United States Department of Agriculture

NRCS Natural Resources Conservation Service

MARYLAND SOIL HEALTHCARD

What is Soil Health?

Soil Health is the continued capacity of a soil to function. Healthy soils support plants, animals, and humans by:

- Cycling nutrients and increasing their availability;
- Increasing water infiltration and availability;
- Maintaining a stable porous structure that withstands natural forces (e.g., water, wind).

Healthy, fully functioning soil creates a habitat that sustains diverse soil micro and macroorganisms.

Why is Soil Health Important?

Soils that lack organic matter, structure, and microorganisms are susceptible to erosion, hold less water, and need more chemical inputs to rebalance their productivity. Improving soil health increases soil aggregates and improves soil structure, resulting in greater water infiltration, decreased erosion, and reduced runoff and sedimentation.

Follow these 4 Key Principles to Improve Soil Health:

1. Minimize soil disturbance;
2. Maximize the diversity of plants in the rotation;
3. Keep living roots in the soil as much as possible;
4. Keep the soil covered with plants and plant residues at all times.

What Is the Soil Health Card?

The Soil Health Card evaluates a soil's health as a function of a select number of soil, water, plant, and other biological properties. The Card is a tool to help you monitor and make suggestions on how to improve soil health based on your own field experience and a working knowledge of soils. It is suggested to review the Web Soil Survey to gain an understanding of the soils mapped where you are measuring soil health. Regular use will allow you to record long-term changes in soil health, and to compare the effects of different soil management practices. It provides a mix of quantitative and qualitative assessment of soil health and evaluation ratings. The purpose is not to measure one soil type against another, but rather to use indicators that assess each soil's ability to function within its capabilities and site limitations. It can be used to compare one tillage practice or land use to another, of the same soil type. The Bucket Kit can be used as a follow up providing a more detailed analysis of the soil's health.

How Do You Use the Soil Health Card?

Step 1 The instructions to determine the "indicator descriptive ratings" is at the end of this document. One should also find out the soil series and map unit at the sample location.

Step 2 Use the table on page 2 for the best times to assess each indicator of soil quality and health.

Step 3 Divide the farm and fields into separate sections for evaluation in the same way you would divide them for soil-fertility sampling: separate by factors such as soil type, topography, and history of tillage, crop rotation, and manure application.

Step 4 Select a representative spot in your field and evaluate each soil health Indicator. Read the Descriptive Ratings in the table, and based on your test results or judgment, rate the indicator as Excellent, Good, Fair, or Poor by checking the box with the best description and entering the point value, in the score column, that you feel is appropriate.

Step 5 If you identify soil health indicators that are Poor or Fair, prescribe management strategies and conservation practices (see page 2) to improve soil health and quality over time.

Step 6 Follow changes in each of the soil health indicators over time, examine current field management practices, and consider ideas for management changes in problem areas.

Using Soil Health Management Strategies and Associated NRCS Conservation Practice Standards to Improve Observed Fair and Poor Soil Health Indicators

Surface Cover, Organic Matter, Soil Odor, and Earthworms Indicators

Management strategies such as:

- Using diverse high-residue crops -- see Conservation Crop Rotation (328);
- Using cover crops and cover crop mixes with grasses and legumes -- see Cover Crop (340);
- Using no-till or reduced tillage -- see Residue and Tillage Management (329) and (345);
- Reducing pesticide risk to beneficial soil organisms -- see Integrated Pest Management (595); and,
- Applying solid manure or compost at a proper agronomic rate -- see Nutrient Management (590).

These strategies will increase soil organic matter, soil biological activity, water holding capacity, and nutrient availability.

Infiltration, Compaction, and Soil Structure Indicators

Management strategies such as:

- Using diverse high-residue crops -- see Conservation Crop Rotation (328);
- Using cover crops, cover crop mixes, and deep-rooted cover crops -- see Cover Crop (340);
- Managing equipment traffic, especially on wet soils; and,
- Using no-till or reduced tillage -- see Residue and Tillage Management (329) and (345).

