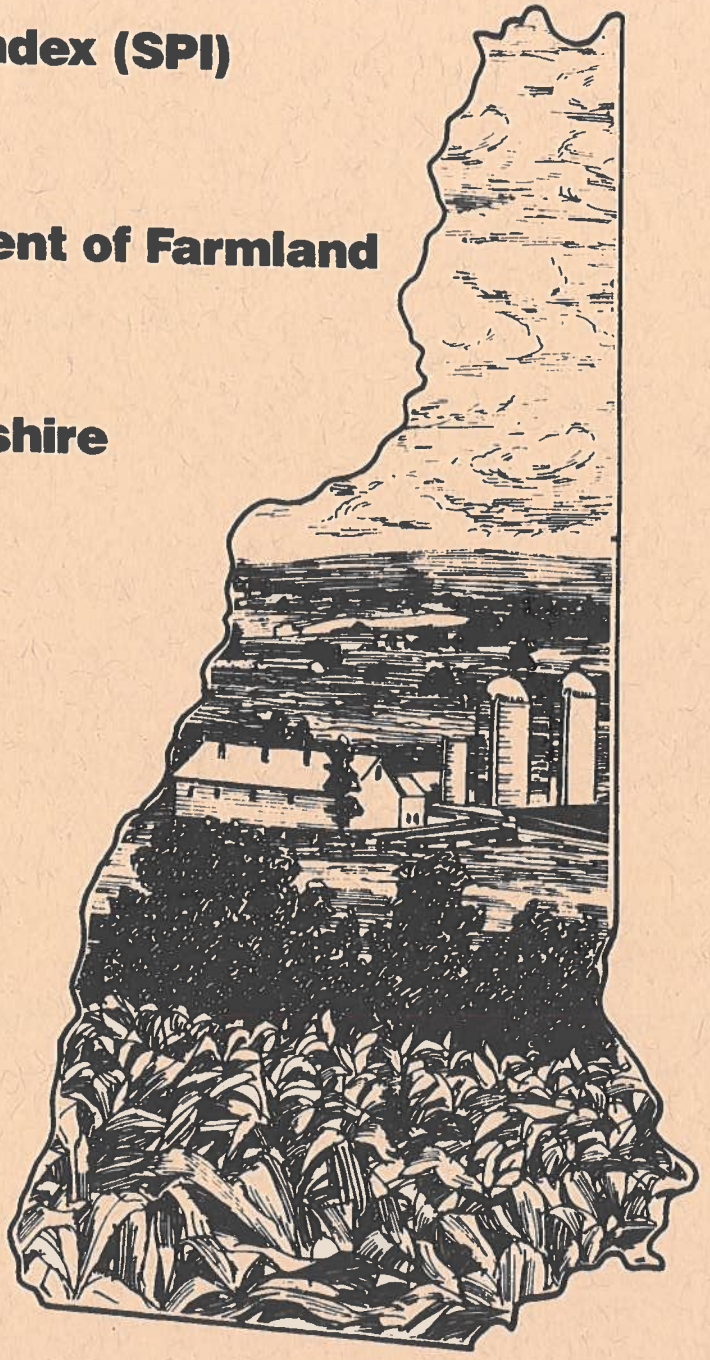
Soil Potential Index (SPI)

for

Current Use Assessment of Farmland

in

New Hampshire



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Soil Conservation Service

NEW HAMPSHIRE SPI AND THE CURRENT USE LAW

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NEW HAMPSHIRE SPI AND THE CURRENT USE LAW

INTRODUCTION

In 1974 the New Hampshire legislative session passed a long-awaited and hard-fought-for Current Use Assessment Law (RSA 79-A). The purpose of this legislation was in the interest of reducing the conversion of open space to more intensive use and encouraging preservation of open space through property taxation based on current use. In order to apply equitable tax assessment to all open land, the New Hampshire Department of Revenue (DRA) adopted the soil potential index rating system (SPI) developed by the USDA Soil Conservation Service in 1988. This system, which ranks the soils of New Hampshire based on their agricultural suitability, was originally established for use in a Land Evaluation and Site Assessment (LESA) system for use as a planning tool by resource conservationists, planners and city and town officials.

During the three years, from 1988 to 1991, this system of tax assessment was in place, a need became apparent to enhance certain criteria used to determine SPI to be more applicable to current use laws (1). With the Legislative Rules committee revising the definition of lands that fall under the current use law for the 1992 tax year, an incentive was provided to enhance the SPI rating system for that year as well.

The enhancement of the old system was conducted over an eight month period from October 1991 to May of 1992. Many of the basic principals developed in 1988 for the LESA system are still valid today for application in the soil potential index system and no attempt was made to adjust or revise this criteria. Many committees and groups of specialists were organized in 1988 to develop the initial ranking of soils and no effort was made during this enhancement to revise the work accomplished by these committees.

