Indiana Soils: Evaluation and Conservation (ID-72, 7/01; rev8/08)

Summary of rule changes

D. P. Franzmeier and G. C. Steinhardt

The changes in rules and the reasons for making them are summarized here. The rules are in Arial font (and blue on the screen) and in boxes. Changes in the text of ID-72 begin on page 4

AGRICULTURE

The following rules were revised. The scorecard does change. The Site card is also changed, but has no affect on the Agriculture contest.

~~A. Land capability class~~ - DELETED

~~Use Table 5 to determine **Land Capability Class**.~~

~~B. Land capability subclass~~ - DELETED

~~Determine **Land Capability Subclass** according to the following rules. Mark all subclasses that apply.~~
~~Mark **SUBCLASS "e"** YES for soils that have either:~~
~~1. slope of 3% or more, or~~
~~2. sandy or moderately sandy surface texture.~~
~~Mark **SUBCLASS "s"** YES for soils that have either:~~
~~1. 40 inches or less to any limiting layer, or~~
~~2. surface texture or subsoil texture that is sandy or moderately sandy.~~
~~Mark **SUBCLASS "w"** YES for soils that are either:~~
~~1. poorly or somewhat poorly drained, or~~
~~2. on floodplain or filled depression landforms.~~

~~C.~~ A. Prime farmland – No change

~~D.~~ B. High potentials for degradation

High potential for soil erosion by water

These soils meet the definition of Highly Erodible Land, which is based largely on slope and tolerable soil loss (T). T depends largely on soil depth, soil slope and depth to a limiting layer.

Mark **High potential for soil erosion by water** YES for soils that:
1. are 20 inches or less to any limiting layer and have slopes more than 2%, or
2. are more than 20 inches to any limiting layer and have slopes greater than **6%**.

High potential for surface water pollution

Soil erosion results in sediment which pollutes surface water. The amount of sediment produced depends greatly on slope, but little on the T factor, so soil depth is not part of the rule.

Mark **High potential for surface water pollution** YES for soils on slopes more than **6%**.

~~E.~~ C. Vegetation and buffer practices

Mark **Possible filter strips** YES for soils with both characteristics:
1. Outwash landform or floodplain landform or poorly drained, and
2. slope of 18% or less.

Filter strips are installed near streams and drainage ways, but many of the sites marked YES are not near streams and drainage ways. That is why the word Possible is in the name of the practice. Mark you answer according to the rules, but ask your instructor or official judge if the site is actually good for filter strips

~~F.~~ D. Tillage and cropping practices - No change
~~G.~~ E. Water management practices - No change
~~H.~~ F. Chemical and fertility practices

~~Mark **High herbicide rate** YES for soils with either of these combinations of properties:~~
1. ~~poorly or somewhat poorly drained, any surface texture, and dark surface color; or~~
2. ~~well or moderately well drained, medium, or more clayey surface texture, and dark surface color.~~

There are few herbicides still in use that are influenced by soil organic matter. Organic matter content may be an issue, but not enough to continue inclusion in the soils contest.

HOMESITE

Five rules are added. The scorecard and site card change.

Landscape and lawn practices

Growing acid-loving plants

This item shows the relationship between soil properties and horticultural practices. It uses pH information, as in Agriculture.

For **Acid-loving plant**s, choose:
1. **No pH adjustmen**t if soil pH is 5.6 or less.
2. **Acidify soil** if soil pH is 5.7 to 7.9.
3. **Plant other species** if soil pH is 8.0 or greater.

Lawn care

Many students are or will be taking care of lawns. Three items related to lawn care, especially soil fertility are added. The rules for P and K are the same as for agriculture.

Mark **pH adjustment**
Lime if pH is 5.9 or less.
No adjustment if pH is 6.0 to 7.5.
Acidify if pH is 7.6 or greater.

Mark **Phosphorus**
Apply if available P is less than 30 pounds per acre.
Do not apply if available P is 30 pounds per acre or more.

Mark **Potassium**
Apply if available K is less than 210 pounds per acre.
Do not apply if available K is 210 pounds per acre or more.

Pumping septic tanks

Many people who use septic systems do not know that their tank must be pumped periodically. This leads to many failures. This item reminds them that pumping is necessary. It is based on factors considered to be important.

The **Septic tank pumping interval** is calculated by the equation:

$$\text{Pumping Interval} = \frac{D \times (G/1000)}{R}$$

where
Pumping **I**nterval = pumping interval in years
D = 7 if Garbage **D**isposer is checked "yes" on site card. D = 10 if it is checked **"**No."
G = capacity of septic tank in **G**allons. In Soils Contests this will always be 1000
R = **R**esidents in the house.