These strategies will improve soil structure and aggregation by increasing organic matter content and porosity, and will improve infiltration while minimizing compaction.

Best Times to Assess Indicators

Indicators	**Recommended Timing for Assessment**				
	Early Spring Before Planting	***Spring***	***Summer***	***Fall***	***After Rainfall***
Surface Cover	X	X	X	X	X
Infiltration	X	X	X	X	
Compaction	X	X		X	
Organic Matter	X	X	X	X	
Soil Structure	X	X	X	X	X
Earthworms	X	X		X	X
Soil Odor	X	X	X	X	X

MARYLAND SOIL HEALTH CARD

Farm/Tract/Field#s:	**Assisted by:**	**Date and air temp:**
Current Tillage System with number and kind of crops in rotation:	**Soil Series and Map unit sym:**	**Soil Surface Texture at site:**
Data from recent soil pH and/or organic matter analysis (if available):		

Indicators	**Descriptive Ratings and Potential Scoring Points**					
	Excellent 9-11 pts	***Good 6-8 pts***	***Fair 3-5 pts***	***Poor 0-2 pts***	**Score**	**Notes**
Surface Cover (Count living plants and dead residue)	>80% living plants and dead residue visible on soil surface.	60-80% living plants and dead residue visible on soil surface.	30-60% living plants and dead residue visible on soil surface.	0-30% living plants and dead residue visible on soil surface.		
Infiltration (Based on soil texture, refer to Infiltration Chart)	Infiltration rate at least two classes higher then listed range, indicates soil absorbs water easily.	Infiltration rate one class higher then listed range, indicates soil absorbs water in a timely manner and is not susceptible to runoff or ponding.	Infiltration rate within listed range, indicates soil absorbs water, but more slowly, and runoff and ponding may occur.	Slower infiltration rate then listed range, indicates soil absorbs water very slowly, and runoff and ponding will occur.		
Compaction/Root growth (Based on moist topsoil conditions)	Wire flag penetrates easily into 8 inches or more of soil with no resistence; unrestricted root growth.	Wire flag penetrates into 6-8 inches of soil with a little resistence; requires a little wiggling of pin flag; little root growth restriction.	Wire flag penetrates into 4-6 inches of soil with a lot of wiggling of pin flag and moderate force; root growth restricted.	Wire flag penetrates into 2-4 inches of soil with force, roots maybe growing laterally.		
Organic Matter (Compare to samples or Munsell book using Hues 7.5YR, 10YR or 2.5Y)	Soil is black in color; organic matter is visible in the topsoil layer. Value $\leq$ 2 and chroma $\leq$ 2.	Soil is dark brown in color; organic matter is visible in the topsoil layer. Value = 3 and chroma = 3.	Soil is somewhat dark in color; little organic matter is visible in the topsoil layer. Any value or chroma that doesn't meet Good or Poor numbers.	Soil is light brown to dull colored; no organic matter is visible in the topsoil layer. Value > 4 and chroma > 4		
Soil Structure/ Aggregation	Soil is granular, soft and crumbly, held together with many fine roots. Looks like cottage chesse.	Soil is granular, but not soft and crumbly, held together with some fine roots.	Soil is blocky and firmer with few fine roots.	Soil is single grain, massive or platy and hard to break apart. It has few or no fine roots.		
Earthworms and Macroinvertebrates	Earthworms/grubs etc. >7 per spade, obvious middens and casts, and many pores.	Earthworms/grubs etc. 4-6 per spade, obvious middens, casts, and pores.	Earthworms/grubs etc. 1 to 3 per spade, few middens, casts, and pores.	Earthworms/grubs etc. None present per spade, no middens, casts, or pores.		
Soil Odor	Earthy/Sweet odor noticeable > 6 inches from nose.	Earthy/Sweet odor, noticeable when close to nose.	Little odor at all.	No odor at all or sour, metallic, kitchen sink, rotten egg, stagnant.		