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(1) When the original SPI system was established, local agricultural experts were aware that new technology may require a change in the methodology used, or when the objective of the user changed considerably from the objective for which the ratings were assigned. Using SPI for current use assessment was such a change. Whereas the previous system was on a county wide basis, there was now the need to have the system on a State-wide basis. Where-as the previous system did not separate certain aerable upland till soils from valley soils, there was now a need to make more refined separations in these and other soils.

The determination of cost factors were a major part of the effort in 1988 using actual costs to overcome soil limitations and costs of reduced yields in less productive soils as a basis for ranking soils. Special committees of agricultural specialists were organized to handle this. For the purposes of this update to current SPI values, it is assumed that inflation over the past four years can be applied equitably for all soils and their limitations, therefore having no effect on the overall ranking of each soil. For this reason, no attempt was made to add an inflation factor for the cost of corrective measures or continuing limitations from what was determined in 1988.

DEFINITION OF SOIL POTENTIAL INDEX

The soil potential index (SPI) is a numerical rating of a soil's relative suitability for growing corn silage and grass legume hay in New Hampshire. These two crops were selected by agricultural specialists as being the two most representative crops grown in the state, from North to South and would be the best crops to use as indicators of a soil's ability to be farmed. Whether or not the soils in a particular region of the state are currently being used to grow such crops, all soils were evaluated equally on their agricultural potential if the soils were planted to these crops. The SPI is derived from indexes of soil production, cost of corrective measures, and the cost for continuing limitations. The SPI can be expressed by the equation: SPI = P - (CM+CL), where P is the index of production or yield capability, CM is the index of costs to apply corrective measures to overcome soil limitations and CL is the index of costs resulting from continued limitations.

These calculations are completed for soils using corn silage as the indicator crop, and completed a second time using grass legume hay as the indicator crop. The resulting two values are then averaged to arrive at the final SPI value. In order to array all of the soils in New Hampshire according to their agricultural potential, a yield production standard was determined and assigned an SPI value of 100. The advantage to setting a production standard at 100 is that the best agricultural soils in the state will have an SPI of 100 and all other soils arrayed in decending values. Ranking all soils from best to worst on a scale of 100 to 0, provides an easy to understand basis for comprehending relative suitability.

PRODUCTION STANDARD

The production standard was established and defined by a committee of agricultural specialists. The standard used in New Hampshire is that soil which has those soil properties that assure the highest yield. The standard soil for corn silage and grass legume hay is a well drained, moderately permeable soil that does not have rock fragments in the

surface layer. It is very deep to bedrock, has a high available water holding capacity, is on a slope of less than 3 percent, and has a mean annual temperature at 20 inches greater than or equal to 47 degrees F. (mesic). This combination of soil properties will produce the highest yields per acre and the soil has the capacity for sustained high production, year to year, with out applying any corrective measures under good management and without damaging the resource base. The production standard in New Hampshire assumes that the soil is intensively managed for corn silage or grass legume hay. Farming operations are timely, lime and fertilizer are applied according to soil analysis, and soil erosion is kept at or below the allowable soil loss value.

SOIL EVALUATION FACTORS

Seven soil evaluation factors are used to determine soil potential ratings. The evaluation factors include slope, available water holding capacity in the upper 40 inches, depth to bedrock, rock fragments in the surface layer, water table level, soil permeability, and mean annual soil temperature. Each of these factors may have detrimental effects that can impact the production of corn silage and grass legume hay in New Hampshire. Other soil factors were considered in the evaluation process such as flooding hazard, soil pH, and contrasting inclusions within soil map units. After lengthy review by a committee of agricultural specialists, it was determined these factors should not be used either because there is little overall impact on agricultural land, there is very little variation in New Hampshire soils and the incorporation of these factors into the evaluation process would add considerable complexity and the end result would not significantly change the overall ranking, or SPI, of the soil.(1)

CORRECTIVE MEASURES AND CONTINUING LIMITATIONS

Since the costs of corrective measures are total initial costs and costs resulting from continuing limitations are annual, economic analysis or amortization was used to derive a common basis for the corrective measures and continuing

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(1) Flood prone soils in New Hampshire do not normally flood during the growing season. Almost all of the soils in New Hampshire have similar soil reaction properties to 20 inches. Contrasting inclusions are expected components of every map unit; when assessing these inclusions for SPI, some have higher SPI values, some lower. After evaluating several map units based on type and extent of inclusions, it was determined that overall SPI ranking does not change appreciably from the SPI of the named soil.

limitations. Amortization is sometimes called the partial payment or capital recovery factor. This factor will convert capital or initial cost to annual cost. It will determine what annual payment including interest must be made to pay off the initial cost over a given number of years.

