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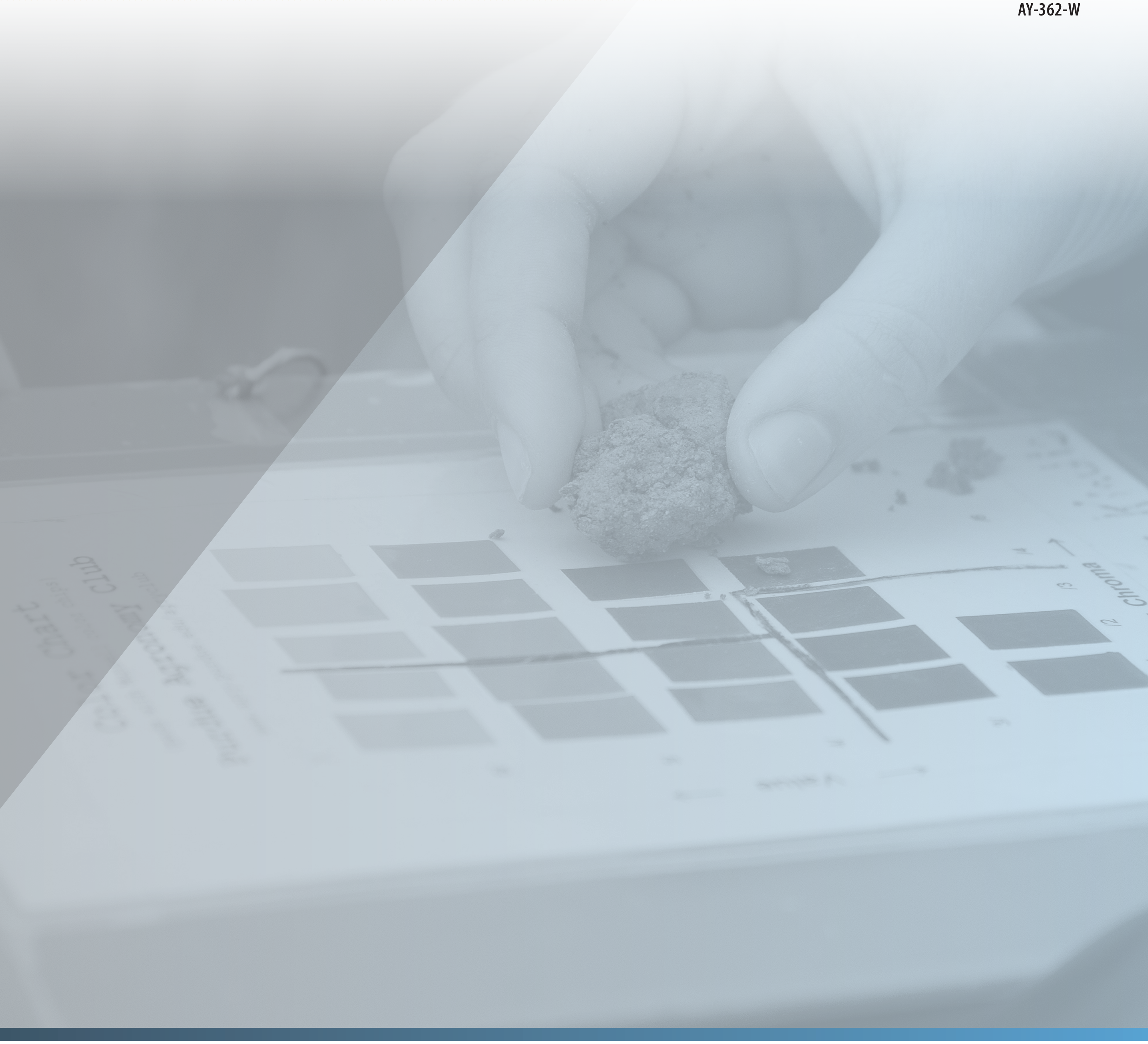

INDIANA SOIL Evaluation Field Book

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PREFACE

First, evaluate soil properties. Then judge which practices are most suitable for that soil.

That's how soil management professionals do it. Students should use the same process: Evaluate (determine the quality of something), then judge (form an opinion after careful thought).

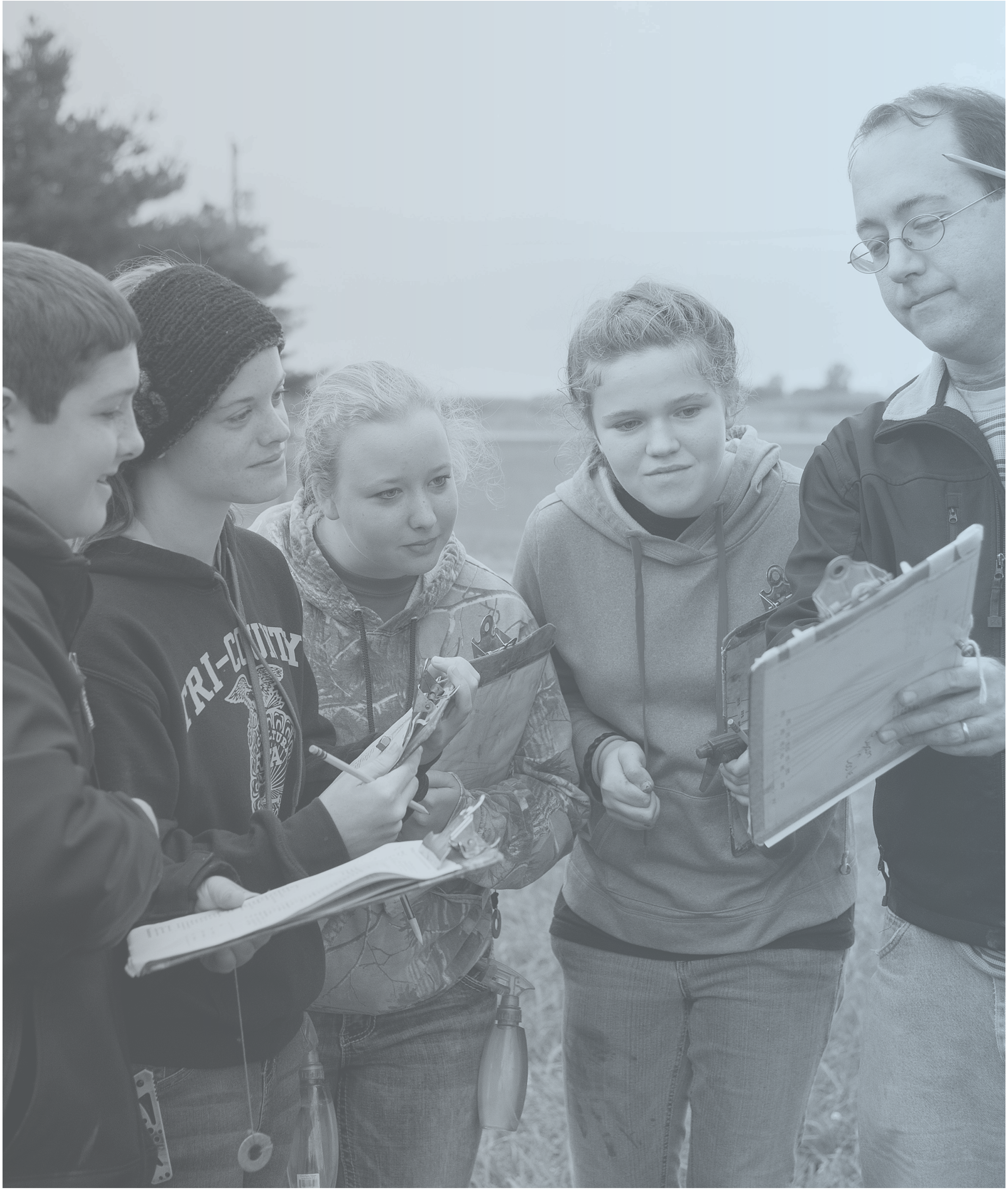
The "after careful thought" part of the definition of "judge" lies behind the soil contest rules described in this field book, which features input from many agriculture science teachers.

The first chapter emphasizes evaluation. The second and third chapters cover soil judging rules and the logic behind them.

The basic publication for teaching soil science and conducting soil judging contests is *Indiana Soils: Evaluation for Agriculture and Home Sites*. It contains a state soil map, more in-depth explanations, and many photos, figures, and tables. It is referred to in this book as *Indiana Soils*.

This field book is a condensed version of *Indiana Soils*. We intend for students to take this book into the field and use it to prepare for soil contests. We encourage students to study *Indiana Soils* to better understand what they do in the field and why they do it.

Both publications will be available from the Purdue Extension Education Store, www.edustore.purdue.edu, 765-494-6795.



CHAPTER 1 — Soil Formation, Soil Properties, and Soil Evaluation

Overview of Landscapes and Soils

Most people who read this Field Book will go outside to observe landscapes and examine soil profiles. Many Indiana **landscapes** can be divided into uplands, terraces, and bottomlands. Visualize a sidewalk leading to a porch with one step in between. The porch illustrates an **upland**, the step illustrates a **terrace**, and the sidewalk illustrates a **bottomland** (or flood plain). Landscapes will be discussed in more detail later.

Soil profiles are vertical exposures of the upper 4 feet or so of the soil. You will soon learn that soils differ greatly from place to place. You will also learn that soils differ greatly as you dig deeper — you will see distinct bands or layers of soil that are called **soil horizons**. This chapter provides a brief glimpse of why they differ.

Indiana Soils: Evaluation for Agriculture and Home Sites (Purdue Extension publication ID-72) provides more information about Indiana soils. We will refer to this publication as the *Indiana Soils* for the rest of this book.

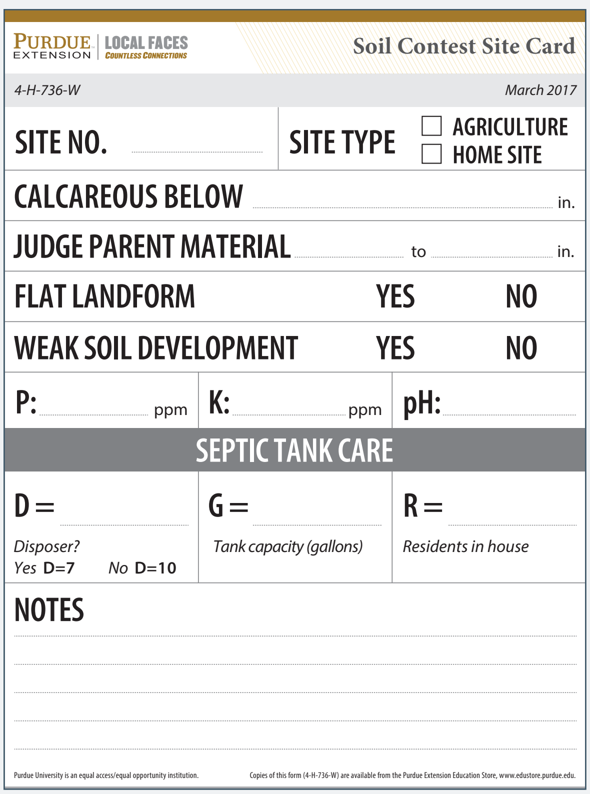
Overview of Soil Evaluation and Judging

In soil competitions, there are several things, described below, that each student should be aware of.

Site Card

At each soil pit used in soil evaluation contests, there will be a **site card** posted on a sign board. The site card (Figure 1 and available on page 45) provides this information:

- Site number
- If the site is to be judged for agriculture, home sites, or both
- Depth at which to evaluate the parent material
- Official judges' decisions about landform and weak soil development
- Soil fertility information
- On-site sewage disposal system information (for home sites)
- Optional notes



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Soil Contest Site Card

4-H-736-W March 2017

SITE NO. .... SITE TYPE ☐ AGRICULTURE ☐ HOME SITE

CALCAREOUS BELOW .... in.

JUDGE PARENT MATERIAL .... to .... in.

FLAT LANDFORM YES NO

WEAK SOIL DEVELOPMENT YES NO

P: .... ppm K: .... ppm pH: ....

SEPTIC TANK CARE

D = ... Disposer? Yes D=7 No D=10

G = ... Tank capacity (gallons)

R = ... Residents in house

NOTES

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Figure 1. *A sample of a soil contest site card. For a full-size version of the site card, see page 45.*

Rules

Rules are key elements in soil judging and evaluation. Soil property rules summarize what a soil evaluator sees in the field. Soil practice rules summarize what research and experience tell us about which practices should be used based on soils with certain properties. Decisions based on rules are recorded on scorecards.

Scorecards

Depending on the competition, you will complete an agriculture scorecard (see page 47), a home site scorecard (see page 48), or both. The soil properties (on the left side) are the same for both cards. The soil practices (on the right side) differ.

Specific properties and practices are identified by a number-letter system. Circle your answers on the scorecard. For example, if you chose a dune landform, circle 6D. If your answer for No-till is Yes, then circle the A after 27 (27A). This system is compatible with electronic grading. If a contest uses electronic grading, then organizers will provide further instructions.

Time at Site

At each soil pit, you will be told how much time you have for evaluation. Contestants rotate among a number of pits.

Critique Session

After you have completed your evaluations and all competitors submit their scorecards for grading, the official judges will give their answers in the pit. They will also answer questions about properties and practices. We encourage you to actively participate in these sessions to help you improve in future contests.

Soil Horizons

The soil profile that you see in a soil pit usually has three main sets of horizons, from the top down:

1. A and E horizons (surface soil)
2. B horizons (subsoil)
3. C and R horizons (substratum)

A Horizons

The mineral layers near the soil surface are called **A horizons**. They contain dark humus mixed with mineral material. Humus is a kind of organic matter (material derived from plants and animals and contains much carbon). Under forest vegetation the A horizon is only a few inches thick. Under prairie grasses, or in depressions, the A horizon can be 10 to 25 or more inches thick. The A is usually the darkest of any horizon in the soil.

Within the A horizon category is designation Ap, which is given to soil that has been mixed by plowing or cultivation. Ap horizons consist mostly of the A horizon, the A and E, or in eroded soils, the remaining A and part of the upper B horizons.

E Horizons

Soils developed under forests commonly have **E horizons** a few inches below the surface. An E horizon is lighter in color, lower in organic matter, and less fertile than an A horizon. Clay, aluminum, iron, and some nutrients have been washed out of or leached from the E horizon.

B Horizons

The mineral layers below A and E horizons are called **B horizons.** They are also referred to as the subsoil. B horizons have one or more of these characteristics:

- An accumulation of clay (more clay than in horizons below the B)
- Prismatic or blocky structure (arrangement of soil material into geometric forms such as blocks)
- Reddish or brownish color (more of these colors than in deeper horizons)
- Weak cementation, resulting in brittle material.

These features are described and explained in *Indiana Soils*.

C Horizons

Materials that cannot be designated as A, E, or B horizons because they lack soil development are called **C horizons**, or substratum. C horizons can be weathered rock, or they can be material that was moved by ice, water, or wind. In many soils, the C horizon is similar to the material from which the overlying horizons formed.

R Horizons

The **R horizon** is consolidated (hard) bedrock, such as limestone, sandstone, or shale. In Indiana, the depth to bedrock varies from a few inches to several hundred feet.

Degree of Soil Development

The C horizon has changed little since the material was deposited, but the A and B horizons have changed significantly. These changes are called soil development. One criterion used to help identify the kind of soil parent materials is the degree of soil development.

Most parent materials (till, outwash and lacustrine deposits, eolian sand, loess, and weathered bedrock) have been in place for a relatively long time, and the soils formed from these parent materials have **normal soil development**, usually shown by B horizons that are much different from C horizons. In contrast, alluvium has been in place a much shorter time and the soils formed in alluvium have **weak soil development**.

Because weak soil development grades by small changes into normal soil development, official judges will circle "Yes" for "Weak soil development" on the site card if the soil in the parent material zone has weak development. They will circle "No" if the soil has normal development.

Soil Properties

Each soil evaluation scorecard will ask you for information about various soil properties, including:

- Kinds of parent materials
- Slope
- Landforms
- Soil color
- Previous erosion
- Soil texture
- Natural soil drainage
- Limiting layers

Each of these properties are discussed later in this book. The terms soil texture and soil color are used often in this book, before they are described in detail. Texture refers to the size of particles (sand, silt, and clay) in a soil sample, and results in the sample feeling gritty, smooth, sticky, etc. Texture is discussed in more detail on pages 16-18. Color is discussed on pages 14-15. If you do not have a general concept of texture and structure, you might read those sections, and then come back to this section.