Total Score =

Interpretation of Total Score Results

Excellent 60-77 pts	***Good 40-56 pts***	***Fair 20-39 pts***	***Poor 0-19 pts***

Instructions to determine the Indicator Descriptive Ratings

Equipment needed: measuring tape, small spray bottle of water, paper towels, 1-quart water, sharp shooter shovel, pin flag. Photos, charts, and guides of Attachments.

All determinations are performed either on the soil surface or within the topsoil layer, 6-12 inches thick. (You should dig a hole to determine the thickness of the topsoil layer).

Soil Texture (see Attachment A)

1. Take sample 2-4 inches into topsoil layer.
2. Follow directions on Guide for Estimating Soil Texture by Feel.

Surface Cover: (see Attachment B)

1. Visual judgement by using NRCS residue photos or with a measuring tape.
2. Make estimates based on decomposing residue and living plant material.

Infiltration (see Attachment C)

1. Dig a small 2-inch-deep hole so that it has a flat bottom with straight sides.
2. Lightly scratch the bottom and sides of the hole with the pin flag.
3. Pour in1 inches of water.
4. Time how long it takes water to completely infiltrate.
5. Repeat two to three times.
6. Compare to Infiltration Chart with soil textures.

Compaction:

1. Hold pin flag about 12-15" from lower end.
2. Push lower end into soil surface, wiggling if needed. Pin flag shouldn't bend.
3. Observe how deep the pin flag penetrates the soil.

Organic Matter (see Attachment C)

1. Select soil sample from topsoil layer.
2. Moisten soil if dry.
3. Match soil with organic matter color chart or use Munsell color chart if available.

Soil Structure/Aggregation: (see Attachment D) Can be done along with Earthworms.
Visual judgement using NRCS photos.

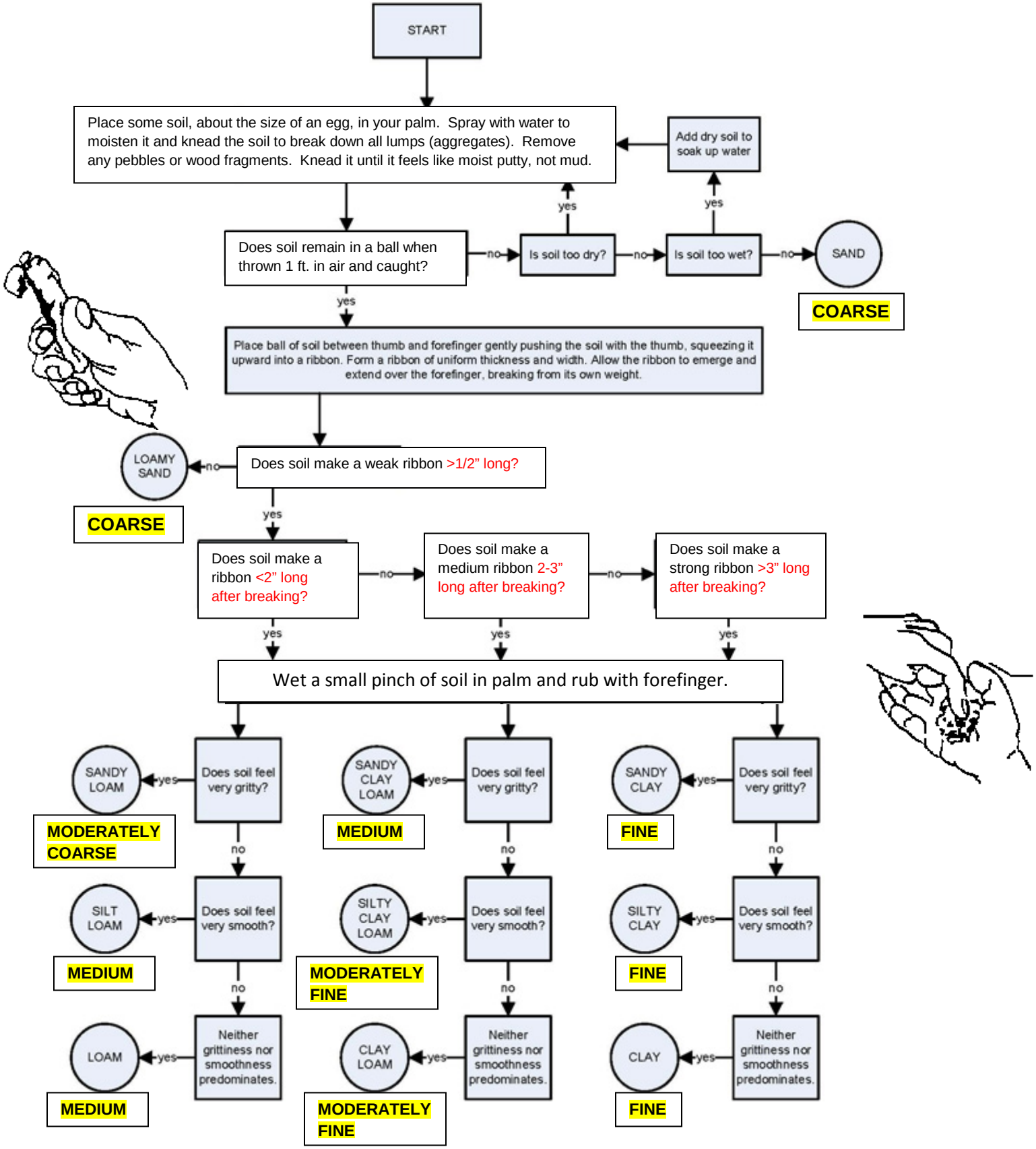
Earthworms:

1. Remove a large shovel of topsoil.
2. Separate the soil gently looking for earthworms and other macroinvertebrates.
3. Count number of them present.

Soil Odor:

1. Cup soil in both hands and smell.
2. Healthy soil should have a sweet earthly aroma.
3. If soil smells sour, metallic, stagnant, or like kitchen cleanser, this may be a good indicator that the soil is not functioning.

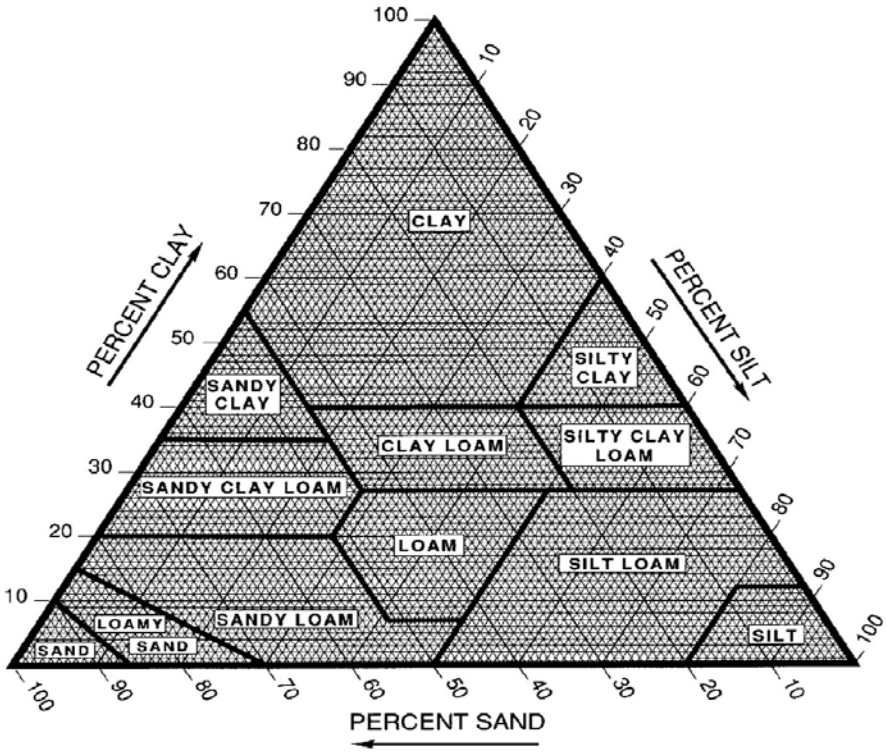
GUIDE FOR ESTIMATING SOIL TEXTURE BY FEEL