For soils with yields less than the standard, the lower yield was considered a continuing limitation equal to a factor representing the amount of yield that was below the standard. This was necessary to account for a lower yield that was not overcome by corrective measures.

A committee of landowners, contractors and specialists provided data on costs for corrective measures and for most of the continuing limitations. All of the assumptions and sources of information were documented so that individuals who use the ratings would understand that some of the measures are not absolute measures of performance.

Sloping land and high inherent erodibility (K) require measures to protect the soil against erosion. Protection can be provided through either no-till, a diversion system, stripcropping, or crop rotation. The local committee estimated the costs for these corrective measures with the basic intent that each measure would ensure that erosion did not exceed the allowable soil loss. Continuing limitations were identified as operation and maintenance costs and the cost resulting from reduced yields.

The cost for corrective measures for seasonal high watertable and soil permeability were estimated using the New Hampshire Soil Conservation Service Drainage Guide. Three permeability groupings were used to calculate costs. These costs reflect subsurface tile drainage systems that have closer spacing as the soil permeability becomes less. the continuing limitation costs were identified as maintenance costs for the tile drainage system and the cost resulting from reduced yields.

Current state and federal land use regulations pertaining to wetlands were not considered in the calculation of SPI for the following reasons. The new SPI values are based on soil physical properties only; land-use regulations do not affect a soil's potential or suitability for a given use. Land-use regulations are subject to change which could result in dramatic variations in SPI values whenever the legislature was so inclined. Most wetlands in New Hampshire are not farmed and are classified as wildlife habitat and do not fall under current-use laws. There are a few areas of farmed wetlands in New Hampshire and those that are farmed obviously have some agricultural value.

Rock fragments in the surface layer is a very common limitation in the upland glacial till soils in New Hampshire. The typical corrective measure is removal of the large fragments that hamper tillage operations. After the corrective measure is complete, there is a continuing limitation of operation of equipment because rock fragments continue to work their way to the surface by frost action. The continuing limitation of stones is more severe when the land is planted to corn rather than hay because of the wear and tear on tillage implements.

There are no feasible corrective measures for some soil limitations such as available water holding capacity and depth to bedrock. For these soils, costs are based on reduced yields and treated as a continuing limitation. Since irrigation is not a typical corrective measure in New Hampshire, no corrective measure is assessed for the available water holding capacity soil limitation. Soils with low or very low available water capacity yield less than the standard, therefore the reduced yield is a continuing limitation. No corrective action is feasible to alter the depth to bedrock therefore the cost of reduced yields is used as a continuing limitation.

There are no corrective measures for soil temperature. It has been documented, however, that soils with a mesic soil temperature regime (mean annual soil temperature greater than or equal to 47 degrees F.) have higher yields for crop production than soils with a frigid soil temperature regime occurring in slightly colder climates if all of the other soil evaluation factors and soil and site conditions remain the same. Therefore, delayed planting and reduced yield are considered a continuing limitation for soils that have a frigid soil temperature. Some soils, in the higher elevations in New Hampshire have a temperature regime cold enough to be considered unsuitable for cropland.

Some soil limitations such as steep slopes and extremely stony cover have no realistic corrective measure. A cost index is assigned as a continuing limitation for soils occupying these areas.

DERIVING CORRECTIVE MEASURES AND CONTINUING LIMITATIONS

Since amortization was used on the corrective measure cost, corrective measure costs are in effect annual costs. The continuing limitation costs are also annual costs. Therefore, the costs for calculating an SPI index are on an equal basis.

A committee of agricultural specialists accepted the "worst-case-scenario" to derive indexes whereby all of the costs for corrective measures and continuing limitations were summed for the soil map unit with the most soil limitations.

Tables 1A through 2F shows that a cost of $8.00 is equal to an SPI index of 1 for either corrective measures or continuing limitations. Any cost figure could have been used to represent 1 SPI index point. The $8.00 figure was chosen because it resulted in a workable spread of SPI values for all of the soil map units in New Hampshire; from 100 to 0.

DEVELOPMENT OF SOIL POTENTIAL RATINGS (SPI)

There are more than 1,700 different soil map units recognized in New Hampshire. All of the SPI ratings were calculated manually. Although the USDA Soil Conservation Service has a soil properties database that stores physical property data, some of the criteria used in the SPI calculations required expert decisions not currently possible with present day technology (1). This manual process was completed by the SCS soils staff in Durham, New Hampshire and forwarded to eight soil scientists around the state for review and cross checking. Each soil was compared against similar soils with similar properties to assure similar SPIs. Groups of soils occurring within small geographic areas were compared against one-another to assure reasonableness in the relative ranking. And all soils within a published soil survey area were reviewed for consistency and compatibility.