Parent Material

Parent material is the material from which soil horizons formed. The site card lists the depth at which to determine the kind of parent material.

The challenge for the soil evaluation participant is to recognize a certain parent material in different horizons. Other than soil properties, there are other factors that can help you determine the kind of parent material:

- **Where you are in the state.** Glacial till (deposited by ice), for example, is a common parent material in the northern part of the state and weathered bedrock is common in the south. Deep loess (deposited by wind) is common east of major rivers. For more information about the location of different parent materials, see *Indiana Soils*.
- **Where you are in the local landscape.** Till and weathered bedrock are common on the highest part of the landscape: uplands. Outwash (deposited by water) is common on intermediate areas: terraces. Alluvium is common in the lowest areas near streams: bottomlands.
- **What you see around the soil pit.** Rounded stones and boulders are typical of till. Box- and book-shaped stones (which are rectangular in cross-section) and boulders with sharper edges and corners are typical of bedrock.

Parent material changes greatly as it forms soil horizons. Understanding these changes will help you recognize why a certain kind of parent material looks different in different parts of a soil profile. Understanding the degree of change will also help you to identify alluvium and local overwash parent materials, as well as flood plain landforms.

The parent materials identified in soil evaluation are:

- Weathered bedrock
- Till
- Outwash and lacustrine deposits

- Eolian sand
- Loess
- Alluvium
- Local overwash
- Other parent materials

WEATHERED BEDROCK

When physical and chemical processes break down bedrock, it is transformed into **weathered bedrock**. All parent materials have been weathered from bedrock to some extent, but here, the term "weathered bedrock" refers to materials that have stayed essentially in place (residuum) or moved downslope and collected at the base of a slope (colluvium). Weathered bedrock usually contains fragments of sandstone, siltstone, shale, limestone, or chert. These fragments are usually flat and may have sharp edges and corners.

By contrast, other parent materials (such as till and outwash) were transported greater distances, so the pebbles in them are more rounded. The corners and edges were knocked off during transport. Also, many of the pebbles in till and outwash are from **igneous** rocks instead of **sedimentary** rocks (see *Indiana Soils* or ask your instructor about the differences between these kinds of rocks). The texture of weathered bedrock varies widely, depending on the size of particles in the original rock.

Other parent materials can be defined more specifically, so weathered bedrock can also be identified by what it is not.

> **EVALUATING RULE**
> **Weathered Bedrock**
>
> **Weathered bedrock** (including bedrock) has one or more of the following characteristics:
>
> - More than 80 percent of the material in the diagnostic zone is so hard that roots will not grow into it (qualifies as bedrock limiting layer).
> - Less than 80 percent of the material is hard, but sedimentary rock fragments are mainly angular, flat, or both.
> - The parent material does not meet the definition of another parent material.

TILL

Till is parent material that was deposited directly by glacial ice. The glacier, up to a few thousand feet thick, ground up the bedrock as it advanced. The glacier then transported that ground material and deposited it mainly in the central and northern parts of the state.

Till was derived mostly from nearby bedrock, but some came from more distant sources. For example, the igneous pebbles and boulders (granite, etc.) in the till must have come mainly from Canada, because all of Indiana is underlain by sedimentary rocks. Glacial pebbles are more rounded than the rock fragments in weathered bedrock, because they were worn down while being pushed along under (and in) the ice.

Till consists of a mixture of clay, silt, sand, and usually coarser fragments. Most tills have medium (loam) or moderately clayey (clay loam or silty clay loam) textures. In Indiana, all till was calcareous.

Calcareous means that the till contains carbonate minerals, such as calcium carbonate ($CaCO_3$) also called lime. These minerals came from the limestone bedrock the glaciers ground up.

Most of the glacial tills in Indiana contained around 20 to 40 percent of carbonate minerals when they were deposited. When the A and B horizons formed, the carbonate minerals were dissolved, and the carbonates were leached out of the upper soil profile.

However, not all calcareous materials are till. Other materials, such as outwash, loess, or alluvium may also be calcareous. The site card in each soil pit notes the upper depth to calcareous material. The tills in Indiana were deposited by glaciers that were hundreds of feet or even a few thousand feet thick. The weight of the ice compressed or compacted the till to a very high density. Till with high bulk density (weight/volume) is called **dense till** and is considered to be a limiting layer for soil evaluation.

Most of the volume of dense till is solid particles; little is pore space. Since roots grow through soil pores, soil horizons with few pores also have few roots. Quite often dense till breaks apart into a platy structure, with plates around 1/8 to 1/2 inch thick. This structure was probably formed when the till was deposited rather than through later soil forming processes. In such till the vertical cracks between plates are offset (like bricks in a wall) so that after a root grows down through one vertical crack, it must grow sideways to find another downward crack. This greatly restricts root growth.

> ▶ **EVALUATING RULE**
> **Till**
>
> **Till** has all of these characteristics:
>
> - Till is directly deposited from glaciers. It is a mixture of sand, silt, clay, and coarser material. There is no stratification.
> - Pebbles, if present, are mainly igneous, but in some areas, there is a mixture of underlying sedimentary rocks incorporated. Pebbles are usually rounded and randomly distributed.
> - Till can be weathered (non-calcareous) or unweathered (calcareous).
> - Unweathered till may have platy structure; weathered till does not.
> - Common texture and color combinations found in unweathered till:
>   - Medium texture (loam) and brownish color (10YR 5/4, 5/6, 5/3) **or**
>   - Moderately clayey texture (clay loam, silty clay loam) and near the brownish/gray color boundary (10YR 5/3, 5/4, 5/2)

OUTWASH AND LACUSTRINE DEPOSITS

When the ice that deposited till melted, the meltwater carried away a lot of gravel, sand, silt, and clay. The meltwater flowed very rapidly when it first left the glacier, but as the streams spread out, they slowed down. This allowed the sand and gravel to settle out as material called **outwash**.

Outwash contains very little silt and clay, and generally is stratified (layered). However, in some materials (especially coarse sand and gravel) the layers are so thick that only one may be visible in a soil pit.

In some places, meltwater streams flowed into lakes. In the still water of the lake, the fine material (such as silt and clay) gradually settled out. Streams that flowed into lakes, however, also carried coarser material (sand) that immediately settled out. Thus, these lake or **lacustrine deposits** contain much silt and clay, but may also contain sand near the edges. Outwash and lacustrine deposits grade into each other and, therefore, are not separated in high school soil evaluation.

According to soil evaluation guidelines, all outwash and lacustrine parent materials must be stratified except material that qualifies as a coarse sand and gravel limiting layer. "Stratified" means that material in the parent material identification zone consists of layers that are visibly different from each other.

> ▶ **EVALUATING RULE**
> **Outwash and Lacustrine Deposits**
>
> **Outwash and lacustrine deposits** have all of these characteristics:
>
> - Pebbles, if present, are mainly rounded and occur in layers (stratified)
> - Material is either:
>   - In the sandy texture group, and the sands are mainly > 0.5 mm in diameter (qualifies as a coarse sand and gravel limiting layer if it is thick enough), **or**
>   - In any texture group and is stratified (consists of layers that are clearly visible)
> - If official judges determine the parent material is outwash or lacustrine material, but the profile does not show clear stratification, or the material is not coarse sand and gravel, officials will give the parent material on the site card.

EOLIAN SAND

When the glaciers melted, it caused great floods on the ancient floodplains that are now terraces. During the winters, the melting slowed, resulting in the plains becoming barren mud flats. Wind blowing over the barren flats picked up certain particles and carried them away. The large materials (coarse sand and gravel) mainly stayed in place.

The medium-sized materials (fine and medium sand) moved by skips and jumps. Eventually this process accumulated piles of wind-transported **eolian sand** into hills called dunes. Fine and medium sands are 0.1 to 0.5 mm in diameter. They can be identified by comparing the sand from a soil pit with two grits (sizes of sand particles) of sandpaper. Eolian sand is not stratified, but it often has thin bands called lamellae that contain slightly more clay and are redder than the material around them. *Indiana Soils* has photographs of lamellae in eolian sand.

> ▸ **EVALUATING RULE**
> **Eolian Sand**
>
> **Eolian sand** has all of these characteristics:
>
> - Sandy or moderately sandy texture at the surface
> - No gravel or pebbles present in the profile
> - Sand grains are mainly fine and medium sand, 0.1 to 0.5 mm in diameter (between 150-grit and 40-grit sandpaper)
> - Not stratified, but may have lamellae that are sandy or moderately sandy in the subsoil. Some soils formed in eolian sand may have moderately clayey subsoil texture

LOESS

As the wind blew over the barren flats of terraces and outwash plains left by retreating glaciers, the wind also picked up silt-size grains. Silt particles are smaller than sand, so the wind lifted them higher in the air and carried them further than eolian sand. These fine grains were eventually deposited as **loess**.

Since loess settled out from the air and was never under the weight of glacier ice, it was not compacted and is not dense. Soil B horizons (including fragipans) are silty clay loam or heavy (high-clay) silt loam. Loess-derived silt loam A horizons are very common in many areas of Indiana.

In summary, loess is the only parent material of a few soils, and is the uppermost parent material of many soils in Indiana. It is not stratified. It commonly forms silt loam A horizons, silty clay loam or heavy silt loam B horizons, and silt or silt loam C horizons.

> ▸ **EVALUATING RULE**
> **Loess**
>
> **Loess** has all of these characteristics:
>
> - Silty textures with little or no sand-size particles (silt, silt loam, or silty clay loam) in the topsoil and could extend into the subsoil
> - No pebbles or, if present, very few — caused by animal activities or weathering processes
> - May or may not be calcareous, but is never dense because it is deposited by wind rather than glacial ice
> - Not stratified, in contrast to water-deposited material)

ALLUVIUM

Alluvium is soil material that was eroded from soils, transported by water, and deposited on a flood plain relatively recently. The material that the water carried and deposited is called **sediment**. Flood plains are low in the landscape and are near streams. Soil evaluators might not be able to tell if the site is close to a stream, but they should notice if the site is low in the landscape relative to the rest of the landscape they can see.

Alluvium has one or more of these characteristics that can be observed in a soil pit:

1. The sediment's texture and organic matter content depend on the kind of soil from which the material was eroded. For example, one storm may have eroded mainly A horizons, so the sediment was dark. Another storm, however, may have been severe enough to cut gullies into B and C horizons, so the sediment was lighter in color. Because of this process dark and light layers alternate in the parent material identification zone of some soils formed in alluvium.
2. The sediment was calcareous, so the alluvium was calcareous to the surface. Because alluvium is very young, there was little time to leach calcareous material out of upper layers. Calcareous material above 20 inches indicates that the parent material is alluvium.
3. The soil has weak soil development.

The rule summarizes this.

> ▸ **EVALUATING RULE**
> **Alluvium**
>
> **Alluvium** has *both* of these characteristics:
>
> - The site is low in the landscape (on a flood plain).
> - The soil has at least one of the following:
>   - Distinct layers of light- and dark-colored soil material in the parent material zone
>   - Calcareous material above 20 inches
>   - On the site card, "Weak soil development" is circled "Yes"

LOCAL OVERWASH

Local overwash is similar to alluvium, except that overwash is soil material that was eroded from nearby hillslopes or swells, then was deposited on top of soils somewhat lower in the landscape. Overwash is usually found in depressions on uplands and terraces, but never on floodplains.

Usually, overwash was eroded from lighter colored soil horizons and overlies darker colored horizons. If overwash buries a light-colored horizon, it may be difficult to distinguish the buried layer. If this is the case, official judges should give the parent material on the site card. If the overwash is 20 inches or more thick, the landform is called a **filled depression** in soil evaluation.

> ▸ **EVALUATING RULE**
> **Local Overwash**
>
> **Local overwash** has all of these characteristics:
>
> - More than 20 inches thick (but the parent material identification zone may not include all 20 inches)
> - Buries a darker horizon
> - Soil horizons in and above the parent material zone have weak development
> - Not on a floodplain

OTHER PARENT MATERIALS

If the material in the parent material zone does not fit any of the guidelines above, official judges will write the name of the parent material on the site card.

Slopes

In soil evaluation, contestants measure the slope between two stakes near the soil pit with a slope finder (see page 46). The stakes are set 25 to 100 feet apart where possible. There are seven slope classes, which are designated by a letter or letters.

Mark the proper Scorecard Designation on the scorecard:

SCORECARD DESIGNATION	SLOPE (%)	DESCRIPTION
3A	0-2	Nearly level
3B	3-6	Gently sloping
3C	7-12	Moderately sloping
3D	13-18	Strongly sloping
3E	19-25	Moderately steep
4A	26-35	Steep
4B	> 35	Very steep

Landforms

As you walk toward a soil pit observe if the pit is on an upland, terrace, or bottomland. As you will see in the definitions of the various landforms below, parent material is used to help determine the landform.

On uplands, common parent materials are weathered bedrock, till, eolian sand, loess, and outwash (in outwash plains, eskers, and kames).

On terraces, the parent material is usually outwash, and on lake plains, the parent material is usually lacustrine deposits. Lacustrine deposits are finer in texture than outwash deposits. For soil evaluation, however, outwash and lacustrine deposits are grouped together, and outwash landforms include terraces, kames, eskers, outwash plains, lake plains, and similar landforms.

On bottomlands (floodplains), the parent material is alluvium.

Local overwash (parent material) occurs in small areas on uplands and outwash landforms.

SWELLS, DEPRESSIONS, AND FLATS

Much of the nearly level glaciated upland of northern and central Indiana is a rolling or undulating **till plain**. In the description that follows, **convex** shapes are those that bulge upward like a ball, and **concave** land forms dip downward like a bowl (Figure 2).

The convex rises of a till plain are called **upland swells**; the concave dips are called **upland depressions**. In the forested part of the state, soils on swells usually have light-colored surfaces and soils in depressions have dark-colored surfaces. Except in sandy materials, upland swells usually have somewhat poorly drained soils, and upland depressions usually have poorly drained soils.

In much of the glaciated part of southern Indiana, the uplands have even less relief and lower slope

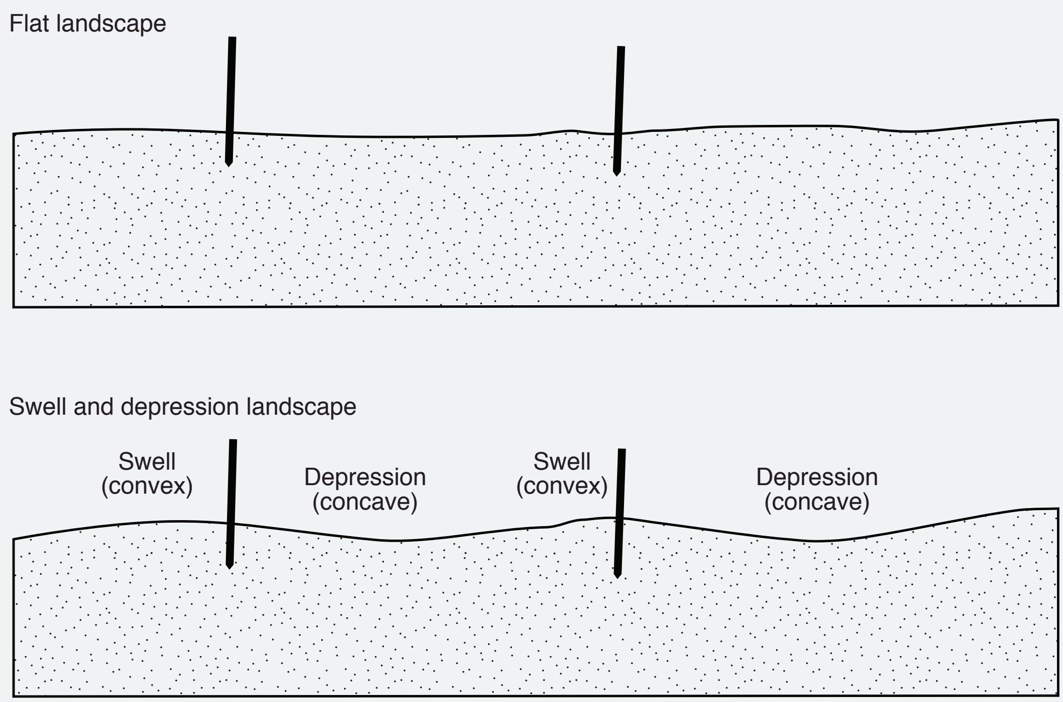


Figure 2. *A cross-sections of a flat landscape and a swell-and-depression landscape. The slope stakes are set to show a depression.*

percentages than the swell-and-depression topography farther north. Some of these uplands are so flat, in fact, that it is difficult to determine whether the surface is concave or convex, so they are called **upland flats.** Upland flats (often called "gray flats") usually have poorly drained soils over much of the flat and somewhat poorly drained soils near the edges of the flat.