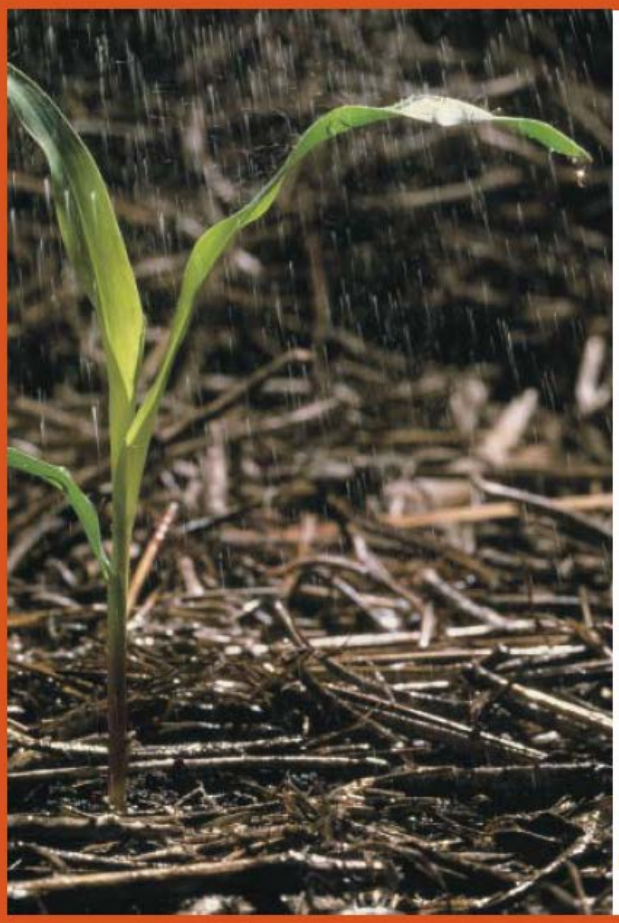


Generally, each inch of ribbon equals 10% CLAY

FIELD CRITERIA USED IN DETERMINING MAJOR TEXTURAL CLASSES

TEXTURE CLASS MAJOR (USDA)	FEEL MOIST	ABILITY TO FORM STABLE BALL	ABILITY TO RIBBON OUT	SOIL HANDS	STICKY	CONSISTENCY MOIST	CONSISTENCY DRY
COARSE (sand)	very gritty	no	no	no	no	loose	loose
COARSE (loamy sand)	very gritty	yes	yes, very weak <1/2" long	yes slight	no	loose	loose
MOD. COARSE (sandy loam)	gritty	yes, easily deformed	yes, dull surface poorly formed	yes	no	very friable	soft
MEDIUM (loam)	slightly gritty	yes	yes, dull surface poorly formed	yes	yes, slight to moderate	friable	soft
MEDIUM (silt loam)	velvety	yes	yes, dull surface poor to well formed	yes	yes, slight to moderate	friable	soft
MOD. FINE (silty clay loam)	velvety & sticky	yes very stable	yes, shiny surface well formed	yes	yes	friable to firm	slightly hard
MOD. FINE (clay loam)	slightly gritty & sticky	yes very stable	yes, shiny surface well formed	yes	yes	firm	slightly hard to hard
MEDIUM (sandy clay loam)	very gritty & sticky	yes very stable	yes, shiny surface well formed	yes	yes	friable to firm	slightly hard to hard
FINE (sandy clay)	very gritty ext. sticky	yes very stable	yes, shiny surface well formed	yes	yes very	firm	hard to very hard
FINE (silty clay)	ext. sticky & very smooth	yes, very resistent to molding	yes, shiny surface well formed	yes	yes very	firm to ext. frim	hard to very hard
FINE (clay)	ext. sticky & very smooth	yes, very resistent to molding	yes, shiny surface well formed	yes	yes very	firm to ext. frim	hard to very hard





Farming with Crop Residues

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service
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How to use the photos

Use these photographs of residue amounts to get a good picture in your mind of what the various percentages of ground cover might look like as you look down at evenly distributed residues.