Round your answer to the nearest whole number (round .50 down to be conservative, e.g., 3.50 years is rounded to 3), and select the closest option on the scorecard (one to six years).

CONDUCTING THE CONTEST

Delete and Add:

In second paragraph "Usually two sites are judged for Agriculture and Environment and two for Homesite."

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Changes in Chapter III. Soils, Agriculture, and Environment

Capability Classes *(Page 37-39. Text and rule change.)*

Delete and/or Add:
On page 37 in the first column modify the second sentence as follows: First, ~~the soil is classified according to capability for crop production. Then~~ the potential of the soil and water resources to be degraded is evaluated.
On page 37 in the first column below the paragraph on Capability Classes add as follows: the soil qualifies as prime farmland. Soils are classified relative to their capability class and subclass in many soil survey reports and other publications. Capability classes and subclasses and how they relate to soil properties are discussed below, but they are not a part of the soils contest.
On page 39 in the left hand column modify the heading as follows: Soil Evaluation Rules – ~~Capability Classes~~ Prime Farmland
Delete rule boxes for both Land Capability Classes and Land Capability Subclass on page 39.

Change Rule:
Delete rule box for both Land Capability Classes and Land Capability Subclass

Soil Erosion by Water *(Page 40. Text and rule change.)*

Delete:
On page 40 delete text from top of right hand column down to Soil Erosion by Wind.

Add:

Add the following in pace of the deleted paragraphs. All farming operations cause some soil erosion. The goal of soil management is to use farming practices that limit soil erosion to an amount that can be tolerated in the long term. Tolerable soil loss is represented by T in equations that deal with soil erosion (Fig. 21). T values vary from 2 tons per acre per year for shallow soils to 5 tons per acre per year for some deep soils of Indiana (Chapter VI). This means that shallow soils must be farmed more carefully than deep soils in order to keep soil productivity high for the long term.

U. S. government agencies have defined Highly Erodible Land (HEL), and have said that farmers must use soil conservation practices on HEL to qualify for certain farm programs. The definition of HEL depends greatly on slope gradient (S in soil loss equations, Chapter VI) and tolerable soil loss (T). This is reflected in the rule below. Check with the local Soil and Water Conservation District for details about current government programs.

Change Rule:
In rule box, add "are 20 inches or less to any limiting layer and have slopes more than 2%, and change 12% to 6%.

Mark **High potential for soil erosion by water** YES for soils that:
1. are 20 inches or less to any limiting layer and have slopes more than 2%, and
2. are more than 20 inches to any limiting layer and have slopes more than 6%.

Soil Erosion by Wind *(Page 40. Part of text changes. The rule does not change.)*

Delete: *(Last part of paragraph above rule box.)*
On page 40 delete the last sentences of the paragraph on the column headed Soil erosion by Wind as follows: ~~For soil evaluation, the potentials for soil erosion by wind are: LOW: soils in which drainage is poor or somewhat poorly, and surface texture is clayey or moderately clayey. MEDIUM: Soil is not rated HIGH or LOW.~~

Add:
In place of the deleted sentences add this sentence: For soil evaluation, soils with high potential for erosion by wind are identified by surface texture.

Soil Compaction

(Page 41. Part of text changes. The rule does not change)

Delete: *(Eight lines of text above rule box)*:
On page 41, on the left hand column above the rule box delete the following: ~~Very few Indiana soils have low potential for compaction. . . .Soil that is not rated HIGH or LOW~~.

Add:
Add in place of the deleted sentences the following: For soil evaluation, soils with high potential for compaction are identified by natural drainage and surface texture.

Surface water pollution *(Page 42. Some text changes. The rule changes.)*

Delete: (*Seven lines of text above rule box*.)
On page 43 delete the following sentences in the left hand column above the rule box: ~~LOW: All soils on 0% to 2% slopes, and soils on . . . . texture is medium or moderately clayey.~~

Change Rule:
In rule box, change 12% to 6%.

Mark **High potential for surface water pollution** YES for soils on slopes more than 6%.

Filter Strips

Change Rule:
On page 45, in rule box, add the word "Possible" to "filter strips."

Mark **Possible filter strips** YES for soils with both characteristics: 1. Outwash landform or floodplain landform or poorly drained, and 2. slope of 18% or less.

High herbicide rate

Change Rule:
On page 60 delete rule box for High herbicide rate.