SPI WORKSHEETS

Tables 1A through 2F represent the worksheets used in determining SPI index points for corrective measures and continuing limitations. Tables 1A through 1G are applied to growing corn silage and tables 2A through 2F are applied to growing grass legume hay. Each table address the soil and site conditions, degree of limitation and effects on land use for a specific soil evaluation factor used in SPI determinations. The kind of corrective measure and continuing limitation is identified and the cost associated

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(1) Upland glacial till soils recognized as non-stony because the stones have been removed, cannot be easily separated in the database from soils that are inherently stone-free. Also, Tables 1A through 2F describe critical breaks in certain soil properties that are not easily decernable in the database. For example, available water holding capacity in the upper 40 inches of soil have critical breaks at 3.2 inches of water, 2.8 inches of water and 2.4 inches of water. Some of the soils recognized in New Hampshire are described as having a range that spans both sides of a critical break. In situations like this, the soil scientists researched actual field documentation and conferred on a decision to place this particular soil feature on one side of the critical break or the other.

with each. Finally, the SPI index value is listed which is determined based on 1 SPI index point for every $8.00 of cost as explained earlier in this report.

EXAMPLE SPI CALCULATION

Table 3 is an example of how an SPI is determined for a particular map unit. In this example, the map unit is Charlton fine sandy loam, 3 to 8 percent slopes, very stony. The SPI index points are determined for each soil evaluation factor.

This soil is well drained and has moderate permeability throughout. Therefore water table and permeability are not limitations and no SPI index points are assigned for growing corn or hay. Bedrock is deeper than 60 inches in this soil so no index points are assigned for this soil factor. The available water holding capacity is greater than 3.2 inches in the upper 40 inches of soil so this factor is not a limitation. The slope of this soil causes a slight erosion hazard when growing corn and has been assigned 2 SPI points for the corrective measure and 1 point for the continuing limitation. Erosion is not a hazard on these slopes if hay is grown and no index points are assigned. This map unit is very stony resulting in 18 SPI points for the corrective measure if growing corn and 5 points for the continuing limitation. Similar points are assigned for the corrective measure when growing hay but only 2 points are assigned for the continuing limitation. This is because stones in the surface layer are less of a limitation when growing hay versus cultivating corn. The mean annual soil temperature in Charlton soils is greater than 47 degree F and is not a limitation.

The resulting SPI index values are as follows: For growing corn silage, the corrective measure points total 20 and the continuing limitation points total 6. For growing grass legume hay, the corrective measure points total 18 and the continuing limitation points total 2.

Using the formula, the SPI for corn silage is: SPI = 100 - (20+6) or 74 The SPI for Grass legume hay is: SPI = 100 - (18+2) or 80. The two SPI values are averaged together and the resulting value of 77 is the final SPI rating for Charlton fine sandy loam, 3 to 8 percent slopes, very stony.

SPI AND PRIME FARMLAND

For many years, the USDA Soil Conservation Service has defined and identified prime farmland soils. These soils are considered to be the best soils for the production of food and fiber. Prime farmland soils in New Hampshire have a range in SPI ranking from 68 to 100 which gives the appearance of inconsistency when some prime farmland soils are rated at 100 and others only at 68. Although there appears to be an apparent conflict, one needs to keep in

mind the difference in the process used to arrive at the different ratings and what they mean.

The most significant difference between the two rating systems is that the economics of overcoming soil limitations and costs of continuing limitations are not factors in the determination of prime farmland, but is a major factor in determining SPI. Also, one needs to keep in mind that the SPI number assigned to any soil has no real meaning or value except to provide a relative placement among all soils in the state. The SPI rating system uses a much finer breakdown in soil physical properties than does the prime farmland rating system. For example, for a soil to qualify as prime farmland, the soil either "has no watertable, or has a watertable that is maintained at a sufficient depth during the growing season to allow cultivated crops common to the area to be grown".

In the SPI rating system, the water table factor is separated into eight divisions based on the severity of the limitation and any economic losses due to continuing limitations.

Based on the water table factor alone, prime farmland soils can have an SPI value ranging from 100 to 78. If one adds to this, the cost factor of removing stones from year-to-year, and subtracting points for frigid temperature regime, the SPI's for some prime farmland soils can drop into the low 70's or upper 60's.

SPI AND SOIL MAP SCALE

The USDA Soil Conservation Service recognizes three levels of mapping detail in New Hampshire, called mapping orders. Order 1 soil maps are the most detailed, produced at scales of 1:12,000 or smaller. Individual map units are one acre or less in size, depending on actual scale used. Order 2 soil surveys are medium intensity, completed at scales of 1:15,840, 1:20,000 or 1:24,000. All of the USDA soil surveys in New Hampshire have been completed at one of these scales with order 2 being the most common mapping intensity. The smallest soil map units range in size from 3 to 5 acres.