30%

60%

How to measure residues

- Use any line that is equally divided into 100 parts. Fifty foot cable transect lines are available for this purpose. Another tool is a 50-foot nylon rope with 100 knots, six inches apart. A 50-foot tape measure using the 6-inch and foot marks also works well.
- Stretch the line diagonally across the rows. Count the number of marks (tabs or knots) that have residue under them when sighting from directly above one end of the mark. It is important to use the same point on each mark for accuracy. Don't count residue smaller than 1/8 inch in diameter.
- Walk the entire length of the rope or wire.

The total number of marks with residue under them is the percent cover under them is the percent cover for the field. If your rope or tape has only 50 marks, multiply by 2; for 25 marks, multiply by 4.

- Repeat the procedure at least 3 times in different areas of the field and average the findings.

Helping People Help the Land.

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INFILTRATION RATE BASED ON SOIL TEXTURE CLASS

(Attachment C)

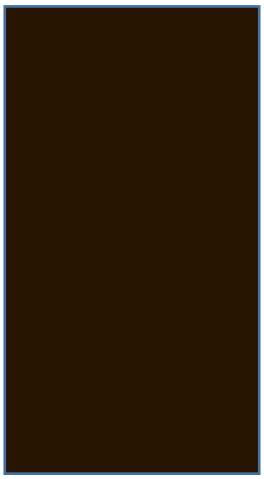
MAJOR SOIL TEXTURE CLASS	USDA SOIL TEXTURE CLASS	INFILTRATION RATE (1 in of water to infiltrate)
Coarse	sand or loamy sand	<10 min
Moderately Coarse	sandy loam	10-30 min
Medium	silt loam, loam, or sandy clay loam	30-120 min
Moderately Fine	silty clay loam, or clay loam	2-10 hrs
Fine	silty clay, clay, or sandy clay	>10 hrs

ORGANIC MATTER DETERMINATION BY COLOR

(Compare using the color chips below or use a Munsell color book.)

EXCELLENT

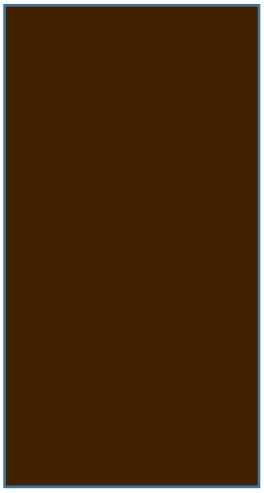
This color or darker



GOOD

This color

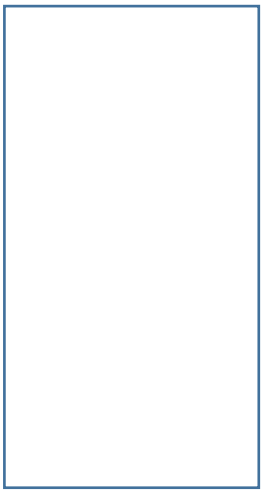
or close to it.



FAIR

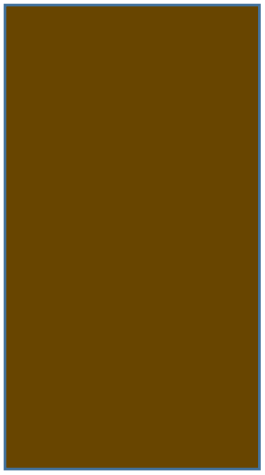
All colors in between

good and poor.



POOR

This color or lighter.



SOIL STRUCTURES USED IN SOIL HEALTH

Granular

Blocky

Single grain

Massive

Platy