Landscaping and Lawn Practices (*Insert on page 72, above* Homesites with Onsite Disposal Systems

Landscaping: Growing acid loving plants

Some landscaping and garden plants, such as azaleas, rhododendrons, blue hydrangeas and blueberries grow best in acid soil. For azaleas and rhododendrons the optimum pH is about 5.5, with a range of 4.5 to 6.0. Blueberries prefer a soil pH of around 4.0 to 5.0. In general, hydrangeas are pink in alkaline soil and blue in acid soil. Blue hydrangeas require a pH of about 5.0 for good color. The pH of many soils can be adjusted to meet the pH requirements of these plants. Soil pH is raised by adding lime (see agriculture practice section).

Acidifying soils

Several soil amendments acidify soil and decrease soil pH. Nitrogen fertilizers containing ammonia compounds (NH_3, NH_4) and urea [$(NH_2)_2CO$] reduce soil pH over a period of years whether or not acidification is desired. Ammonia is converted to nitric acid (HNO_3) by nitrifying bacteria:

$$NH_3 + 2O_2 \rightarrow HNO_3 + H_2O.$$

Nitric acid makes the soil more acid. Soils used for crop production are generally heavily fertilized with ammonia compounds and thus need to be limed periodically.

Soils can also be acidified by adding sulfur (S). Sulfur is converted to sulfuric acid (H_2SO_4), also by microbial action:

$$2S + 3O_2 + 2H_2O \rightarrow 2H_2SO_4.$$

Sulfuric acid also makes the soil more acid. This reaction takes several weeks because microbial populations must be built up to carry it out.

Many soils can be acidified to grow acid loving plants. Some soils, however, contain lime ($CaCO_3$), which must be dissolved before the soil can be acidified. These soils usually have pH values of 8.0 or higher. Acidifying these soils could require much sulfur and take a long time. It may be more practical to choose species that do not need acid soil, as reflected in soil evaluation rules.

Soil evaluation rule

For **Acid-loving plants**, choose:
1. **No pH adjustment** if soil pH is 5.6 or less.
2. **Acidify soil** if soil pH is 5.7 to 7.9.
3. **Plant other species** if soil pH is 8.0 or more.

Lawn care

This section is based largely on three extension bulletins of the AY series, listed at the end of the section. Detailed information about lawn care in Indiana is available in these and several other several extension bulletins. This section emphasizes practices that depend on soil properties.

General practices

Turf experts say that improper mowing causes more problems on lawns than any other maintenance practice. Most lawns are mowed too short, not often enough, and/or with a dull blade. Mowing height depends on grass species, but most common species grown in Indiana (except zoysia) should be mowed at 3.0 to 3.5 inches, and longer in shaded areas. Lawns should be mowed frequently enough so as not to remove more than 1/3 of the leaf blade in a single mowing, Also mower blades should be sharpened four to six times a year. It is recommended that usually clippings should be left on the lawn instead of bagged and removed.

Plant Nutrition and Soil Fertility

Plants require 18 elements to grow and complete their life cycle. Nine are called *macronutrients* because plants require fairly large amounts of them. Three macronutrients -- carbon (C), hydrogen (H), and oxygen (O) -- come mainly from air and water. Six macronutrients -- nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and sulfur (S) -- come mainly from the soil. Plants also require small amounts of nine *micronutrients* -- iron (Fe), manganese (Mn), etc.

In Indiana, there is either enough Ca and Mg in the soil to supply plant needs or the elements are added by liming. Usually much of the N, P, and K needed by plants is supplied by fertilizer. All fertilizers have three numbers on the label that represent the percentages of N, P, and K in the bag. For example, a fertilizer labeled 24-4-8 contains 24% N, 4% P_2O_5 and 8% K_2O. Many lawn fertilizers also contain some sulfur and micronutrients, as shown on the label.

It is best to fertilize lightly in spring and early summer, little or none in summer, and heavy in fall. In the fall, soil temperature is high relative to air temperature which encourages growth of roots more than growth of leaves. A vigorous root system benefits the plants through subsequent growing seasons.

The amount of **nitrogen** (N) fertilizer to apply depends mainly on the over-all lawn management level the homeowner chooses to use. The maximum program is for homeowners who want the greenest lawn, and are also willing to devote considerable time to mowing and irrigation. The minimum program is for those who are satisfied with a less attractive lawn. In the minimum program, N is applied only in September, and in the maximum program, N is applied four times a year.