Swells, flats, and depressions are described above for till plains, but they are also found on outwash and lacustrine deposits. The difference between a landscape that has swell-depression topography and a landscape that has flat topography can be very small. Therefore, officials will circle "Yes" for "Flat landscape" on the site card if they called the landscape flat. If the officials circle "No" on the card, and the slope is 2 percent or less, evaluators must decide if the site is a swell or a depression. Officials will set slope stakes so that the area between them represents either a swell or a depression. Figure 2 shows the difference between a flat landscape and a swell-swale landscape. It also shows the position of stakes.

HILLSLOPES

Hillslopes are landform components that have slopes of 3 percent or greater. On 3 to 6 percent slopes, soils are usually well- or moderately well-drained, but may have small areas of somewhat poorly drained soils. On slopes with more than 6 percent slope, most soils are well drained.

SOIL EVALUATION RULES FOR UPLAND LANDFORMS

Landforms for soil evaluation are defined based on their position in the landscape, parent materials, and the shape and steepness of slope. If the landform does not meet any of the guidelines described in the Evaluation Rules below, officials will write the name of the landform on the site card.

EVALUATING RULE
Upland Landforms

Upland landforms have these two characteristics:

- Parent material is weathered bedrock, till, or loess
- Soil has normal development

Upland landforms are further differentiated as:

- **Upland hillslope** — slope is 3 percent or more
- **Upland swell** — slope is 2 percent or less and surface is convex
- **Upland flat** — slope is 2 percent or less and surface is flat ("Yes" is circled for "Flat landscape" on the site card)
- **Upland depression** — slope is 2 percent or less and surface is concave

EVALUATING RULE
Landforms on Outwash and Lacustrine Deposits

Landforms on outwash and lacustrine deposits (abbreviated Outwash/Lacustrine) have these two sets of characteristics:

1. "Weak soil development" is circled "No" on the site card
2. The soil has one of the following:
   – Parent material is outwash or lacustrine deposit, with any slope
   – Parent material qualifies for eolian sand and slope is 2 percent or less

Outwash/lacustrine landforms are further differentiated as follows:

- **Outwash/lacustrine hillslope** — slope is 3 percent or more
- **Outwash/lacustrine swell** — slope is 2 percent or less and surface is convex
- **Outwash/lacustrine flat** — slope is 2 percent or less and surface is flat ("Yes" is circled for "flat landform" on the site card)
- **Outwash/lacustrine depression** — slope is 2 percent or less and surface is concave

EVALUATING RULE
Dune

A **Dune** has both of these characteristics:

- Parent material is eolian sand
- Slope is 3 percent or more

EVALUATING RULE
Flood Plain

A **Flood plain** has all of these characteristics:

- Parent material is alluvium
- Located low in the landscape
- "Weak soil development" is circled "Yes" on the site card

EVALUATING RULE
Filled Depression

A **Filled depression** has all of these characteristics:

- Parent material is local overwash that is 20 inches or more thick
- Most nearby landforms are uplands or outwash landforms (not floodplains)
- "Weak soil development" is circled "Yes" on the site card

Soil Color

To determine a soil's color, compare a moist soil sample to a Munsell soil color chart and pick the chip that matches best. All soil colors can be placed into *three soil evaluation groups*: **gray, brown**, and **black**. The groups are based on the value and chroma (defined in Figure 3) regardless of hue. A group includes many color chips such as 10YR 4/6 (dark yellowish brown).

While gray, brown, and black are specifically defined color groups, terms such as "light," "dark," "grayish," and "brownish" are relative. Brownish colors fall toward the right of the color chart; grayish colors to the left; light colors are to the top; dark colors are to the bottom.

COLOR GROUP OF SURFACE HORIZON

How you handle soil samples for evaluating color is important. To accurately determine a surface soil's color, moisten the soil (if it is dry). Then mix and mash the sample well before comparing the sample to the color chart. Record surface color results on the scorecard. You do not mark subsurface color on the scorecard, but you do use subsurface color to determine natural soil drainage.

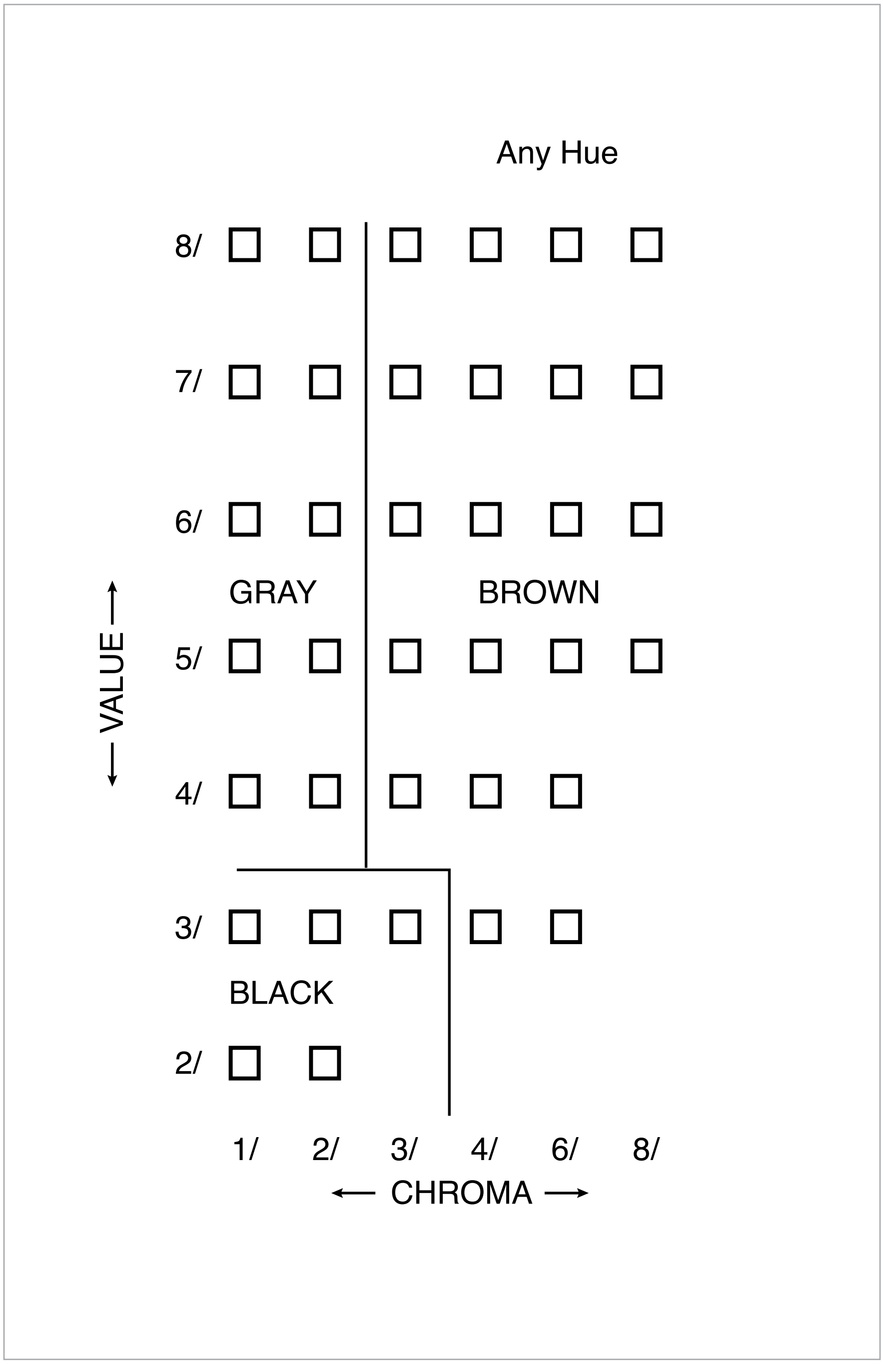


Figure 3. *A sample Munsell color chart showing the definitions of soil evaluation color groups: gray, brown, and black. The grouping applies to all hues (pages in a color book). Munsell Color chart provided by X-Rite, Inc., munsell.com.*

> ▸ **EVALUATING RULE**
> **Determining Surface Color**
>
> Determine the **Surface soil color group** from the center of the surface horizon, unless the site card gives a specific depth. Crush moist soil material between your fingers and compare it with a Munsell color chart. Mark **gray, brown**, or **black** on the scorecard.

Many Indiana surface horizons have colors between 10YR 3/3 and 10YR 4/3. If the color is near this class boundary, or other boundaries, officials should provide the Munsell designation on the site card.

COLOR OF SUBSOIL HORIZONS

An **aggregate** is a collection of many soil particles, and a **ped** is a soil structural unit that is composed of many aggregates that formed by natural processes. It breaks from the rest of the soil along natural surfaces. Peds are separated from each other by natural spaces so they can be easily removed from a soil profile (see the discussion of soil structure in *Indiana Soils*).

In subsoils, the natural fabric of the sample is important, so do not mix and mash the sample. The **fabric** is the arrangement of peds and colors, like in a shirt. Select a ped that you can easily remove from the face of a soil pit, and cut through the ped with a knife or spatula. You will see that the color of the outside of the ped often is different from the inside. Note the outside color, which usually represents a *clay skin* or a *silt coat* (explained later).

The inside of the ped often consists of small areas of one color and small areas of another. Note these colors and determine which one is dominant. In some pits, a face has been cut with a sharp spade, and this face shows the inside and outside of peds.

Previous Erosion

This section explains how soil evaluators describe the amount of erosion that has already happened. This explanation is based on the kinds of soil horizons discussed above (if you haven't read it yet, you might wish to).

Before they were farmed, Indiana soils had a dark-colored A horizon that varied in thickness from a few inches to a few feet. In areas with thinner A horizons there usually was a light-colored E horizon just below the A. Below the E horizon (or in areas with thicker A horizons, below the A horizon), was a B horizon.

Moldboard plowing mixed the upper horizons (A, E, or both) to create an **Ap horizon**. Where the original A horizon was thick, the Ap horizon was dark. Where the original A horizon was thin, the Ap horizon was usually grayish.

In most soils, erosion removed some of the Ap horizon, so when the soil was next plowed, the plow cut into lower horizons, often reaching B horizons. Farmers plowed to about the same depth every year, often about eight inches, so there was a clearly defined lower boundary of the Ap horizon.

However, as the use of moldboard plowing faded, the lower boundary of the Ap horizon became less distinct. If that is the case, the upper eight inches is considered to be equivalent to the Ap horizon. As soil erosion continued, the Ap horizon included even more of B horizon soil. That means, *the more B horizon material and the less A and E horizon material in the A, the greater the amount of erosion*.

In a many soil pits, soil evaluators can observe the B horizon, but they cannot observe the original A and E horizons, because they have been lost by erosion or mixed with other horizons. We do know, however, that A and E horizons are more *friable* than B horizons, so we equate "more friable material" with "A and E horizons."

Friable soil is soil that crumbles easily. The guidelines below explain how to identify material in the Ap that is more friable than the B horizon just below the Ap. This B horizon is called the *reference horizon*.

When you determine **previous erosion** in a competition, the *reference horizon* is the B horizon or C horizon just below the Ap horizon. More friable material has *some combination* of these traits when compared with the reference horizon:

- It crumbles more easily in your fingers
- It is darker in color (higher in organic matter)
- It provides less resistance when you poke it with a knife
- It contains more roots

If the lower boundary of the Ap horizon is not distinct, consider the upper eight inches to be the Ap horizon.

> ▸ **EVALUATING RULE**
> **Previous Erosion**
>
> Examine the top eight inches of the soil. For soil plowed deeper than eight inches, examine the entire plow layer. Between the plow layer or top eight inches, choose whichever is deeper.
>
> Mark **Previous erosion** on your scorecard according to the following.
>
> - If underlain by topsoil, or lighter-colored horizon, or it appears the site has never been plowed, mark: NONE to SLIGHT.
> - If underlain by subsoil, previous erosion depends on the percentage of topsoil material mixed with subsoil material. If the percentage of topsoil material is
>   - 76 to 100%, mark: NONE TO SLIGHT
>   - 26 to 75%, mark: MODERATE
>   - 0 to 25%, mark: SEVERE

The latter part of the rule refers to the *amount* of friable material. The *pattern* of more friable material and less friable material in the upper eight inches can vary among sites. The upper part of the 8-inch zone can be composed almost entirely of more friable material, while the lower part can be composed mostly of less friable material (like the dark brown and white layers of a separated Oreo cookie). Or, the materials could be mixed (like chocolate chips in a cookie — is the percentage of chocolate chips in your cookie more like none to slight or moderate?

Another clue that will help you determine the amount of previous erosion is the depth to calcareous material. If this depth is much less than in other soils in the area, then the soil is likely to be severely eroded.

Soil evaluators often have the opportunity to compare similar soils (one severely eroded, the other slightly eroded) and to think about the relative ability of the two soils to grow plants. This comparison will demonstrate the importance of using soil-conserving practices, as described in Chapter 2.

Soil Texture

Soil texture refers to the relative proportion of sand, silt, and clay in the soil. The texture triangle (Figure 4) shows the limits in the percentages of sand, silt, and clay for **texture classes** and **texture groups**. Specific classes (such as *silt loam*) are shown in lighter print. Soil evaluation groups of classes (such as *medium*) are shown in darker print.

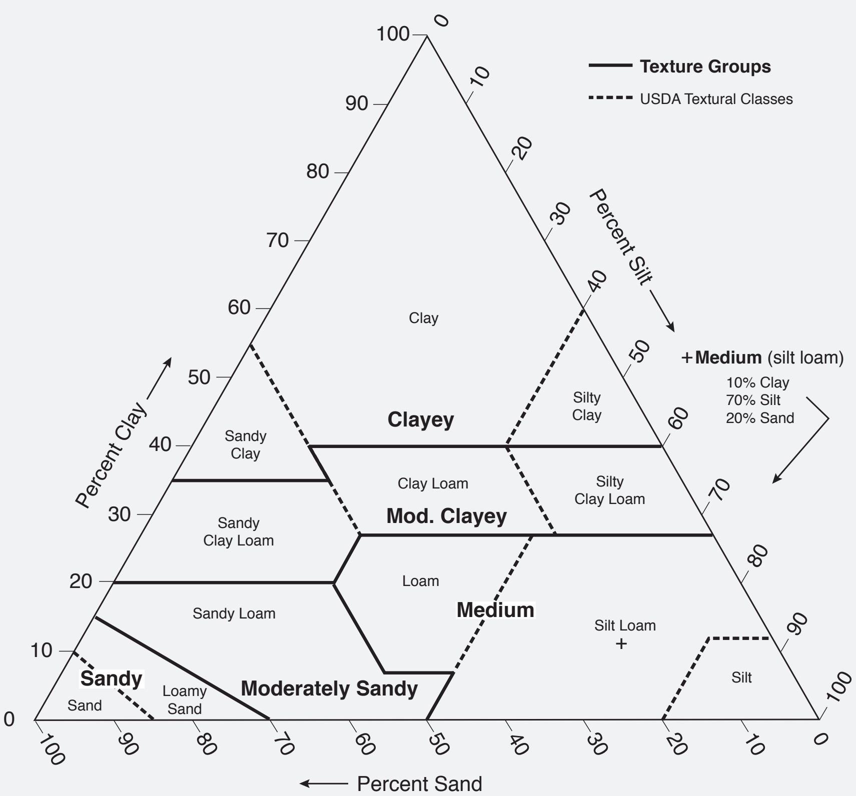


Figure 4. This soil texture triangle shows texture classes (dashed lines) and soil evaluation texture groups (solid lines). A soil sample located at the + point on the triangle would be composed of 10 percent clay, 70 percent silt, and 20 percent sand. This soil falls in the medium texture group and the silt loam texture class.