Order 3, or low intensity soil surveys are completed in remote, mountainous regions of Northern New Hampshire where the predominant land use is forestry related or for recreation. In New Hampshire the mapping scale in 1:20,000 or 1:24,000 and the smallest map unit is about 40 acres in size.

Currently, only the medium intensity, Order 2 soil surveys are being used to determine SPI values. The Order 3 soils mapping is too general and is not of sufficient detail to be used for the determination of SPI. There are very few areas in New Hampshire that are in farmland that were also mapped

at the Order 3 level. This situation will only occur where forestland, previously soil surveyed at the Order 3 level, was cleared and converted to cropland or pastureland. It is current SCS policy in New Hampshire to produce an Order 2 soil survey on any farmland, without this level of soil survey detail, before an SPI determination is made. The Soil Conservation Service will complete an Order 2 survey at no charge to the landowner.

The highly detailed Order 1 soil surveys are not conducted by the Soil Conservation Service in New Hampshire except for rare instances where detailed soils information is necessary to carry out the mandates of the Food Security Act. Order 1 mapping is not being used for SPI determination simply because soil surveys at this level of detail are not available.

Because Order 2 soil surveys show different soils only down to 3 to 5 acres in size, it is recognized some farmland in New Hampshire may have small areas of different soils that can affect SPI ratings that do not show up on the published soil survey. These are areas defined as contrasting inclusions within a soil map unit. They are typical and expected, but are too small to show on the soil map because of the cartographic limitations of map scale. These included soils are described in the narrative portion of the map unit located in the published report. Landowners that believe these conditions exist on his or her farmland, can acquire an Order 1 soils map of their land for a re-determination of SPI. Landowners need to keep in mind, however, that inclusions can have a higher SPI rating as well as lower and acquiring an Order 1 survey may not change the overall SPI rating and may even increase the SPI.

The Soil Conservation Service, being a federal agency, does not have the authority to carry out detailed Order 1 soils mapping on private land for the purpose of current use assessment. An Order 1 soil survey can be completed by a soil consultant, certified by the State of New Hampshire, if a land owner would like to have one completed on his or her property. There is a fee connected with this service, however, if the landowner's concerns are legitimate, the SPI should go down and costs for the Order 1 survey can be recovered over a period of time.

SUMMARY

This process of determining SPI has resulted in a consistently applied evaluation process that is scientifically sound and legally defensible. This is not to say that current SPI values will never need further refinement. As the soil science community continues to make technological advancements and expands the knowledge base from which soil behavioral characteristics are determined, there will most likely be a need to re-visit the current SPI system.

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 1A

Soil Use: Corn Silage

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES KIND	COST	INDEX	TYPICAL CONTINUING LIMITATIONS KIND	COST	INDEX
Water table level 1/ and permeability of subsoil and substratum	>3' (well drained)	Slight	None	None	-	-	None	-	-
	1.5-3' >6"/hr.	Moderate	Reduced vigor and yield	Subsurface tile drainage	$46	6	Reduced yield (1 ton)	$30	4
	1.5-3' 0.2-6"/hr.	Moderate	Reduced vigor, yield, aeration, and efficiency	Closer spacing of tile system	$69	9	Reduced yield (1 ton)	$30	4
	1.5-3' <0.2"/hr.	Severe	Reduced vigor, yield aeration, and root efficiency. Poor trafficability	Surface bedding system	$76	10	Reduced yield (2 tons) Maintain system	$60 $20	8 2
	0-1.5' >6"/hr.	Moderate	Reduced vigor and yield, very poor trafficability	Intensive subsurface tile drainage	$69	9	Reduced yield (2.5 tons)	$75	9
	0-1.5' 0.2-6"/hr.	Moderate	Reduced vigor, yield, aeration, and root efficiency, very poor trafficability	Closer spacing of tile system	$100	13	Reduced yield (2.5 tons)	$75	9
	0-1.5' <0.2"/hr.	Severe	Reduced vigor, yield, aeration, and root efficiency. Very poor trafficability	Surface bedding system	$114	14	Reduced yield (4.5 tons) Maintain system	$135 $20	17 2
	+1-0'	Severe	Reduced vigor and yields. Equipment limitations, very poor trafficability	No typical corrective measures	-	-	Wetness	-	100

1/ Only soils that are moderately well drained or wetter will normally need drainage. Water table level reflects that growing season (May 1 to September 1).

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 1B

Soil Use: Corn Silage

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES			TYPICAL CONTINUING LIMITATIONS		
				KIND	COST	INDEX	KIND	COST	INDEX
Depth to bedrock	>60"	Slight	None	None	-	-	None	-	-
	10-60" 1/	Moderate	Variation in root zone (AWC) and equipment limitations	None	-	-	Reduced yield (6 tons)	$180	22
	0-60" 2/	Severe	Variation in root zone (AWC) and equipment limitations	No typical corrective measures	-	-	Excessive bedrock outcropping, equipment operation	-	100

1/ Soil and site conditions for soil complexes that are shallow to very deep to bedrock.