Nitrogen fertilizers come in two basic forms: quick release (soluble) nitrogen and slow release (insoluble) nitrogen. Quick release nitrogen normally causes a response in a

week or less, whereas slow release nitrogen will cause a response in three to 10 weeks or more. Quick release nitrogen is inexpensive and may burn leaf blades if applied improperly. Slow release forms tend to be more expensive but will rarely burn leaf blades even when applied at temperatures above 85^{o}. Both N forms can and should be used on lawns. Both forms of N are often blended in one fertilizer bag. This is advantageous because the quick release N gives a response shortly after application and the slow release N results in a more gradual and longer response. Quick release forms of N are urea, ammonical N (NH_4), and ammonium nitrate (NH_4NO_3). Slow release forms include sulfur coated urea, polymer coated urea, methylene ureas, and natural organics.

The best way to determine how much **phosphorus (P)** and **potassium (K)** to apply is to do a soil test. The recommended application rates are given in Table 1.

Table 1. Recommended annual P and K applications for established turf based on soil test results. (AY-18).

Management level	Phosphorus (P)		Potassium (K)	
	Soil test results	Application rate	Soil test results	Application rate
	lb. P/acre	lb. P2O5/ 1000 ft2	lb. K/ acre	lb. K2O/ 1000 ft2
Very low			0-50	6
Low	0-25	3	51-100	4
Normal	25-50	2	101-150	2
High	51+	1	151-200	1
Very high			200+	0

Bulletin AY-18 gives more details about P and K applications. The soil testing limits above which little or no fertilizer is applied to lawns are similar to those used in agriculture. Therefore, for soil evaluation the same rules are used.

Soil pH adjustment

Turf grass tolerates a fairly wide pH range. Turf specialists consider a pH between 6.0 and 7.5 to be optimum for grass growth. If soil pH is less than 6.0, they recommend lime application. Lime increases soil pH and supplies calcium and usually magnesium to the soil. If soil pH is more than 7.5, they recommend increasing the fertilizer application rate by 25%. The extra N promotes soil acidification. Also, many micronutrients (e. g., iron and manganese) are less available to plants at high soil pH than at low pH. The extra fertilizer may contain some of these micronutrients.

Extension Bulletins

The following Purdue University extension bulletins were used extensively in this section. All are by Zac Reicher and Clark Throssel.

AY-8. Mowing, Thatching, Aerifying, and Rolling Turf.

AY-18: Soil Testing for Lawns.

AY-22: Fertilizing Established Lawns.

Soil Evaluation Rules -- Lawn Practices

Mark **pH adjustment**
Lime if pH is 5.9 or less.
No treatment if pH is 6.0 to 7.5
Acidify if pH is 7.6 or greater.

Mark **Phosphorus**
Apply if available P is less than 30 pounds per acre.
Do not apply if available P is 30 pounds per acre or more.

Mark **Potassium**
Apply if available K is less than 210 pounds per acre.
Do not apply if available K is 210 pounds per acre or more.

Septic tank pumping interval

(*Insert on page 92 above the heading*, **Reducing the flow of wastewater)**
Note: The text just above this insert will need slight revision. It says two factors are important rather then the three used in the rule (It mentions, but does not count, the number of people.)

For soil evaluation, three factors are considered in determining the interval at which a septic tank should be pumped: Number of residents living in the home, size of septic tank, and whether or not a garbage disposer is used. This information is given on the site card.

The **Septic tank pumping interval** is calculated by the equation:

Pumping **I**nterval = $\frac{\mathbf{D} \times (\mathbf{G}/1000)}{\mathbf{R}}$

where
Pumping **I**nterval = pumping interval in years
D = 7 if Garbage **D**isposer is checked "yes" on site card. D = 10 if it is checked **"**No."
G = capacity of septic tank in **G**allons. In Soils Contests this will always be 1000
R = **R**esidents in the house.

Round your answer to the nearest whole number (round .50 down to be conservative, e.g., 3.50 years is rounded to 3), and select the closest option on the scorecard (one to six years).

Example calculations:

A. Four people, garbage disposer, 1,000 gallon tank

$$I = \frac{D \times (G/1{,}000)}{P} = \frac{7 \times (1{,}000/1{,}000)}{4} = 1.75 \text{ years}$$

Nearest answer is 2 years, **B,** on scorecard.

B. Five people in family, garbage disposer in kitchen, 1,000 gallon septic tank.

$$I = \frac{7 \times (1{,}000/1{,}000)}{5} = 1.4 \text{ years}$$

Check **A** (one year) on scorecard.

C. Three people, no garbage disposer, 2,000 gallon tank.

$$I = \frac{10 \times (2{,}000/1{,}000)}{3} = 6.7 \text{ years}$$

Rounds to 7 years, but the nearest answer on the scorecard is 6 years

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Chapter V. Soil Evaluation Contests and Resources

Conducting the Contest *(page 96)*

Delete and Add:

In second paragraph "Usually two sites are judged for Agriculture and Environment and two for Homesite."