All soil texture triangles place soils very high in clay near the top. Textures high in sand are in the lower-left corner, and soils high in silt are near the lower-right corner. Soils with relatively equal amounts of sand, silt, and clay are in the center of the triangle.

Texture is an important soil characteristic, because it determines or influences many other properties. Texture mainly determines how fast water will run into or through a soil horizon, how much water the horizon will hold, and how easily the soil can be tilled. This, in turn, affects many agricultural and home site uses.

HOW TO DETERMINE TEXTURE

Estimate texture by working the soil with your hands, then feeling it with your thumb and fingers. Soils are often too dry for estimating texture, so you must moisten them first. You should carry a small water container to moisten samples — squirt-top plastic bottles are handy.

To estimate texture, take a heaping tablespoon of soil and mold it with your hand. While squeezing the soil, slowly add water until the sample mimics modeling clay and you can form it readily into different shapes.

When the sample is moist enough, squeeze it in your hand and observe the kind of cast it forms (Figure 5 A and B). Making a cast is especially helpful to identify sandy and moderately sandy textures, Soils that are finer than moderately sandy all make good casts. After you determine the kind of cast the sample makes, rub the soil between your thumb and forefinger and try to make a thin ribbon (Figure 5, C-F). You will evaluate the strength of the cast, the length and rigidity of the ribbon, the smoothness and shininess of the rubbed soil ribbon, and the stickiness of the sample to determine soil texture.

The descriptions of the five basic texture groups used in soil evaluation are described below. These descriptions will help you get started with determining soil textures. But to develop your skills, you should work with samples of known textures and compare your results with those of experienced people.

The **sandy** texture group includes the sand and loamy sand texture classes. Soil samples with a sandy texture do not stick together enough to form a cast (Figure 5A), or they form a weak cast that can falls apart with any but the most gentle handling. You cannot form sandy soils into a ribbon, and when you rub the surfaces they appear very grainy. Sandy soils are not sticky.

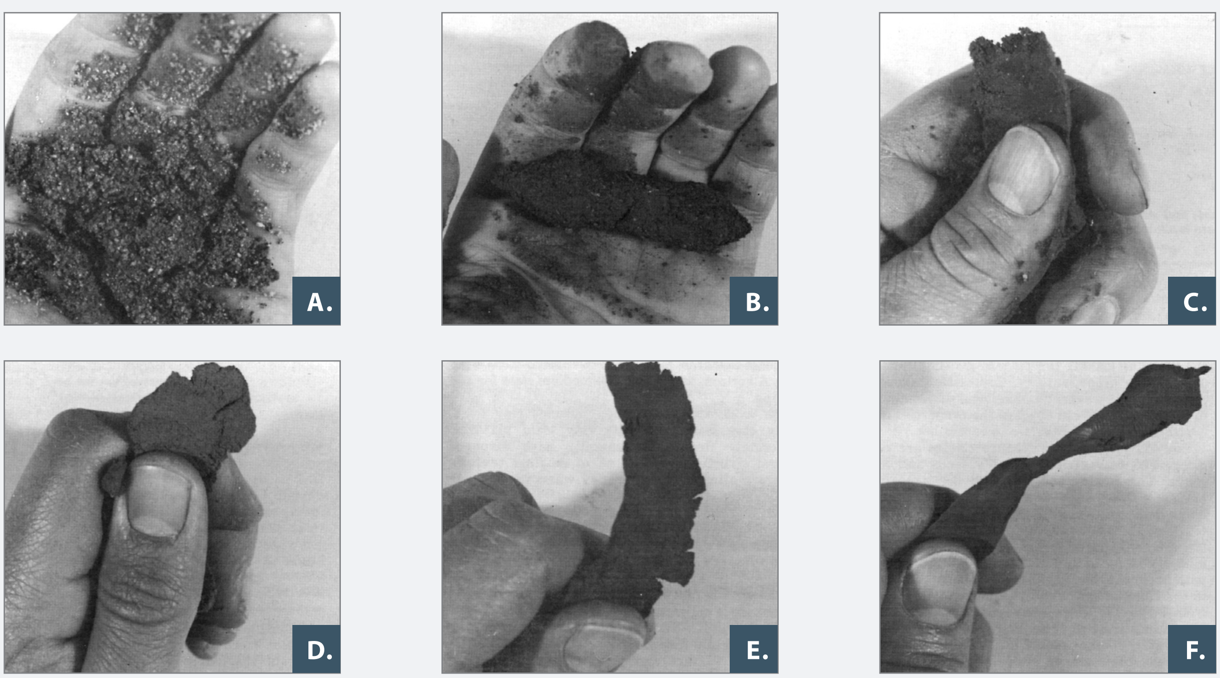


Figure 5. *The casts of different soil samples when you squeeze them in your hand to determine soil texture group. A: a sandy texture. B and C: moderately sandy. D: medium. E: moderately clayey. F. clayey.*

The **moderately sandy** texture group is the same as the sandy loam class. Soil samples with a moderately sandy texture form a good cast (Figure 5B) and a weak ribbon (Figure 5C). When you rub the surfaces, samples appear grainy, but you can see the "glue" (silt and clay) that holds the sand grains together. Moderately sandy soils are not sticky.

The **medium** texture group includes the loam, silt loam, and silt classes. Soil samples with a medium texture form a good cast and a moderately weak ribbon (Figure 5D). The ribbon's strength varies from somewhat better than the ribbon shown in Figure 5C to somewhat weaker than the one shown in Figure 5E. In Indiana, many of the medium texture soils are silt loams. Medium-textured soils are slightly sticky.

Moderately clayey (sandy clay loam, clay loam, and silty clay loam) soils form a fairly long ribbon because they contain moderately high amounts of clay (Figure 5E). The appearance varies from very smooth to very grainy. Moderately clayey soils are relatively sticky.

The **clayey** texture group includes the sandy clay, clay, and silty clay classes. The clay content of clayey soils varies considerably, but all clayey soils form a long ribbon that you can squeeze very thinly and still support its own weight (Figure 5F). When you rub the surfaces, samples appear mainly very smooth and shiny or waxy, but they could have some graininess. Clayey soils are very sticky.

► **EVALUATING RULE**
Surface Texture

For **Surface texture**, determine the texture group in the Ap horizon or the upper 8 inches of soil if the Ap is less than 8 inches thick.

► **EVALUATING RULE**
Subsoil Texture

For **Subsoil texture**, determine the texture of the finest layer (contains the most clay) exposed below the surface horizon.

If conditions warrant, officials may write on the site card the depth where students should sample to evaluate surface and/or subsoil texture. Alternatively, officials may put samples in a bucket or box outside the soil pit.

Natural Soil Drainage

LOCATION OF SOIL COLORS

To determine natural soil drainage, you must consider the colors of soil peds — both inside and on the surface. The inside of a ped is what you see on the face of a soil pit that has been shaved with a spade. The surface of a ped is what you see when you pick the surface with a knife, and soil material falls away along natural breaks in the soil.

You can also remove a few peds from the wall of a pit (leave some of the peds intact to see the surfaces) and cut through some peds with a knife or spatula to observe the insides. Ask your coach or an official to help you examine ped interiors and ped surfaces. Estimate the percentages of gray material and brown material (Figure 3) that show on these inside exposures.

Also estimate the percentages of gray material and brown material on the clay skins. To do this, you must first distinguish clay skins from silt coats and carbonate coats on soil ped surfaces.

Clay skins coat peds like a layer of paint. They often have a somewhat shiny or waxy appearance. A clay skin can be in any of the three main color classes (gray, black, or brown), but it is usually somewhat different in color from the inside of the ped.

Silt coats and **carbonate coats** appear grainy or dusty, and they are usually light gray to white when dry on soils of all drainage classes. If you drop water on a thin, dry silt coat, the silt becomes practically invisible. Silt coats, tend to be lighter in color (Munsell value 7 or 8) than clay skins, which are often darker gray or brownish (Munsell value 4 or 5).

Carbonate coats are calcareous, and they usually coat large peds that are calcareous on the inside. Carbonate coats are typically in dense till. They look much like the light-colored silt coats in fragipans.

In summary, clay skins appear to be painted on and waxy. They are usually dark gray or brownish when moist. On the other hand, silt coats and carbonate coats appear dusty or grainy. They are usually light gray when moist, and very light gray to white when dry.

SOIL DRAINAGE TERMINOLOGY

A soil that has definite brown masses and definite gray masses is called **mottled.** The brownish masses are called brown mottles, iron concentrations, or just concentrations. The gray masses are called gray mottles, iron depletions, or just depletions. When you use the soil drainage key, you will be asked to determine the percentages of brown and gray colors in a soil horizon. When you determine the color of a subsoil horizon before using the drainage key, give equal consideration to the interior of peds and the clay skins on ped surfaces. Do not consider the color of silt coats or carbonate coats.

One coach summarized step three by asking students if the soil looked like a brown suit with gray spots or a gray suit with brown spots. If the zone you get from using the flow chart does not represent the soil very well, officials may provide the natural soil drainage on the site card.

▸ EVALUATING RULE
Natural Soil Drainage

Determine **Natural soil drainage** using the soil key (Figure 2.19).

To use the soil key:

1. Measure the thickness of the black surface horizon. If it is greater than 10 inches, use the left side of the diagram; if it is 10 inches or less, use the right side.
2. Find the 6-inch zone (left side of diagram) or 8-inch zone (right side) in which to examine soil color closely.
3. Decide if the combined color of ped interiors and clay skins in that zone is predominantly gray or predominantly brown.
4. Determine if there are any gray colors above 30 inches

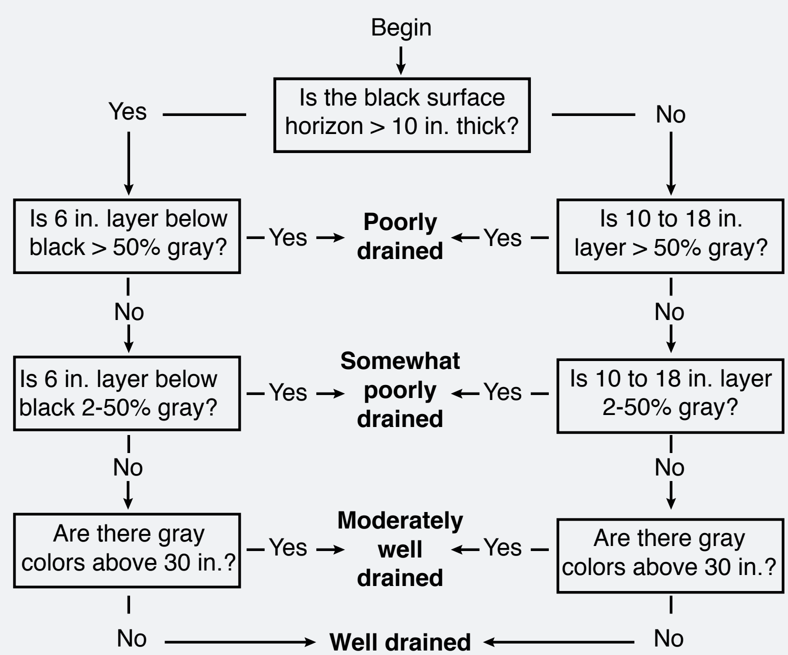


Figure 6. This soil key is a flow diagram for determining natural soil drainage. See Figure 3 for the definition of black and gray soil evaluation color groups.

Limiting Layers

There are four kinds of limiting layers recognized in soil evaluation:

- Bedrock
- Dense till
- Fragipan
- Coarse sand and gravel

> ▸ **EVALUATING RULE**
> **All Limiting Layers**
>
> To be a **limiting layer**, the layer must be more than 10 inches thick. If the layer or material meets the requirements in an individual rule and extends to the bottom of the pit, assume that it is more than 10 inches thick, thus a limiting layer.

There are also three recognized depth zones to a limiting layer:

- 0 to 20 inches
- 21 to 40 inches
- More than 40 inches (or no limiting layer visible in soil pit)

The kind of limiting layer and the depth of the layer combine to make nine distinct soil evaluation classes as shown on the scorecards.

Bedrock, dense till, and fragipans have little pore space, so they restrict root penetration and conduct water or sewage effluent very slowly. On the other hand, few roots grow into coarse sand and gravel, because it has big spaces between the particles and cannot hold much water.

The depth to a limiting layer is important because it determines how much soil material is available for plant roots. A shallow (thin) soil limits how much water the soil can hold for plant growth. For home sites, the depth to a limiting layer largely determines the kind of soil absorption field that is suitable for the site.

LIMITING LAYER: BEDROCK

Bedrock gradually weathers to become weathered bedrock parent material, and then continues to change to become another kind of soil horizon. The evaluation rule below describes when rock material is hard enough and continuous enough to be considered a limiting layer.

> ▸ **EVALUATING RULE**
> **Bedrock Limiting Layer**
>
> **Bedrock** is considered a limiting layer if more than 80% of the layer is rock material that meets *one* or *both* of the following:
>
> - It cannot be cut with a spade or dug into with a knife
> - Roots cannot grow into it

LIMITING LAYER: DENSE TILL

The section about till as a parent material (page 8) describes till's characteristics. In Indiana, practically all till is dense, but in a few areas till was not dense when it was deposited.

Also, in horizons that are transitional between B and C horizons, clay skins might penetrate into till, which decreases the horizon's bulk density. *For soil evaluation, however, all calcareous till is considered dense.* Therefore, the criteria used to identify till parent material are used to identify dense till.

From a standpoint of land use, dense till limits the depth to which the roots of a crop can grow. In addition, dense till is very slowly permeable and affects the type of septic system design recommended for home waste disposal.

> ▸ **EVALUATING RULE**
> **Dense Till Limiting Layer**
>
> **Dense till** has all of these characteristics:
>
> - Not all till is calcareous, but for this contest, all calcareous till is considered to be dense till
> - Pebbles, if present, are mainly igneous, but in some areas, there is a mixture of underlying sedimentary rocks incorporated. Pebbles are usually rounded and randomly distributed.
> - May have platy structure that is characteristic of unweathered till
> - Common texture and color combinations found in dense till:
>   - Medium texture (loam) and brownish color (10YR 5/4, 5/6, 5/3) **or**
>   - Moderately clayey texture (clay loam, silty clay loam) and near the brownish/gray color boundary (10YR 5/3, 5/4, 5/2)

LIMITING LAYER: FRAGIPANS

Fragipans are firm, brittle subsoil horizons through which water moves very slowly and roots do not penetrate easily. A soil is considered brittle if a moist piece of soil (about ½ to 1 inch across) ruptures suddenly or pops when you pinch it between your thumb and forefinger rather than deforms slowly.

Fragipans are usually medium or moderately clayey in texture — near the boundary of silt loam and silty clay loam. Usually, a fragipan's upper surface is 20 to 50 inches below the soil surface. A fragipan is typically 10 to 30 or more inches thick (See *Indiana Soils*).

But a fragipan's most recognizable characteristic is its overall appearance. Fragipans consist of large structural units called prisms, which are taller than they are wide. The outside face of a prism is covered with gray coatings that consist mainly of silt in the upper part of the fragipan and of silt and clay in the lower part. This gray material tapers like a funnel into the gray silty streaks that coat the peds. The interior of the prism is brownish mottled with gray colors. In poorly drained soils, the gray colors may be dominant. The interior material is firm and brittle when moist.

The prism coatings appear as gray vertical streaks in a soil profile. When viewed from the top, they form a polygonal pattern (something like a giraffe's hide or chicken wire, but with a less regular pattern). The prisms must be, on average, more than 4 inches across to be considered a fragipan. Roots grow readily down in the gray silt between the prisms, but few grow into the interior of the prisms. In soil evaluation pits, a horizontal shelf or surface through the prisms might be dug.

Fragipan soils present special problems for farming. Because water can't penetrate a fragipan very quickly, spring rains waterlog the soil above the pan. Roots cannot penetrate into fragipan prisms, so crop plants get very little water from fragipan horizons. In the winter, freeze-thaw cycles may heave plants with long taproots (like alfalfa) out of the soil.

