland)	1
Ondawa (Low Bottomland)	1
Ossipee[1]	-
Pawcatuck[2]	-
Paxton	6
Peacham	6
Pemi	3
Peru	6
Pillsbury	6
Pipestone	2
Pittstown	6
Pittstown Variant	6
Plaisted	6
Podunk	1
Podunk Variant (Metallak)	1
Pootatuck	1
Raynham	3
Ridgebury	6
Rippowam	1
Roundabout	3
Rumney	1
Rumney Variant (Cohos)	1
Saco	1A
Saco Variant	1

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SOIL SERIES	Drainage Group	Soil Series	Drainage Group
Saugatuck	2		
Scantic	3A		
Scarboro	2		
Scio	3		
Scitico	3A		
Scituate	6		
Searsport	2		
Skerry	6		
Squamscott	4		
Stissing	6		
Sudbury	2		
Sunapee	5		
Sutton	5		
Swanton	4		
Tidal Marsh[2]	-		
Walpole	2		
Wareham	2		
Waumbek	5		
Westbrook[2]	-		
Whitman	6		
Winooski	1A		
Woodbridge	6		

[1]Organic soils that are difficult and complex to drain and recommendations are not included in this guide.

[2]Occur in one or more wetland types 3 through 20 described in Circular 39, Fish and Wildlife Service, U.S. Department of the Interior. Soil Conservation Service cannot provide technical assistance.

DRAINAGE GROUP 1

Flood plain soils formed in sandy alluvial deposits. These soils are subject to frequent flooding..

Soil Series	Slope Class	Drainage Class	SURFACE DRAINAGE: Drainage Mains & Laterals: Permissible Velocity	Drainage Field Ditch: Depth Feet	Drainage Field Ditch: Spacing Feet	Drainage Field Ditch: S:S	SUBSURFACE DRAINS: Systems: Depth Feet	Systems: Spacing Feet	Random Inflow Rate cfs/1,000 ft.
Ondawa	A	WD	Land smoothing or grading may be needed to eliminate ponding after flooding.						
Occum	A	WD							
Podunk	A	MWD	2.5	3-4	100-200	1.5:1	3-3.5	100-150	0.15 *
Pootatuck	A	MWD							
Rumney	A	PD							
Rippowam	A	PD							
Mixed Alluvial Land	A	VPD							
Podunk Variant (Metallak)	A	MWD	3.5	3-4	150-250	1.5:1	3-3.5	150-200	0.30 *
Rumney Variant (Cohas)	A	PD							
Saco Variant	A	VPD							

* Filter usually needed — DO NOT USE SYNTHETHIC FABRIC FILTER.

DRAINAGE GROUP 1A

Flood plain soils formed in very fine sandy and silty alluvial deposits. These soils are subject to frequent flooding.

Soil Series	Slope Class	Drainage Class	SURFACE DRAINAGE: Drainage Mains & Laterals Drainage Field Ditch: Permis. Vel. ft./sec.	Depth Feet	Spacing Feet	S:S	SUBSURFACE DRAINS: Systems: Depth Feet	Spacing Feet	Random Inflow Rate cfs/1,000 ft.
Hadley	A	WD	2.0	Land smoothing may be needed to eliminate ponding after flooding.					
Fryeburg	A	WD							
Winooski	A	MWD	2.0	3-3.5	100-125	2:1	2.5-3.5	80-120	0.10 *
Lovewell	A	MWD							
Limerick	A	PD							
Charles	A	PD							
Saco	A	VPD							
Medomak	A	VPD							

* Filter usually needed — DO NOT USE SYNTHETHIC FABRIC FILTER.

DRAINAGE GROUP 2

Soils formed in sandy and gravelly deposits on glacial outwash plains and terraces.

Soil Series	Slope Class	Drainage Class	SURFACE DRAINAGE: Drainage Mains & Laterals Drainage Field Ditch: Permis. Vel. ft./sec.	Depth Feet	Spacing Feet	S:S	SUBSURFACE DRAINS: Systems: Depth Feet	Spacing Feet	Random Inflow Rate cfs/1,000 ft.	
Croghan	A&B	MWD	2.5	3-4	200-300	1.5:1	2.5-3.5	200-250	0.20	*
Deerfield	A&B	MWD	2.5	3-4	200-300	1.5:1	2.5-3.5	200-250	0.20	*
Duane	A&B	MWD	3.0	3-4	200-300	1.5:1	3-3.5	200-250	0.25	*
Madawaska	A&B	MWD	2.5	3-4	200-300	1.5:1	3-3.5	150-200	0.15	*
Ninigret	A&B	MWD	2.5	3-4	200-300	1.5:1	3-3.5	100-150	0.15	*
Grange	A&B	SWP&PD	2.5	3-4	200-300	1.5:1	3-3.5	100-150	0.15	*
Sudbury	A&B	MWD	3.5	3-4	250-350	1.5:1	2.5-3.5	200-300	0.25	
Pipestone	A&B	PD	2.5	3-4	200-250	1.5:1	2.5-3.5	150-200	0.17	*
Au Gres	A&B	PD	2.5	3-4	200-250	1.5:1	2.5-3.5	150-200	0.17	*
Naumburg	A&B	SWP&PD	2.5	3-4	200-250	1.5:1	2.5-3.5	150-200	0.17	*
Kinsman	A&B	SWP&PD	2.5	3-4	200-250	1.5:1	2.5-3.5	100-150	0.17	*
Saugatuck	A	PD	2.5	3-4	150-200	1.5:1	2.5-3.5	100-150	0.17	*
Finch	A	SWP	2.5	3-4	150-200	1.5:1	2.5-3.5	100-150	0.17	*
Walpole	A&B	PD	3.5	3-4	200-250	1.5:1	3-3.5	150-300	0.25	
Moosilauke	A&B	PD	3.5	3-4	200-250	1.5:1	3-3.5	150-200	0.25	
Wareham	A	PD	2.5	3-4	200-300	1.5:1	2.5-3.5	200-250	0.20	
Scarboro	A	VPD	2.5	3-4	200-300	1.5:1	2.5-3.5	200-250	0.20	*
Searsport	A	VPD	2.5	3-4	200-300	1.5:1	2.5-3.5	200-250	0.20	*

* Filter usually needed.