2/ Soil and site conditions for soil complexes that have a rock outcrop component or are very rocky or are extremely rocky.

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 1C

Soil Use: Corn Silage

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES KIND	COST	INDEX	TYPICAL CONTINUING LIMITATIONS KIND	COST	INDEX
Available water capacity 1/	>3.2"	Slight	None	None	-	-	None	-	-
	2.4-3.2"	Moderate	Slightly droughty	None	-	-	Reduced yield (6 tons)	$180	22
	<2.4"	Severe	Droughty	None	-	-	Reduced yield (12 tons)	$360	45

1/ Total available water capacity to a depth of 40 inches or a root limiting zone.

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 1D

Soil Use: Corn Silage

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES KIND	COST	INDEX	TYPICAL CONTINUING LIMITATIONS KIND	COST	INDEX
Slope K factor <.28 1/	0-3%	Slight	None	None	-	-	None	-	-
	3-8%	Moderate	Erosion hazard	No till and/or diversion or stripcropping or crop rotation	$18	2	Operation and maintenance	$7.50	1
	8-15%	Moderate/Severe	Erosion hazard and equipment limitations	No till and diversion or stripcropping or crop rotation	$149	19	Operation and maintenance Reduced yield (2 tons)	$14 $60	2 8
	15+%	Severe	Erosion hazard, equipment limitations, and degradation of resource base	No typical corrective measures	-	-	Slope and equipment operations		100

1/ T/K = 12.5 for purposes of calculating corrective measures. Amortized costs reflect a no till/diversion system that does not exceed a T value of 3 on average slopes of 5 and 10 percent.

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 1E

Soil Use: Corn Silage

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES KIND	COST	INDEX	TYPICAL CONTINUING LIMITATIONS KIND	COST	INDEX
Slope K factor >.28	0-3%	Slight	None	None	-	-	None	-	-
	3-8%	Moderate	Erosion hazard	No till and/or diversion or strip cropping or crop rotation	$32	4	Operation and maintenance	$7.50	1
	8-15%	Moderate/Severe	Erosion hazard and equipment limitations	No till and diversion or strip cropping or crop rotation	$280	35	Operation and maintenance Reduced yield (2 tons)	$14 $60	2 8
	15+%	Severe	Erosion hazard, equipment limitations, and degradation of resource base	No typical corrective measures	-	-	Slope and equipment operation	-	100

1/ T/K = 9.375 for purpose of calculating corrective measures. Amortized costs reflect a no till/diversion system that does not exceed a T value 3 on average slopes of 5 and 10 percent.

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 1F

Soil Use: Corn Silage

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES KIND	COST	INDEX	TYPICAL CONTINUING LIMITATIONS KIND	COST	INDEX
Rock fragments in surface layer. Percent cover (>3 inches)	None	Slight	None	None	-	-	None	-	-
	Rock fragments present 1	Slight	None	Remove rocks	$16	2	Remove rocks Equipment operation	$24 $14	3 2
	Very Stony	Severe	Equipment limitations	Obstruction removal	$144	18	Remove Rocks Equipment operation	$24 $14	3 2
	Extremely stony	Severe	Equipment limitations	No typical corrective measures	-	-	Surface boulders, stones, and cobbles	-	100

1. This condition comprises areas cleared of stones in upland sites that have rock fragments in the surface layer on a year-to-year basis due to frost action.

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 1G

Soil Use: Corn Silage

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES KIND	COST	INDEX	TYPICAL CONTINUING LIMITATIONS KIND	COST	INDEX
Soil Temperature	Mesic	Slight	None	None	-	-	None	-	-
	Frigid	Moderate	Reduced vigor and yields	None	-	-	Delayed planting and reduced yields (1 ton)	$30	7

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 2A

Soil Use: Grass-Legume Hay

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES KIND	COST	INDEX	TYPICAL CONTINUING LIMITATIONS KIND	COST	INDEX
Water Table Level and Permeability of subsoil and substratum	>3' (well drained)	Slight	None	None	-	-	None	-	-
	1.5-3' >6"/hr.	Moderate	Reduced vigor and yield	Subsurface tile drainage	$46	6	Reduced yield (.5 ton)	$45	6
	1.5-3' 0.2-6"/hr	Moderate	Reduced vigor, yield, aeration, and root efficiency	Closer spacing of tile system	$69	9	Reduced yield (.7 ton)	$67	8
	1.5-3' <0.2"/hr	Severe	Reduced vigor, yield, aeration, and root efficiency. Poor trafficability	Surface bedding system	$76	10	Reduced yield (1 ton) Maintain system	$90 $20	11 3
	0-1.5' >6"/hr	Moderate	Reduced vigor and yield, very poor trafficability	Intensive subsurface tile drainage	$69	9	Reduced yield (1 ton)	$90	11
	0-1.5' 0.2-6"/hr	Moderate	Reduced vigor, yield, aeration, and root efficiency, very poor trafficability	Closer spacing of tile system	$100	13	Reduced yield (1.2 tons)	$108	13
	0-1.5' <0.2"/hr	Severe	Reduced vigor, yield, aeration, and root efficiency. Very poor trafficability	Surface bedding system	$114	14	Reduced yield (1.5 tons) Maintain system	$135 $20	17 2
	+1-0'	Severe	Reduced vigor and yields. Equipment limitations	No typical corrective measures	-	-	Wetness	-	100