> ▸ **EVALUATING RULE**
> **Fragipan Limiting Layer**
>
> A **Fragipan** limiting layer must have *all* of these characteristics:
>
> - Prisms that, on average, are 4 inches or more wide
> - The material inside the prisms is brittle
> - The prisms contain few or no roots

LIMITING LAYER: COARSE SAND AND GRAVEL

Coarse sand and gravel is a limiting layer because it cannot supply much water to plants. Although fine sands have relatively high water-supplying abilities, the wide spaces between coarse sands hold very little water. Therefore, a limit based on sand size has been established between the sandy materials that restrict plant growth and those that do not. This limit is between the medium sands and the coarse sands.

In soil evaluation, "coarse sand and gravel" is defined as sandy material (defined in the *Texture* section) in which most of the sand particles are larger than 0.5 millimeter (the size of grains on 40-grit sandpaper). Most coarse sands also contain quite a bit of gravel, but some coarse sand does not.

Usually, if you moisten and squeeze a coarse sand, it will not form a cast, or if it does, the cast will not hold its shape when you gently toss it up and down in the air. Sandy materials that are not limiting layers include some water-deposited sandy materials and eolian sand deposits.

Thin bands of coarse sand and gravel are less of a limitation than thick deposits. Therefore, in soil evaluation, a layer of coarse sand and must be 10 or more inches thick to be considered a limiting layer. Coarse sand and gravel can be the lowest horizon in the soil pit, or it can be found between finer textured layers.

Coarse sand and gravel layers do not affect water availability if the water table is permanently within reach of the plant roots. However, most poorly and very poorly drained soils in Indiana have a fluctuating water table, which becomes low enough in summer to make the subsoil's water-holding capacity important. Therefore, in soil evaluation, coarse sand and gravel layers are considered limiting layers, regardless of drainage class.

> ▸ **EVALUATING RULE**
> **Coarse Sand and Gravel Limiting Layer**
>
> A **Coarse sand and gravel** limiting layer has *both* of these characteristics:
>
> - It qualifies for the sandy texture group, and the sands are mainly > 0.5 mm in diameter (the size of 40-grit sandpaper)
> - Gravel is usually present, but may be lacking

CHAPTER 2 – Agriculture Practices

In soil evaluation, a contestant first determines the soil properties and marks the answer on the left side of the scorecard. Then, the contestant will make judgments about how to use the soil.

These judgment options are:

- Restore its original vegetation
- Use it for agriculture
- Use it for home sites

This chapter discusses the first two options — restore original vegetation and use for agriculture. Chapter 3 discusses home site use.

Any site can be restored to its original vegetation. That means you should interpret soil evaluating rule 15 (see below) to mean, "If the soil is to be restored, which plant communities should be established?" not "Is the soil better suited for restoration than for crop production?"

► **JUDGING RULE**
15. Restore Original Vegetation

For **Restore original vegetation,** select:

- **Wetland** if the soil is poorly drained
- **Prairie** if the soil is somewhat poorly drained, moderately well-drained or well-drained and has a black surface horizon that is more than 10 inches thick
- **Mesic forest** if the soil does not qualify for wetland or prairie
- If the area being evaluated still has its original vegetation, interpret the rule as "Preserve" instead of "Restore" original vegetation.

Land Use Overview

When European settlers first arrived in Indiana, practically all of the state was mesic forest, prairie, or wetland ("mesic" means medium moisture conditions). Gradually, farmers cleared the forest, drained wetlands, and plowed up the prairie, so very few of the original plant communities remain.

There are many woodland remnants, but most of them have had some trees removed or have been grazed. Hardly any native prairie remains. Now, however, there is significant interest in preserving remaining natural areas and converting farm land and other areas to original vegetation communities.

Restore Original Vegetation

If you recommend restoring original vegetation, then the vegetation should match the kind of vegetation that was present when settlers first cleared the land. Poorly drained soils should be restored to wetlands. Somewhat poorly drained, moderately well-drained, and well-drained soils with more than 10 inches of dark surface (black color group) should be restored to prairie. Other soils should be restored to mesic forest.

Prime Farmland

Much land in Indiana will continue to be farmed. The rest of this chapter deals with how best to farm the land while protecting the soils. In recent years, many have expressed concerns about losing excellent farmland to nonagricultural uses such as highways, urban sprawl, apartments, shopping centers, industrial areas, and surface mines. To help local governments preserve soils for continued food production, the U.S. Department of Agriculture defines prime farmland as land capable of producing good yields of adapted crops in most years. The USDA's definition relies on soil properties, many of which are determined in soil evaluation. Many local, state, and federal planning units consider prime farmland soil properties as a guide for identifying land that should remain agricultural rather than be used for urban development.

Soils that are frequently flooded, have low water-holding capacity (they are sandy, or shallow to a limiting layer), or are very erodible (usually on slopes steeper than 6 percent) are excluded from the definition of prime farmland.

▸ **JUDGING RULE**
16. Prime Farmland

Mark "Yes" for **Prime farmland** if the soil has all of these properties:

- Its subsoil texture is moderately sandy or finer
- It is more than 20 inches to a bedrock or coarse sand and gravel limiting layer
- It has a slope of 6 percent or less
- Landform is not a floodplain

Erosion and Compaction Potentials

Most Indiana soils will be used for agriculture and home sites. But these uses can potentially harm the soil (on-site degradation) or pollute other areas (off-site degradation). Most sections of this chapter explain how to manage the soil for agriculture while minimizing both on-site and off-site degradation.

Erosion by Water

The potential for water erosion depends largely on the steepness and length of slope. Steepness is important because, soil material moves down a *steep* slope faster than down a *gradual* slope. Slope length is important because the amount of runoff water increases the *farther it goes* down the hill. Slope steepness (percent) appears in several rules. The rule below also reflects that shallow soils need special care because losing even a little bit of a shallow soil will greatly affect the soil's ability to grow plants.

▸ **JUDGING RULE**
17. High Potential for Water Erosion

Mark "Yes" for **High potential for water erosion** if the soil has one of these properties:

- 20 inches or less to any limiting layer and slope is more than 2 percent
- More than 20 inches to any limiting layer and slope is more than 6 percent

Erosion by Wind

Eolian sand (as explained in the Parent Material section above) is material that was picked up, carried by the wind, and deposited thousands of years ago. Now, the same material can again be picked up by the wind in the process of wind erosion. The rule identifies material that can be readily transported by wind.

▸ **JUDGING RULE**
18. High Potential for Wind Erosion

Mark "Yes" for **High potential for wind erosion** if the soil has a sandy or moderately sandy surface texture.

Soil Compaction

Wet soils can be compacted more readily than dry soils, and this is reflected in the rule below. Also, it is difficult to compact very sandy soils.

▸ **JUDGING RULE**
19. High Potential for Soil Compaction

Mark "Yes" for **High potential for soil compaction** if the soil has *both* of these properties:

- Natural drainage that is somewhat poor or poor
- Surface texture that is moderately sandy or finer

Buffers and Cover Crops

This section describes several farming practices that protect soil and water resources by maintaining vegetative cover. Such practices include conservation buffers and cover crops. These practices slow water runoff, trap sediment, and enhance water infiltration into the soil in the buffer. For soil contests, they are marked according to the rules below, even if the soil pit is not in a cropped field.

Grassed Waterways

Grassed waterways are strips of grass in cropland areas where water flow concentrates. While grassed waterways are primarily used to prevent gully erosion, they can be combined with filter strips to help trap contaminants and sediment. Grassed waterways are used in sloping cropped fields.

> ▸ **JUDGING RULE**
> **20. Grassed Waterways**
>
> Mark "Yes" for Grassed waterways if the slope is 3 to 18 percent.

Windbreaks

A windbreak is a row of trees, shrubs, or other vegetation used to reduce wind erosion, protect young crops, and control blowing snow. Windbreaks are placed near the field boundary that is most nearly perpendicular to the direction of the prevailing wind — since most prevailing winds come from the west in Indiana, most windbreaks are oriented north-south.

> ▸ **JUDGING RULE**
> **21. Windbreaks**
>
> Mark "Yes" for **Windbreaks** if the surface texture is sandy or moderately sandy.

Filter Strips

Filter strips are long, narrow strips of vegetation (usually grass) that are established between fields and waterways (such as streams, ditches, and drainageways). Filter strips slow the flow of runoff from fields and trap sediment, nutrients, pesticides, and other pollutants before they reach surface waters. Filter strips also protect the soil from erosion.

Filter strips typically vary from 20 feet wide (on nearly level soils) to 60 feet wide (on sloping soils). Forage crops can be planted on these strips and hay can be harvested from these strips.

Filter strips are established along areas in which water flows, but these areas cannot be identified using properties determined in a soil pit. Soil judgers identify places in the contest area that they believe are appropriate for filter strips and make a note about the location. They will compare their judgment with that of coaches and contest officials during the critique session. Soils on slopes more than 18 percent are not used as cropland and thus do not need filter strips.

> ▸ **JUDGING RULE**
> **22. Consider Filter Strips**
>
> Mark "Yes" for **Consider filter strips** for soils with slopes of 18 percent and less.

Judges may identify locations in the soil judging area they believe are suitable for filter strips during the critique session.

Cover Crops

A cover crop is grown between periods of regular crop production. Cover crops can prevent soil erosion and provide other environmental benefits by providing soil cover during the late fall, winter, and early spring. Cover crops can be grasses, legumes, and other crops. The more common cover crop species include annual ryegrass, cereal rye, crimson clover, turnips, and oilseed radishes. Typically, farmers seed cover crops into standing crops using high-clearance equipment or aerial seeding in late August or early September; or they seed cover crops directly after harvesting the cash crop such as corn or soybeans. Cover crops die (from cold) or are killed (with herbicides) before farmers plant the next summer crop.

Cover crops can be used in practically all tillage-management systems. Cover crops have many benefits (see *Indiana Soils*), but their two main advantages are controlling erosion and taking up nitrogen and other nutrients before they leach through the soil into groundwater or to tile drainage water (the crop **scavenges** nitrogen).

To follow the rules, soil judgers must think about *why* cover crops are used. Erosion is more likely to occur on sloping soils. Scavenging is important on nearly level soils and soils with coarse-textures where leaching is more likely to occur.

> ▸ **JUDGING RULE**
> **23. Cover Crops**
>
> Choose the most significant benefit of **Cover crops** for this site by marking:
>
> - **Scavenge nitrogen** if the soil has *either* of these properties:
>   - Slope is 0-2 percent
>   - Slope is 3-6 percent and the soil has a sandy subsoil or a coarse sand and gravel limiting layer
> - **No need** if the slope is more than 18 percent (the soil is not tilled)
> - **Erosion control** for all other soils

Cropping Systems

A cropping system refers to the kind of crops grown and their sequence over a time period of several years. This section describes the kinds of cropping systems commonly used in Indiana and how well these systems protect soils from erosion. The potential for soil erosion largely determines the kind of cropping system a farmer can use on a certain soil. Cropping systems are closely related to the tillage practices described above. Timber stand improvement does not involve typical farm crops, but is listed with cropping systems below.

Timber Stand Improvement (TSI)

TSI is a practice that improves the quality of a timber stand. Landowners allow the best trees in a stand to grow so they can eventually be harvested, and they remove other trees and vines that may be in the way of the good trees.

> ▸ **JUDGING RULE**
> **24. Forestry with TSI**
>
> Mark "Yes" for **Forestry with TSI** for all soils.

Permanent Pasture

This is land with perennial vegetation that is used for grazing rather than for harvesting hay.

> ▸ **JUDGING RULE**
> **25. Permanent Pasture**
>
> Mark "Yes" for **Permanent pasture** for soils with slopes 25 of percent or less

Crop Rotation

Crop rotation refers to growing a certain sequence of different crops in a field, in contrast to continuous cropping. The main row crops in Indiana are corn and soybeans. Farmers often grow them in a rotation with each other.

There are many possible combinations of crops and the length of time they are grown in a crop rotation. The rotation assumed for the rule below provides almost continuous cover and protects the soil from erosion on slopes as steep as 18 percent. In the following discussion:

- **Forage crops** include perennial crops grown in a rotation for animal feed as hay or pasture.
- **Cover crops** are grown between periods of regular crop production, usually with corn and soybeans (page 25).
- **Small grains** refer to a variety of crops. Winter wheat is the most common small grain crop in Indiana, but oats and barley are also grown.

The rotation is designated C-G-F-F-F-F, a six-year cycle — the C = corn, G = small grain (wheat), and F = forage crop. In year one, farmers plant corn in the forage crop residue. In year two, they plant a mixture of seeds for wheat, a legume, and a grass in the corn residue. After harvesting the wheat, the field fills in with the grass-legume mixture, which remains in place for four years.

> ▸ **JUDGING RULE**
> **26. Crop Rotation**
>
> Mark "Yes" for **Crop rotation** for soils with slopes of 18 percent or less.

Tillage Systems

Tillage is what farmers do to prepare land for planting. Depending on the cropping system, farmers may till the soil every year, or they may never completely till it. The more a soil is tilled, the more subject it is to erosion and compaction.

Conservation Tillage

Conservation tillage includes all tillage systems that leave at least 30 percent of the soil surface covered with live plants or crop residue at planting time. It includes no-till and strip-till. Conservation tillage has become more common because manufacturers developed new herbicides that control weeds without plowing and they developed planters that can drill or slice through heavy residue cover. Controlling erosion by leaving crop residue on the surface is one of the chief benefits of conservation tillage systems.

No-till

In no-till planting, farmers plant the crop in soil that has a residue cover. The residue may be left from a previous row crop (such as soybeans or corn) or from vegetation that was recently killed with herbicides (such as a cover crop).

No-till double cropping is the practice of planting soybeans into small grain stubble immediately after harvesting the small grain crop (usually in late June). No-till planting saves fuel because it requires fewer tillage trips over the land.

STRIP-TILL

Strip-till planting is similar to no-till except that farmers clear residue from a narrow strip. They then till the strip and plant seeds in it. Usually, farmers just push the residue out of the row, leaving the same amount of total residue, but some of it could be buried in the operation. Strip-till has the same soil requirements as no-till and is considered the same as no-till for soil contests.

> ▸ **JUDGING RULE**
> **27. No-till**
>
> Mark "Yes" for **No-till** for soils that have both of these properties:
>
> - 6 percent or less slope, **and**
> - Either:
>   - Well-drained or moderately well drained soils with any surface texture, **or**
>   - Poorly or somewhat poorly drained soils with moderately clayey or coarser surface texture.

Moldboard or Chisel Plowing

For years, the standard tillage method was to turn under crop residues with a moldboard plow, and then till the soil to a shallow depth with a disc harrow or other implement to prepare the seedbed. Then, chisel plowing, which disturbed the soil less than moldboard plowing, became more popular.

> ▸ **JUDGING RULE**
> **28. Chisel or Moldboard Plowing**
>
> Mark "Yes" **Chisel or moldboard plowing** for soils with *all* of these properties:
>
> - Slope is 2 percent or less
> - Medium or finer surface texture
> - Poorly or somewhat poorly drained

Rules and Cover Crops

The rules above assume that cover crops *are not* used. If cover crops *are* used, a practice may be used on slopes greater than those stated in the rule. For example, No-till might be used on slopes steeper than 6 percent. Making these kinds of recommendations, however, are left to professional soil conservationists and are beyond the scope of soil contests.

Notice that soils on steep slopes have few options for tillage and cropping; soils on gradual slopes have more options.

Water Management

Managing water is a critical component of farm operations. Soil judging contestants decide if it is feasible to:

- Drain wet soils
- Irrigate droughty soils
- Install structures that control water flow and soil erosion

Drainage

Plants must have water and oxygen in their root zones if they are to thrive. Poorly drained and somewhat poorly drained soils have so much water that there is little available oxygen in the root zone, essentially suffocating the plant. Before one can use these soils for efficient crop production, the water must be removed to allow room in the pore spaces for air.

Systems that remove excess water from the soil surface and within the soil may be called *man-made drainage* or *artificial drainage* (in contrast with n*atural drainage* described on page 18). In this section, we refer to all artificial systems simply as drainage. Drainage allows for timely field operations and helps crops get an early start. Another benefit of drainage is that it decreases ponding in swales. In un-drained fields, water may pond in low areas long enough to kill or greatly harm crop plants.