Only soils that are moderately well drained or wetter will normally need drainage. Water table level reflects that depth in the growing season (May 1 to September 1).

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 2B

Soil Use: Grass-Legume Hay

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES			TYPICAL CONTINUING LIMITATIONS		
				KIND	COST	INDEX	KIND	COST	INDEX
Depth to Bedrock	>60"	Slight	None	None	-	-	None	-	-
	10-60" 1/	Moderate	Variation in root zone and (AWC)	None	-	-	Reduced yield	$145	18
	0-60" 2/	Severe	Variation in root zone and (AWC)	No typical corrective measures	-	-	Excessive bedrock outcropping, equipment operation	-	100

1/ Soil and site conditions for those maps that are shallow to very deep to bedrock.

2/ Soil and site conditions for those map units that have a rock outcrop component or are extremely rocky.

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 2C

Soil Use. Grass-Legume Hay

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES			TYPICAL CONTINUING LIMITATIONS		
				KIND	COST	INDEX	KIND	COST	INDEX
Available water capacity 1/	>3.2"	Slight	None	None	-	-	None	-	-
	2.4-3.2"	Moderate	Slightly droughty	None	-	-	Reduced yield	$135	17
	<2.4"	Severe	Droughty	None	-	-	Reduced yield	$225	28

1/ Total available water capacity to a depth of 40 inches or a root limiting zone.

SOIL POTENTIAL INDEX

DEFINITION: A NUMERICAL RATING OF A SOIL'S RELATIVE SUITABILITY FOR A GIVEN USE.

THE AGRICULTURAL SOIL POTENTIAL INDEX DEVELOPED FOR NEW HAMPSHIRE IS BASED ON:

1. SOIL PERFORMANCE LEVEL FOR PRODUCING CORN SILAGE AND GRASS LEGUME HAY
2. THE RELATIVE COST OF APPLYING PRACTICES TO MINIMIZE THE EFFECTS OF ANY SOIL LIMITATION.
3. THE ADVERSE AFFECTS OF CONTINUING LIMITATIONS.

SOIL POTENTIAL INDEX CAN BE DEFINED BY THE FORMULA:

$$SPI = \frac{100 - (CMC + CLC) + 100 - (CMH + CLH)}{2}$$

SPI = SOIL POTENTIAL INDEX

CMC = CORRECTIVE MEASURE NEEDED TO GROW CORN SILAGE
CLC = CONTINUING LIMITATION FOR GROWING CORN SILAGE

CMH = CORRECTIVE MEASURE NEEDED TO GROW GRASS LEGUME HAY
CLH = CORRECTIVE MEASURE NEEDED FOR GRASS LEGUME HAY

PRODUCTION STANDARD:

THE ACTUAL PRODUCTION CAPABILITY OF EACH SOIL IS COMPARED AGAINST A "STANDARD". THE STANDARD USED IN NEW HAMPSHIRE IS THAT SOIL WHICH HAS SOIL PROPERTIES THAT ASSURE THE HIGHEST YIELDS UNDER INTENSIVE MANAGEMENT PRACTICES WITHOUT THE NEED TO APPLY ANY CORRECTIVE MEASURES, OR HAVE ANY CONTINUING LIMITATIONS.

IN NEW HAMPSHIRE, THIS IS A SOIL THAT IS DEFINED AS FOLLOWS:

1. IS WELL DRAINED (SEASONAL HIGH WATERTABLE BELOW 3')

2. DOES NOT HAVE ROCK FRAGMENTS GREATER THAN 3" IN SIZE ON THE SOIL SURFACE.

3. HAS BEDROCK OCCURING DEEPER THAN 60 INCHES.

4. THE AVAILABLE WATER HOLDING CAPACITY IS GREATER THAN 3.2 INCHES WITHIN THE TOP 40 INCHES OF SOIL.

5. SLOPE IS LESS THAN 3 PERCENT

6. HAS A MEAN ANNUAL SOIL TEMPERATURE AT 20" GREATER THAN 47 DEGREES F.

7. THE SOIL PERMEABILITY RANGES BETWEEN .2 INCHES PER HOUR TO 6 INCHES PER HOUR IN THE UPPER 60 INCHES.

THEREFORE, EACH SOIL IN NEW HAMPSHIRE IS EVALUATED ON SEVEN FACTORS:

1. DEPTH TO WATERTABLE
2. STONYNESS
3. DEPTH TO BEDROCK
4. WATER HOLDING CAPACITY
5. SLOPE
6. SOIL TEMPERATURE
7. PERMEABILITY

United States Department of Agriculture
Soil Conservation Service
Federal Building
Durham, New Hampshire 03824

January 28, 1993

NEW HAMPSHIRE BULLETIN NO. 430-3-3

SUBJECT: SOI--Publication: "Soil Potential Index (SPI) for Current Use Assessment of Farmland in New Hampshire"

TO: All Field Offices, Carter Christenson, Gerald Lang, Steven Hundley

Purpose. To distribute publication and provide instructions on dissemination.

Expiration Date: When contents have been noted.

This bulletin transmits copies of "Soil Potential Index (SPI) for Current Use Assessment of Farmland in New Hampshire". This publication provides an explanation of what Soil Potential Index is, how it was derived, and its relationship to prime farmland and map scale.

A supply should be kept on hand at the field office and provided to interested landowners that have questions concerning how their SPI was determined. Community officials and others may also be interested. Additional copies should be printed locally.

Gerald J Lang

for DAWN W. GENES
State Conservationist

Enclosure
Soil Potential Index

DIST: F, SO

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 2D

Soil Use. Grass-Legume Hay

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES			TYPICAL CONTINUING LIMITATIONS		
				KIND	COST	INDEX	KIND	COST	INDEX
Slope	0.8%	Slight	None	None	-	-	None	-	-
	8-15%	Moderate	Equipment limitations	None	-	-	Reduced yield (.5 ton)	$45	6
	15-25%	Moderate	Equipment limitations	None	-	-	Equipment operation and reduced yield (1 ton)	$100	13
	25+%	Severe	Erosion hazard, equipment limitations, and degradation of resource base	No typical corrective measures	-	-	Slope and equipment operation	-	100

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 2E

Soil Use: Grass-Legume Hay

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES			TYPICAL CONTINUING LIMITATIONS		
				KIND	COST	INDEX	KIND	COST	INDEX
Rock fragments in surface layer	None	Slight	None	None	-	-	None	-	-
	Rock fragments present 1/	Moderate	Equipment limitations	Remove rocks	$16	2	Remove rocks	$16	2
	Very stony	Severe	Equipment limitations	Obstruction removal	$144	18	Remove rocks	$16	2
	Extremely stony	Severe	Equipment limitations	No typical corrective measures	-	-	Surface stones, boulders, and cobbles	-	100

1/ This condition comprises areas cleared of stones in upland sites that have rock fragments in the surface layer on a year-to-year basis due to frost action.

WORKSHEETS FOR PREPARING CORRECTIVE MEASURES
REVISED: JANUARY 1993

Table 2F

Soil Use. Grass-Legume Hay

Area: New Hampshire

SOIL EVALUATION FACTOR	SOIL & SITE CONDITIONS	DEGREE OF LIMITATIONS	EFFECTS ON USE	TYPICAL CORRECTIVE MEASURES			TYPICAL CONTINUING LIMITATIONS		
				KIND	COST	INDEX	KIND	COST	INDEX
Soil temperature	Mesic/Frigid	Slight	None	None	-	-	None	-	-
	Cryis (tops of mountains)	Severe	Too cold	None	-	-	Cold climate, short growing season	-	100

TABLE 3

MAP UNIT: 63B CHARLTON FINE SANDY LOAM,
3 TO 8 PERCENT SLOPES, VERY STONY

	CORN SILAGE		GRASS LEGUME HAY	
	CORRECTIVE MEASURE	CONTINUING LIMITATION	CORRECTIVE MEASURE	CONTINUING LIMITATION
WATER TABLE GREATER THAN 6'	0	0	0	0
SLOPE RANGE 3 TO 8 PERCENT	2	1	0	0
BEDROCK GREATER THAN 6'	0	0	0	0
AVAILABLE WATER CAPACITY: 4.8"	0	0	0	0
STONES COVER 1 TO 3 PERCENT OF THE SURFACE	18	5	18	2
SOIL PERMEABILITY .6 - 6.0 IN/HR	0	0	0	0
MEAN ANNUAL SOIL TEMPERATURE GREATER THAN 47 DEGREES F.	0	0	0	0
	20	6	18	2

$$SPI = \frac{100 - (20 + 6) + 100 - (18 + 2)}{2}$$

$$SPI = \frac{74 + 80}{2}$$

$$SPI = 154/2 = 77$$