There are three drainage practices commonly used in Indiana:

- Surface drainage, which involves grading the field to facilitate the movement of surface water off the field
- Subsurface drainage, which removes subsoil water through open ditches
- Subsurface drainage, which removes surface and subsoil water through drain (tile) lines

Current federal programs discourage draining wetlands for crop production — draining them could lead to losing federal benefits. The rule described below assumes that the field has been drained previously.

Usually, somewhat poorly drained and poorly drained soils respond to artificial drainage, so most of those soils are checked "Yes" for drainage. The exception is somewhat poorly and poorly drained soils on flood plains. Some of these soils can be drained, but many have flooding problems that make drainage impractical.

▸ JUDGING RULE
29. Drainage

Mark "Yes" for **drainage** if the soil has *both* of these characteristics:

- Natural drainage is poor or somewhat poor
- Landform is not a flood plain

Irrigation

Irrigation involves adding water to soils to help produce crops. Whether crop irrigation will be beneficial usually depends on the soil properties, crop types, the farmer's management skills, and the weather during the growing season.

Some soils that hold very little water in the profile, such as sandy soils and shallow soils, will respond well to irrigation. Specific soil properties are stated in soil judging rule 30 below. The most common irrigation systems in Indiana are center pivot systems, travelling sprinkler systems, and sub-irrigation.

Center pivot water systems spray water from sprinklers along a horizontal pipe that rotates around a pivot at one end of the pipe. The water supply comes through the pivot from streams or a well. Wheels support the pipe as it rotates. Electric motors or gasoline or diesel engines usually drive the unit.

Travelling sprinkler systems use a large sprinkler (big gun) that is attached to a flexible hose and rotates 360 degrees. The sprinkler is mounted on a cart that moves in a straight path through a field.

Sub-irrigation systems supply water underground. In sandy soils these systems can be combined with open ditch drainage. During the wettest part of the year, the ditches remove water from the field. When plants begin to use water, farmers block the flow of water in the ditches. During drought, farmers can pump water from streams into the ditches. In finer textured soils, farmers adjust the water level using control boxes in drainage (tile) lines.

▸ **JUDGING RULE**
30. Irrigation

Mark "Yes" for **irrigation** if the soil has *both* sets of properties:

- Slope is 6 percent or less, **and**
- Either:
  - Subsoil is sandy or moderately sandy, **or**
  - Soil has a coarse sand and gravel limiting layer within 40 inches of the surface

Terraces

A **terrace** is an embankment or ridge constructed across sloping soils on the contour or at a slight angle to the contour. A terrace intercepts surface runoff so that it can soak into the soil or flow slowly through a grass waterway or a tile outlet.

A terrace system breaks a long slope into shorter segments, which reduces soil erosion. Terraces are constructed parallel to each other and parallel to the direction of field operations. You can minimize interfering with farming operations if you space the terraces so they are multiple widths of the planting and harvesting equipment.

Soil contests consider two kinds of terraces:

- Water and sediment control basins (WASCOBS) — these are more common in Indiana
- Parallel tile outlet (PTO) terraces (see *Indiana Soils* for diagrams of these terraces)

▸ **JUDGING RULE**
31. Terraces

Mark "Yes" for **Terraces** if the soil has *all* of these properties:

- Soil is well-drained, moderately well-drained, or somewhat poorly drained
- It is more than 40 inches to any limiting layer
- Slope is 3 to 12 percent
- Subsoil texture is medium or finer

Plant Nutrient Application

Most Indiana farmers use chemical fertilizers and many use manure. When used properly, these fertilizing materials promote productivity and do little harm to the environment. In fact, high-technology agriculture might enhance the environment —if cropland is more productive, we need less land to produce the food we need. Using less land leaves more land for natural areas.

In soil competitions, judgers consider nitrogen (N), phosphorus (P), and potassium (K). They also consider lime, which is used to reduce soil acidity and to supply calcium (Ca).

Nitrogen (N)

N application rate recommendations are based on soil yield potential, crop price, and cost of N fertilizer. Soil contest rules place all soils into three yield potential classes.

▸ **JUDGING RULE**
32. Nitrogen (N)

There are three application rates for **nitrogen (N)**. Select:

- **High** if the soil has *all* of these properties:
  - Soil is more than 40 inches to any limiting layer
  - The subsoil and surface soil textures are medium or moderately clayey
  - Soil is poorly drained or somewhat poorly drained
  - Surface color is black
- **Medium** for other soils that have *all* of these properties:
  - Soil is more than 20 inches to any limiting layer
  - The subsoil and surface soil textures are moderately sandy or finer
  - The slope is 12 percent or less
- **Low** (or no nitrogen) for all other soils

Phosphorus (P) and Potassium (K)

P and K application recommendations are based on laboratory tests that determine the amount of available P and K in the soil. Soil testing laboratories report these levels in units of parts per million (ppm). For example, a test result of 1 ppm K means that the soil has 1 pound of available K in 1,000,000 pounds of soil. In some cases, results are reported in units of pounds per acre in place of ppm. When that happens, the pounds per acre is double the ppm: so, 1 ppm equals 2 pounds per acre.

▸ **JUDGING RULE**
33. Phosphorus (P)

There are three application rates for **phosphorus (P)**. Select:

- **Add** if available P is less than 15 ppm
- **None** if available P is 15-100 ppm
- **Deplete** if available P is greater than 100 ppm

▸ **JUDGING RULE**
34. Potassium (K)

There are three application rates for **Potassium (K)**. Select:

- **Add** if available K is less than 100 ppm
- **None** if available K is 100-250 ppm
- **Deplete** if available K is greater than 250 ppm

Lime

Lime application has two main functions — it supplies calcium (Ca) and often magnesium (Mg) which are essential for plant growth, and it combats soil acidity. For soil contests, lime rate recommendations depend on soil acidity.

▸ **JUDGING RULE**
35. Lime

There are two application rates for **lime**. Select:

- **Add** if the soil pH is 6.4 or lower as noted on the site card
- **None** if the soil has a different pH

Nutrient Pollution Potential

In some cases, farmers can apply too much of a nutrient, which can cause problems on and off the farm. Nutrients can move off the farm in the solid phase and the liquid phase.

In the solid phase, nutrients move with soil particles as they are eroded from soils. Later, these nutrients move from the soil particles into the surrounding water.

In the liquid phase, dissolved nutrients can run off the soil and into surface water or leach through soils into the surface water and ground water. Reducing soil erosion and applying nutrients at proper rates reduce the potential for harming the environment.

Nitrogen Pollution

N is one nutrient that especially tends to move down through the soil, into drain lines, and then into surface waters such as ditches, creeks, and rivers. Excess N (as nitrate) in water can make people ill and can even be fatal to babies.

> ▸ **JUDGING RULE**
> **36. Nitrogen (N) Pollution Potential**
>
> There are three possible ratings for **nitrogen pollution potential**. Select:
>
> - **High for groundwater** if the soil has both of these properties:
>   - A sandy subsoil and/or a coarse sand and gravel limiting layer
>   - Soil is moderately well-drained or well-drained
> - **High for surface water** if the soil has both of these properties:
>   - Soil is poorly drained or somewhat poorly drained
>   - Soil is not on a flood plain
> - **Medium** for other soils

Phosphorus Pollution

Too much P causes excessive growth of algae in surface waters — called an algal bloom. The algae can produce toxins (poisons) that get into drinking water. When that happens, people must drink bottled water until the water supply is cleaned up.

The algal toxins can also kill fish directly and indirectly. Indirect fish kills are caused when algae covers the water's surface enough to prevent light from reaching the plants that grow in the water. These plants die from lack of light, and the organisms that decompose the plants use up all the oxygen in the water.

When soil fertility levels are too high, nutrients can be removed from the soil by taking grain, hay, or other plant material off the field. Forage crops such as alfalfa remove large amounts of P and K.

> ▸ **JUDGING RULE**
> **37. Phosphorus (P) Pollution Potential**
>
> There are three possible ratings for **phosphorus pollution potential**. Select:
>
> - **High** for soils on slopes steeper than 12 percent.
> - **Medium** for all soils on:
>   - 7-12 percent slopes
>   - 3 to 6 percent slopes in which the surface texture is medium or moderately clayey
> - **Low** for other soils

CHAPTER 3 – Home Site Practices

This section has three main parts:

1. Site selection and construction practices
2. Landscape and lawn practices
3. On-site sewage disposal practices

Two key questions that direct the flow of soil judging are:

1. Are the soils suitable for a home site?
2. Are the soils suitable for a soil absorption field?

If the answer to either of these questions is "No," the judging process is greatly shortened.

Site Selection and Construction Practices

Sites that are subject to flooding and severe ponding are not suitable home sites. **Flooding** refers to areas that get covered with water from a stream. **Ponding** refers to areas where the water comes instead from nearby higher areas.

Newscasts abound with reports of houses sitting in water. Many of these houses were built on flood plains, and the flooding tragedy could have been avoided if the original builder had heeded the advice in this section.

Depressions on uplands and terraces are subject to ponding. Builders can compensate for minor ponding problems. If a depression has more than 20 inches of recent sediment over the original soil, however, the area has major problems and should not be used for a home site.

> ▸ **JUDGING RULE**
> **15. Is the Soil Suitable for a Home Site**
>
> Is the Soil Suitable for a Home Site? Mark:
>
> - **No** if the landform is a flood plain or a filled depression — if you mark "No" here, then mark all subsequent home site (52-74) "No," "Not applicable," or "N/A."
> - **Yes,** if the land form is *not* a flood plain or filled depression —proceed to judging rule 16.

Construction Practices and Rules

PRESERVE AND PLANT TREES

Trees on home sites provide a range of environmental, social, and economic benefits that improve the quality of life. Healthy trees increase in value with age and pay big dividends by cleaning air, purifying water, reducing energy costs, and beautifying communities.

Because older trees provide more benefits, it is especially important to preserve existing trees. Most tree roots are in the upper 12 inches of soil where compaction caused by heavy equipment can damage them. The main area of concern is inside a tree's dripline, which is the area directly under the outermost leaves of the tree. If there is construction activity on a home site, you should erect a fence around the dripline to keep out all construction activity.

All potential home sites that have no trees will benefit from planting new trees, and most sites with a few trees will benefit from planting more. However, you must consider the site conditions when selecting tree species. For example, you should plant only small trees under power lines.

> ▸ **JUDGING RULE**
> **16. Preserve Existing Trees and Plant New Ones**
>
> Mark "Yes" for **Preserve existing trees and plant new ones** for all sites.

STOCKPILE TOPSOIL

Surface soil horizons (topsoil) provide a better medium for lawns and gardens than subsurface horizons. For this reason, after workers have protected all trees on a site, they should remove and stockpile all the topsoil on a home site.

Construction activities will mix and compact the deeper soil horizons and parent materials. After construction is complete and the site has been graded to establish surface drainage, spread the stockpiled topsoil on the surface with as little compaction as possible.

MAINTAIN SOIL COVER DURING CONSTRUCTION

Construction on all sites (especially sloping sites) should be done in a way that disturbs existing vegetation as little as possible. If workers must remove any vegetation, they should establish new vegetation as soon as possible to reduce erosion and off-site damage from sediment resulting from erosion. If a construction site will be active for more than 45 days, sow seeds of a suitable grass species.

> ▸ **JUDGING RULE**
> **17. Maintain Soil Cover During Construction**
>
> Mark "Yes" for **Maintain soil cover during construction** if either of these conditions are found:
>
> - Slope is greater than 2% and/or
> - Surface texture is sandy or moderately sandy — regardless of the slope

IMPROVE SURFACE DRAINAGE

Good surface drainage is important, and in Indiana surface drainage often needs to be improved. The state's flat and gently sloping topography has very slow surface drainage and is dominated by poorly drained and somewhat poorly drained soils. Poorly drained soils are often in depressions, which are frequently ponded.

You should channel surface waters away from the house and away from on-site septic system absorption fields. If you do not do this, the surface water will make a high water table problem worse.

> ▸ **JUDGING RULE**
> **18. Improve Surface Drainage**
>
> Mark "Yes" for **Improve surface drainage** if the soil has *both* of these properties:
>
> - Poorly drained or somewhat poorly drained soils
> - Slope is 0-2 percent

SUITABILITY OF SOIL FOR BASEMENT

Many people want basements under their houses, but some soil properties limit basements and are very difficult and expensive to overcome.

Soil properties that limit basements include:

High water tables. Well-drained soils have a low water table and have few drainage limitations. Foundation drainage (judging rule 22) can alleviate some high water table limitations.

Excavation problems. Bedrock is very difficult to dig into.

Steep slopes. Buildings on very steep slopes may slip downslope if not built properly.

Swelling clays. Some kinds of clay swell up when they get wet. This swelling can exert so much pressure on basement walls that they crack and buckle. This is one phase of the problem explained in judging rule 20. Swelling clays also cause problems for on-site sewage disposal systems.

> ▸ **JUDGING RULE**
> **19. Is the Soil Suitable for a Basement?**
>
> Mark "Yes" for **Is the soil suitable for a basement?** if the soil has all of these properties:
>
> - Soil is well-drained
> - No bedrock closer than 40 inches from the soil surface
> - Slope is 12 percent or less

DESIGN FOR HIGH-CLAY SUBSOILS

Soils with high clay contents cause special construction problems for houses. In soils with coarser textures the friction between large particles (sand and gravel) support the weight of the structure. Clayey soils lose strength rapidly as they take up moisture. Clay particles have layers of water between them and slide easily over each other. For this reason, it is important to increase the size (width and depth) of footings on clayey subsoils.

Also, many fine-textured soils expand when they are wet and shrink when dry. If workers backfill the excavated area around basement walls with soil material, a space will develop between the wall and the soil when the soil dries out and shrinks. Soil material might fall into this space, and when the soil becomes wet again, it will swell, and that added soil material will press into the building's foundation wall and may cause it to crack. Backfill the excavated area around basement walls with pea gravel to minimize this swelling pressure.

▸ **JUDGING RULE**
20. Design for High-clay Subsoils

Mark "Yes" for **Design for high-clay subsoils** if the subsoil texture is clayey.

POTENTIAL CONSTRUCTION HAZARDS ON SLOPES

Soils on steep slopes cause some special problems for equipment operations. There is a great rollover hazard on slopes above 12 percent. This is true for both construction equipment as well as lawn maintenance equipment. Great care must be exercised when operating equipment on steep slopes. Homeowners should be aware of these problems when planning and building houses, and should discuss them with builders and contractors.

▸ **JUDGING RULE**
21. Potential Construction Hazards on Slopes

Mark "Yes" for **Potential construction hazards on slopes** if the slope is more than 12 percent.

INSTALL DIVERSION STRUCTURES AND DRAINS

To avoid soggy areas around the house and wet basements, builders must make provisions to divert surface and subsurface water away from the building. If a house is built on sloping land (but not at the top of a hill), the lot may receive a lot of runoff from the land above it.

Construction crews can build **diversion structures** that direct surface runoff away from the lot. In some soils, water also moves downslope within the soil profile. This *subsurface* water flow can result in wet basements or cause on-site sewage systems to fail. To intercept and divert subsurface seepage water away from the area, workers can install subsurface drain pipes called **diversion drains.**

▸ **JUDGING RULE**
22. Install Diversion Structures and Drains

Mark "Yes" for **Install diversion structures and drains** if the soil has *both* of these properties:

- Slope is more than 2 percent
- Either:
  - There is a bedrock, dense till, or fragipan limiting layer closer than 40 inches to the soil surface
  - Subsoil texture is moderately clayey or clayey

PROVIDE FOUNDATION DRAINAGE

Foundations are built into soils, so builders must consider soil properties when they design any building. Installing footing drains will remove subsurface water from around the base of the foundation and from underneath the basement floor.

Footing drains are typically made from perforated plastic tubes that workers lay next to the footings while they are building a foundation. They remove water from outside of the basement walls and reduce water pressure on the basement walls and floor. If a gravity outlet is not available for the footing drains or sub-floor drains, then a sump pump is needed to remove the water.

▸ **JUDGING RULE**
23. Provide Foundation Drainage

Mark "Yes" for **Provide foundation drainage** for soils that have these properties:

- Moderate, somewhat-poor, or poor drainage, regardless of other properties or
- Well-drained soils that do not have:
  - Sandy subsoil texture and/or
  - Coarse sand and a gravel limiting layer less than 40" from the soil surface

HIGH RISK FOR CAVE-IN DURING CONSTRUCTION

All excavations have a potential to cave-in, but sandy soils are especially vulnerable.

▸ **JUDGING RULE**
24. High Risk for Cave-in During Construction

Mark "Yes" for **High risk for cave-in during construction** for soils that have one or both properties:

- Landform is Dune, Outwash/Lacustrine, or Floodplain, and/or
- Any poorly drained soil, regardless of landform

Landscape and Lawn Practices

Plants thrive best when they are well-suited to the soil they grow in. Once established, turf and landscape plantings need continued care, particularly fertilization. This section explains how soils are important in lawn and landscaping practices. The practices considered for soil contests involve soil acidity and the nutrient elements: nitrogen (N), phosphorus (P), potassium (K), and calcium (Ca).

Manage Soil Reaction

Some landscaping plant species (such as azaleas and rhododendrons) require very acidic (low pH) soils. Homeowners can lower soil pH in some soils by adding sulfur (S) or aluminum sulfate. For other soils, however, it is so difficult to lower the pH that it is more practical to plant species that tolerate higher pH conditions better.

▸ **JUDGING RULE**
25. Manage Soil Reaction for Acid-loving Shrubs

Mark **Manage soil reaction for acid-loving shrubs**. Select:

- **No application** if the soil pH is 5.6 or less
- **Apply sulfur** if the pH is 5.7 to 7.9
- **Plant other species** if the pH is 8.0 or more

▸ **JUDGING RULE**
26. Manage Soil Reaction for Lawns

Mark **Manage soil reaction for lawns**. Select:

- **Apply lime** if the pH is 5.9 or less
- **No application** if the pH is 6.0 to 7.5
- **Plant other species** if the pH is 7.6 or greater

Manage Soil Fertility

Lawns are fertilized mainly with N, P, and K. N application rates are based on the level of management the homeowners want to commit to. If they wish to have very green and lush lawns, they apply high N rates. Application rates for P and K are based on soil test results, which are reported in units of parts per million (ppm). If the soil is very acidic, apply lime to raise soil pH and supply calcium (Ca). If the soil has a high pH, choose turf species that are adapted to alkaline conditions.

P and K fertilizer recommendations are available in *Turfgrass Management: Establishing a Lawn from Sod* (Purdue Extension publication AY-28-W), available from the Education Store, www.edustore.purdue.edu.

▸ **JUDGING RULE**
27. Apply Phosphorus (P) to Lawn

Mark "Yes" for **Apply phosphorus (P) to lawn** if available P is less than 25 ppm

▸ **JUDGING RULE**
28. Apply Potassium (K) to Lawn

Mark "Yes" for **Apply potassium (K) to lawn** if available K is less than 75 ppm

On-site Sewage Disposal and Suitability

Sewage is liquid-carried waste generated as part of normal living. It comes from toilets, bathtubs, showers, sinks, washing machines, dishwashers, and other sources. In cities and towns, water is piped to homes through a water system, and sewage flows through sewer lines to a central treatment plant. Home sites that are not served by centralized water and sewer systems usually draw water from wells and treat sewage with **on-site sewage disposal systems**, which process sewage on the site where it is produced.

All on-site sewage disposal systems have two main parts:

- A septic tank, which processes the sewage and produces effluent
- A soil absorption field, which allows the soil to absorb and further purify the effluent

First, to save time and effort, let's see if the site is suitable for any kind of system

Soil Suitability for Soil Absorption Fields

Some soils are not suitable for soil absorption fields. They are separated out early.

▸ **JUDGING RULE**
29. Is the Soil Suitable for an Absorption Field?

Mark "Yes" for **Is the soil suitable for an absorption field?** for all soils except for those that have one or more of these properties:

- Bedrock, fragipan, sand and gravel, or dense till limiting layer less than 20" from the soil surface
- Slope greater than 25%
- Upland depression or outwash depression landform

NOTE:

- If you mark "NO" to this question, then questions 30-38 should also be marked "NO" or "N/A"
- All other soils should be marked "Yes"; then continue to #30.

Septic Tank Care Practices

A septic tank is a large air- and watertight tank in which anaerobic (without oxygen) microbes break down the sewage. Most septic tanks for single family homes hold 1,000 to 2,000 gallons. Three kinds of material form in septic tanks:

- **Liquid effluent.** Most sewage becomes liquid effluent. Eventually, effluent flows out of the septic tank through an outlet filter to the soil absorption field.
- **Scum.** Anaerobic organisms do not break down sewage completely. Some of the remaining material floats on the effluent as scum which accumulates near the top of the tank until it is pumped out. Scum is composed mainly of fats, oils, and greases (FOG).
- **Sludge.** Other material not broken down by anaerobes is heavy. It sinks to the bottom of the tank as sludge and remains there until it is

pumped out.

Septic Tank Care: Outlet Filter

A septic tank has an outlet filter that removes solid material that does not break down (toothpicks, hair, foil, etc.) from the effluent. The filter must be cleaned periodically, otherwise, the solid material will get into the soil absorption field and slow its ability to absorb effluent.

The more people living in the house, the more frequently the filter must be cleaned. The actual time intervals between cleanings may vary from these rules based on the occupants' lifestyle choices.

▶ JUDGING RULE
30. Septic Tank Outlet Filter Cleaning Interval

For **Septic tank outlet filter cleaning interval**, select one of these options:

- 1-3 people in the home — clean septic tank outlet filter once a year
- 4 or more people in home — clean septic tank outlet filter every six months

Septic Tank Care: Tank Pumping

Homeowners must have scum and sludge removed from the septic tank periodically to keep the system from failing. However, you can't just remove scum and sludge, so the entire contents of the tank are removed at cleaning time. The time between tank cleanings:

- Increases with larger septic tanks — larger tanks store more sludge and scum
- Decreases if the house has a garbage disposer — much ground up garbage from the disposer does not digest quickly and settles out as sludge
- Decreases with more residents — each resident contributes to the accumulation of sludge and scum

Rule 31 provides the equation for this relationship.

▶ JUDGING RULE
31. Septic Tank Pumping Interval

Calculate the **Septic tank pumping interval** using this equation:

$$PI = \frac{(D \times G) / 1{,}000}{R}$$

Where:

PI = Pumping Interval (in years)

D = 7 if garbage disposal is checked "Yes" on site card

D = 10 if garbage disposal is checked "No"

G = Septic tank capacity (in gallons)

R = Number of residents in the house

Select the closest answer on the scorecard

Round your answer to the nearest whole number, and round 0.50 down to be conservative — round 3.50 years down to 3. If your calculation is 5 or more years, choose 5 years on the scorecard.

Here are some example calculations using the equation:

$$PI = \frac{(D \times G) / 1{,}000}{R}$$

Example 1. Five people live in the house, which has a 1,000-gallon septic tank and a garbage disposer. Therefore, D = 7, G = 1,000, and R = 5.

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

Round to 1 year, "A" on the scorecard.

Example 2. Three people live in the house, which has a 1,500-gallon septic tank and no garbage disposer. Therefore, D = 10, G = 1,500, and R = 3.

$$PI = \frac{(10 \times 1{,}500) / 1{,}000}{3} = \frac{15}{3} = 5$$

5 years is "D" on the scorecard.

Soil Absorption Field Practices

A soil absorption field is an area of soil that further processes effluent from a septic tank. In the soil, aerobic organisms (those that require oxygen) further purify the effluent. In addition to processing effluent biologically, the soil adsorbs some products (such as phosphates) chemically.

Ideally, the soil removes organic matter and harmful organisms from sewage, and the treated effluent moves down to the groundwater or aquifer. The absorption field must have at least 24 inches of aerated soil to effectively treat effluent.

The list below compares soil properties that are ideal for soil absorption fields with those properties that make the soil unsuitable for a field:

- **Flooding and ponding**. Soils suitable for soil absorption fields are not flooded or ponded with water. Soils prone to flooding and ponding are unsuitable.
- **Soil permeability**. Soils suitable for soil absorption fields have soil layers that have moderate permeability. Soil layers with very slow permeability are unsuitable, because they cannot absorb effluent as quickly as it is produced. Unsuitable layers include bedrock, dense till, and fragipan limiting layers. Also, if the permeability is too high, the effluent will flow through the soil very fast and not remain in the soil long enough for aerobic organisms to treat it. Unsuitable layers include coarse sand and gravel.
- **Water table**. In ideal soils, the water table is deep. If the seasonally high water table is shallow there is not enough aerated soil to purify the effluent. Subsurface drainage or alternative designs can lower the water table and improve the chances for successful systems.
- **Slope**. In soils with gradual slopes, effluent moves downward and is processed. Several kinds of absorption fields can be used on these soils. In soils with steep slopes, effluent might seep to the surface before it is processed. Soils with slopes of more than 25 percent are not suitable for soil absorption fields. Also, soils in depressions are not suitable because surface water moves into the depression and tends to keep the water table high.

These properties are reflected in the discussion and rules that follow.

If you mark "No" for this item, a house may be built on this site only if it is served by a centralized sewer system.

Kinds of Soil Absorption Fields and Effluent Application

Effluent from the septic tank usually moves to a distribution box. The distribution box distributes the effluent uniformly to several parallel lines of perforated pipes that are buried in the soil. These lines of pipes are called **laterals**, and the whole system constitutes **a soil absorption field**. The effluent can move through a soil absorption field by gravity or under pressure.

Next, we describe several kinds of absorption fields. Then we describe secondary treatment and additional drainage, which help soil absorption fields function better.

SUBSURFACE TRENCH, GRAVITY FLOW SYSTEMS

Subsurface trench, gravity flow systems are commonly used for soil absorption fields. In these systems, effluent flows by gravity from the septic tank, through a distribution box, and then to distribution lines (laterals) that are in trenches that are about 10 to 36 inches deep and 18 to 36 inches wide. The length of the laterals depends on how much effluent a soil can absorb in a day (called the soil loading rate) and the amount of effluent from the septic tank. In any case, a lateral must be less than 100 feet long.

Each lateral consists of a perforated plastic pipe (usually four inches in diameter) that is surrounded by aggregate (usually gravel) in the trench. A geotextile fabric (wide enough to cover the trench) is laid on top of the aggregate to keep soil material out. The fabric is covered with soil material.

In subsurface trench gravity flow systems, effluent flows through the distribution box to laterals. When the effluent level in the septic tank rises above the outlet pipe, the effluent flows out of the tank by gravity. From the laterals, the effluent moves through the aggregate and the soil where aerobic microorganisms break down the organic components. The soil itself also filters out and adsorbs some effluent components.

► **JUDGING RULE**
32. Subsurface Trench, Gravity Flow System

Mark "Yes" for **Subsurface trench, gravity flow system** if the soil has *all* of these properties:

- No bedrock, fragipan, coarse sand and gravel, or dense till limiting layer within 40 inches of the soil surface
- Soil is well-drained
- Subsoil texture is moderately sandy, or medium
- Slope is 12 percent or less

SUBSURFACE TRENCH, FLOOD DOSE SYSTEMS

Subsurface trench, flood dose systems are similar to gravity flow systems, except that flood dose systems pump effluent. Effluent flows from the septic tank into a dose tank. Once a day, the system pumps effluent from the dose tank, through the distribution box, and then to the laterals.

These systems can be used where the absorption field is higher than the septic tank, or more commonly, where the soil absorption field has long laterals because the soil has a low loading rate. Compared to gravity flow systems, flood dose systems have an advantage: A large dose of effluent will fill all trenches more evenly and more of the trench will be used for absorption.

► **JUDGING RULE**
33. Subsurface Trench, Flood Dose System

Mark "Yes" for Subsurface trench, flood dose system if the soil has all of these properties:

- No bedrock, fragipan, sand and gravel, or dense till limiting layer within 40 inches of the soil surface
- Soil is well-drained
- Subsoil texture is moderately clayey or clayey
- Slope is 12 percent or less

SUBSURFACE TRENCH, PRESSURE DOSE SYSTEMS

Subsurface trench, pressure dose systems pump effluent under pressure all the way to the distribution laterals. This distributes effluent more uniformly to each lateral. These systems are particularly well-suited to areas where the subsoil is fine and medium sand (such as in the eolian parent material of sand dunes). Elevated sand mounds and drip distribution systems also use pressure dosing.

► **JUDGING RULE**
34. Subsurface Trench, Pressure Distribution System

Mark "Yes" for Subsurface trench, pressure distribution system if the soil has all of these properties:

- No bedrock, fragipan, sand and gravel, or dense till limiting layer within 40 inches of the soil surface
- Soil is well-drained
- Subsoil texture is sandy
- Slope is 12 percent or less

ELEVATED SAND MOUND SYSTEMS

Elevated sand mound systems are used when there is a limiting condition near the soil surface — such as a limiting layer or a high water table. In elevated sand mound systems, installers place a layer of sand at least 12 inches thick on the soil surface, then place distribution pipes (laterals) in an aggregate (gravel) bed about 12 inches thick on top of the sand. Installers then cover the aggregate bed tubes with geotextile and soil fill.

The effluent flows into a dose tank and then is pumped into the mound under pressure — usually four times a day. Do not use mound systems on soils that have a slope of more than 6 percent, because effluent might seep out and pond around the mound's base.

> ▸ **JUDGING RULE**
> **35. Elevated Sand Mound System**
>
> Mark "Yes" for **Elevated sand mound system** if the soil has all these properties:
>
> - No bedrock, fragipan, coarse sand and gravel, or dense till limiting layer above 20 inches
> - Soil is well drained or moderately well drained
> - Slope is 6 percent or less

DRIP DISTRIBUTION SYSTEMS

Drip distribution systems treat sewage in a septic tank just like other systems. From the tank, effluent flows to a dose tank and then is pumped to a secondary treatment device (described later) that further cleans the effluent. This cleaner effluent is distributed under pressure to drip tubing lines. These small-diameter tubes have outlet ports spaced along the tubes. The ports open when the effluent in the tubes is under pressure and close when the pressure subsides. These tubes are placed in slots cut into surface soil horizons.

The system injects effluent into the biologically active zone of the soil. In this way, the effluent provides water and nutrients to lawns, natural areas, or crops. The topsoil and plant root system provide an excellent environment for treating effluent. Professionals can install drip distribution systems on much steeper slopes than other onsite sewage systems. If secondary treatment does not clean the effluent, the outlets ports would soon become clogged.

SOIL ABSORPTION FIELD SUPPLEMENTS

Some supplemental practices help absorption fields function better. They are explained below. Later, basic soil absorption field designs are combined with supplements to create some supplemented systems.

Two of the supplements, perimeter drains and interceptor drains, lower the seasonally high water table so the absorption field has sufficient *aerated* soil to process effluent properly.

Perimeter drains are installed in soils with slopes of 2 percent or less. They completely surround soil absorption fields. They are installed at least 10 feet from the outside edge of a field and are placed deep enough so that the seasonal high water table is more than 2 feet below the bottom of the absorption field trench. But to work properly these drains must have an outlet for the water to drain by gravity — and this requirement is often difficult to meet. For contests judging, they are used with sand mounds.

Interceptor drains are installed in soils with slopes of 3 percent or more and only on the upslope side of an absorption field. These drains keep groundwater from seeping into the field. Although it is not included in soil judging rules, *interceptor drains should be used with any absorption field in which water could seep through the soil profile into the absorption field*. They are similar to diversion drains (see judging rule 22 and related discussion, page 35), except that interceptor drains are installed closer to the fields.

Secondary treatment of effluent. Effluent that flows out of a septic tank may appear clean, but it contains significant amounts of organic matter and other contaminants. Secondary treatment removes much of this organic matter after it leaves the septic tank and before it moves to the soil absorption field. Secondary treatment also adds oxygen to the effluent to encourage aerobic decomposition of organic matter. Some secondary treatment systems inject air into effluent. Other systems allow effluent to absorb oxygen passively as it trickles down through sand or other media such as geotextile fabric. The resulting effluent is much cleaner, which extends the life of the soil absorption field. Secondary treatment systems, however, require more maintenance than conventional systems because they have pumps, valves, and other mechanical equipment that must be routinely checked and serviced by professionals. Indiana requires that outflow from secondary treatment be further treated by the soil rather than discharged onto the soil surface or into surface water. Homeowners in wooded areas often use secondary treatment so they can use a drip distribution system, which requires clearing less area than a conventional trench soil absorption field. Secondary treatment systems are also used to repair or replace a failed conventional system.

Soil judging rules are based on systems that *do not use* secondary treatment, except for drip distribution, which requires secondary treatment.

Rules for supplemented systems

The rules below combine ordinary absorption fields with supplements.

> ▸ **JUDGING RULE**
> **36. Elevated Sand Mound System and Perimeter Drainage**
>
> Mark "Yes" for **Elevated sand mound system and perimeter drainage** if the soil has all these properties:
>
> - No bedrock, fragipan, coarse sand and gravel, or dense till limiting layer above 20 inches
> - Soil is somewhat poorly drained or poorly drained
> - Slope is 6 percent or less

Most poorly and somewhat poorly drained sites are on slopes of 2% and less. If the slope is 3% or greater, an interceptor drain will be installed instead of a perimeter drain

DRIP DISTRIBUTION

Secondary treatment is *required* for drip distribution systems. It will extend the life of *any* absorption system, however, as reflected in these rules.

> ▸ **JUDGING RULE**
> **37. Drip Distribution System and Secondary Treatment**
>
> Mark "Yes" for **Drip distribution system and secondary treatment** if the soil has all of these properties:
>
> - No bedrock limiting layer less than 20" from the soil surface
> - Well-drained or moderately well-drained if perimeter drainage is installed
> - Slope of 25% or less

> ▸ **JUDGING RULE**
> **38. Secondary Treatment**
>
> Mark "Yes" for **Secondary treatment** if you marked "Yes" for at least one soil absorption field practice (judging rules 32 to 37).

Soil Water Cycle

Ideally, an on-site sewage system cycles water in this way:

1. Homeowners pump water into the house from an aquifer (underground layer saturated with water).
2. They use the water for drinking, bathing, flushing toilets, washing dishes and clothes, etc. This water use adds impurities that transform the water into sewage.
3. The sewage enters the septic tank where anaerobic microbes partially treat it to produce mainly liquid effluent. Resistant solids settle on the bottom of the tank, and scum floats on top of the effluent.
4. The partially treated effluent flows from the tank through the outlet filter and into the soil absorption field.
5. In the absorption field, aerobic microbes break down organic contaminants and harmful organisms in the effluent, and soils adsorb inorganic contaminants.
6. The treated water moves into the aquifer.
   Note that this list starts and ends with water in an aquifer and thus describes a cycle. This cycle illustrates how important soil is in maintaining a safe supply of household water.

The sections below explain which soils are suitable for soil absorption fields, and which kinds of systems can be used on suitable soils. To come as close as possible to achieving the ideal described above, the on-site sewage system must be well designed, installed properly in suitable soils, and well maintained.

The sections below summarize these processes. See *Indiana Soils* for more thorough descriptions of the processes.

Actual Practice and Innovative Systems

Soil judgers may mark several suitable systems "Yes". In practice, usually the least expensive one is chosen.

Some of the depth and slope limits in soil contest rules are not the same as state rules. For example, state law allows trench systems on slopes of 15 percent or less, but soil contest limits are at 12 percent and 18 percent, so we set the limit at 12 percent.

The discrepancy also applies to some depth limits. Soil contest rules demonstrate general principles, but if you plan to install an on-site sewage system, always check with county officials first to know community requirements.

Also note that there are many innovative systems we don't mention in this guide that might be applicable and practical for some sites — such as plastic chambers to reduce the trench size, sand-lined large pipes, and aerobic treatment units that digest waste more intensely before sending the effluent to the absorption field. Always check with a certified on-site system installer and local public health officials for details about these and other systems.

RESOURCES – Site Card and Scorecards

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Soil Contest Site Card

4-H-736-W

March 2017

SITE NO. ....

SITE TYPE ☐ AGRICULTURE ☐ HOME SITE

CALCAREOUS BELOW .... in.

JUDGE PARENT MATERIAL .... to .... in.

FLAT LANDFORM YES NO

WEAK SOIL DEVELOPMENT YES NO

P: .... ppm	K: .... ppm	pH: ....

SEPTIC TANK CARE

D = ...	G = ...	R = ...
Disposer? *Yes* D=7 *No* D=10	*Tank capacity (gallons)*	*Residents in house*

NOTES

....

....

....

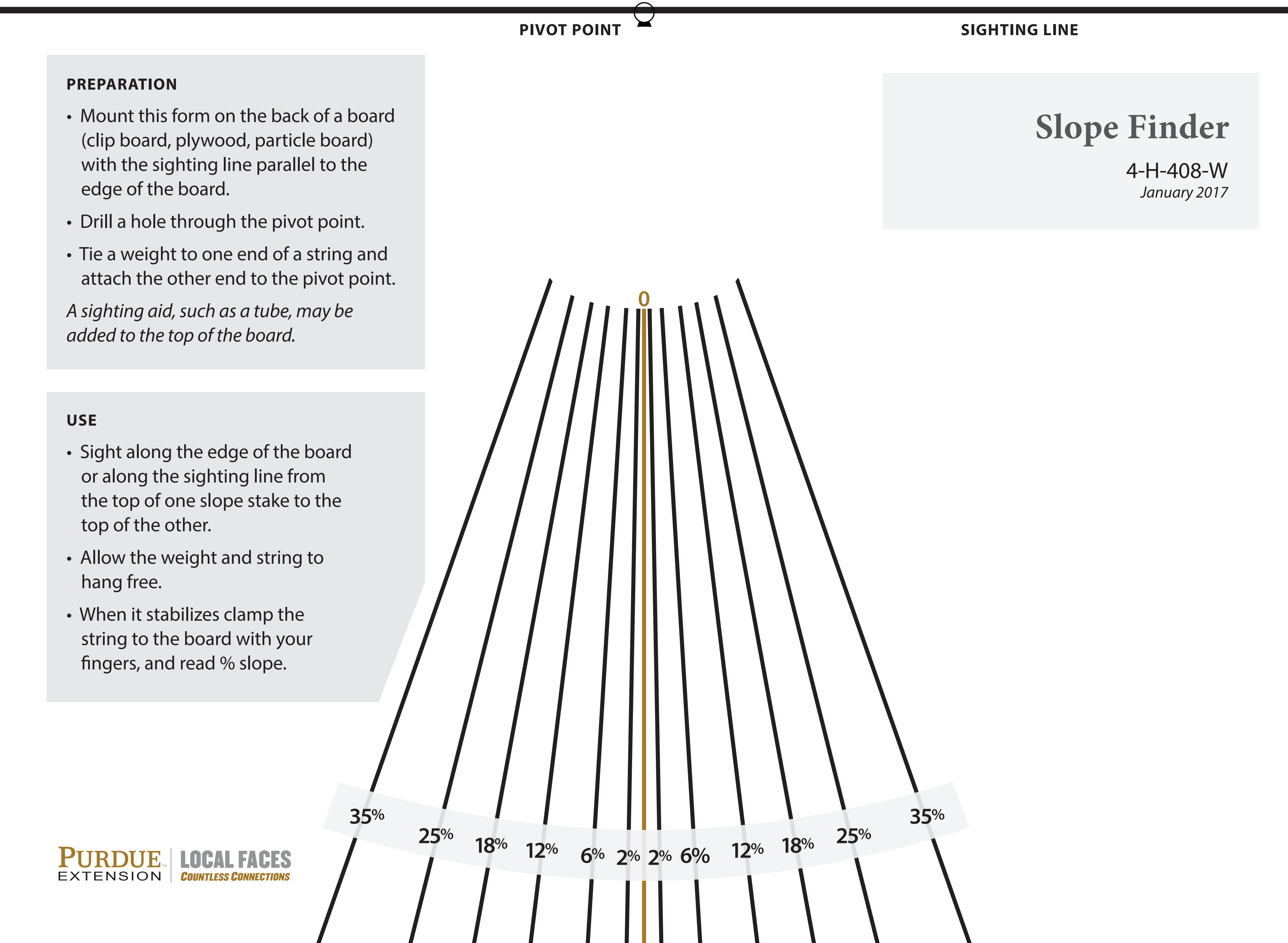
....

....

Copies of this form (4-H-736-W) are available from the Purdue Extension Education Store, www.edustore.purdue.edu.

Slope Finder

4-H-408-W
January 2017



PREPARATION

- Mount this form on the back of a board (clip board, plywood, particle board) with the sighting line parallel to the edge of the board.
- Drill a hole through the pivot point.
- Tie a weight to one end of a string and attach the other end to the pivot point.

A sighting aid, such as a tube, may be added to the top of the board.

USE

- Sight along the edge of the board or along the sighting line from the top of one slope stake to the top of the other.
- Allow the weight and string to hang free.
- When it stabilizes clamp the string to the board with your fingers, and read % slope.

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Indiana Soil Evaluation Scorecard

4-H-394-W AGRICULTURE

I. SOIL PROPERTIES *(5 points each, 45 total)*

A. PARENT MATERIAL

1A Weathered bedrock
1B Till
1C Outwash/Lacustrine deposits
1D Eolian sand
1E Loess
2A Alluvium
2B Local overwash

B. SLOPE

3A 0-2%
3B 3-6%
3C 7-12%
3D 13-18%
3E 19-25%
4A 26-35%
4B >35%

C. LANDFORM

5A Upland hillslope
5B Upland swell
5C Upland flat
5D Upland depression
5E Outwash/Lacustrine hillslope
6A Outwash/Lacustrine swell
6B Outwash/Lacustrine flat
6C Outwash/Lacustrine depression
6D Dune
6E Flood plain
7A Filled depression

D. SURFACE SOIL COLOR GROUP

8A Gray
8B Brown
8C Black

E. PREVIOUS EROSION

9A None to slight
9B Moderate
9C Severe

F. SURFACE TEXTURE

10A Sandy
10B Moderately sandy
10C Medium
10D Moderately clayey
10E Clayey

G. SUBSOIL TEXTURE

11A Sandy
11B Moderately sandy
11C Medium
11D Moderately clayey
11E Clayey

H. NATURAL SOIL DRAINAGE

12A Poorly
12B Somewhat poorly
12C Moderately well
12D Well

I. LIMITING LAYER

13A Bedrock, 0-20 in
13B Bedrock, 21-40 in
13C Dense till, 0-20 in
13D Dense till, 21-40 in
13E Fragipan, 0-20 in
14A Fragipan, 21-40 in
14B Coarse sand & gravel, 0-20 in
14C Coarse sand & gravel, 21-40 in
14D None within 40 in

II. AGRICULTURE PRACTICES *(3 pts. each, 69 total)*

A. LAND USE OVERVIEW

15 Restore original vegetation to:
A - Wetland; **B** - Prairie; **C** - Mesic forest

	Yes	No	
16	A	B	Prime farmland

B. EROSION AND COMPACTION POTENTIALS

17	A	B	High for erosion by water
18	A	B	High for erosion by wind
19	A	B	High for soil compaction

C. BUFFERS AND COVER CROPS

20	A	B	Grassed waterways
21	A	B	Windbreaks
22	A	B	Filter strips

23 Most significant benefit of cover crops:
A - Scavenge N; **B** - No need; **C** - Erosion control

D. CROPPING PRACTICES

	Yes	No	
24	A	B	Timber stand improvement (TSI)
25	A	B	Permanent pasture
26	A	B	Crop rotation

E. TILLAGE PRACTICES

27	A	B	No till
28	A	B	Moldboard or chisel plowing

F. WATER MANAGEMENT

29	A	B	Drainage
30	A	B	Irrigation
31	A	B	Terraces

G. PLANT NUTRIENT APPLICATION

		A	B	C
32	N:	Low	Med.	High
33	P:	Add	None	Deplete
34	K:	Add	None	Deplete
35	Lime:	Add	None	

H. NUTRIENT POLLUTION POTENTIAL

36 Nitrogen pollution potential:
A - High, ground water; **B** - High surface water; **C** - Med.

37 Phosphorus pollution potential:
A - High; **B** - Medium; **C** - Low

Team / Contestant number: ____________________

Contestant name: ____________________

School / Club name: ____________________

Site number: ____________________

SCORE

Part I *(45 points possible)*: ____________________

Part II *(69 points possible)*: ____________________

Total *(114 points possible)*: ____________________

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PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Indana Soil Evaluation Scorecard

4-H-255-W **HOME SITE**

I. SOIL PROPERTIES *(5 points each, 45 total)*

A. PARENT MATERIAL

1A Weathered bedrock
1B Till
1C Outwash/Lacustrine deposits
1D Eolian sand
1E Loess
2A Alluvium
2B Local overwash

B. SLOPE

3A 0-2%
3B 3-6%
3C 7-12%
3D 13-18%
3E 19-25%
4A 26-35%
4B >35%

C. LANDFORM

5A Upland hillslope
5B Upland swell
5C Upland flat
5D Upland depression
5E Outwash/Lacustrine hillslope
6A Outwash/Lacustrine swell
6B Outwash/Lacustrine flat
6C Outwash/Lacustrine depression
6D Dune
6E Flood plain
7A Filled depression

D. SURFACE SOIL COLOR GROUP

8A Gray
8B Brown
8C Black

E. PREVIOUS EROSION

9A None to slight
9B Moderate
9C Severe

F. SURFACE TEXTURE

10A Sandy
10B Moderately sandy
10C Medium
10D Moderately clayey
10E Clayey

G. SUBSOIL TEXTURE

11A Sandy
11B Moderately sandy
11C Medium
11D Moderately clayey
11E Clayey

H. NATURAL SOIL DRAINAGE

12A Poorly
12B Somewhat poorly
12C Moderately well
12D Well

I. LIMITING LAYER

13A Bedrock, 0-20 in
13B Bedrock, 21-40 in
13C Dense till, 0-20 in
13D Dense till, 21-40 in
13E Fragipan, 0-20 in
14A Fragipan, 21-40 in
14B Coarse sand & gravel, 0-20 in
14C Coarse sand & gravel, 21-40 in
14D None within 40 in

II. HOME SITE PRACTICES *(3 pts. each, 72 total)*

A. SITE SELECTION AND CONSTRUCTION PRACTICES

	Yes	No	
15	A	B	Is the soil suitable for a homesite? *If NO, mark practices 16-38 as NO, N/A, or No application*
16	A	B	Preserve trees & plant new ones
17	A	B	Maintain soil cover during construction
18	A	B	Improve surface drainage
19	A	B	Is the soil suitable for a basement?
20	A	B	Design for high-clay subsoils
21	A	B	Potential construction hazards on slopes
22	A	B	Install diversion structures and drains
23	A	B	Provide foundation drainage
24	A	B	High risk for cave-in during construction

B. LANDSCAPE AND LAWN PRACTICES

25 Manage soil reaction for acid-loving shrubs
A - No application; **B** - Apply sulfur; **C** - Plant other species

26 Manage soil reaction for lawns
A - Apply lime; **B** - No application; **C** - Plant other species

	Yes	No	
27	A	B	Apply phosphorus (P) to lawn
28	A	B	Apply potassium (K) to lawn

C. ON-SITE SEWAGE DISPOSAL - SUITABILITY

	Yes	No	
29	A	B	Is soil suitable for an absorption field? *If NO, mark practices 30-38 as NO or N/A*

D. SEPTIC TANK PRACTICES

30 Septic tank outlet filter cleaning interval
A - 6 months; **B** - 1 year; **C** - N/A

31 Septic tank pumping interval (PI, years)

31A 1-2
31B 3
31C 4
31D ≥5
31E N/A

$$PI = \frac{(D \times G) / 1{,}000}{R}$$

$$PI = \frac{(\_\_\_ \times \_\_\_) / 1{,}000}{\_\_\_} \qquad PI= \_\_\_\_\_\_$$

D=Disp. (Y = 7; N = 10); G = tank size, gal.; R = Resid.

E. SOIL ABSORPTION FIELD PRACTICES

	Yes	No	
32	A	B	Subsurface trench, gravity flow system
33	A	B	Subsurface trench, flood dose system
34	A	B	Subsurface trench, pressure distrib. system
35	A	B	Elevated sand mound system
36	A	B	Elev. sand mound & subsurface drain
37	A	B	Drip distribution & secondary treatment
38	A	B	Secondary treatment

Team / Contestant number: ____________

Contestant name: ____________

School /Club name: ____________

Site number: ____________

SCORE

Part I *(45 points possible)*: ____________

Part II *(72 points possible)*: ____________

Total *(117 points possible)*: ____________

Notes

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December 2018