Soil Field Guide for Identifying Ecological Sites

Version 1.4, 2006

NRCS Natural Resources Conservation Service

FOREWORD

The "Soil Field Guide for Identifying Ecological Sites" was designed for on-site use by individuals with limited soils experience. Knowledge of "Texture by Feel Method" and several key soil features will enable users to assign ecological sites. Soils are defined by a range in characteristics that change gradually over the landscape. Determining where to examine the soil will greatly influence your outcome. Always choose a representative site within the area of investigation.

Table of Contents

Using the Field Guide

The field guide arranges ecological sites in a hierarchy of ecological groups. Utilizing the criteria below, **determine the ecological group using the first match starting with Group 1**. If a field site does not correspond with Groups 1-5, consider the site in the Loamy Ecological Group. Ecological sites are determined within each group using ecological site criteria.

Criteria	Ecological Group
Criteria	Ecological Group
Somewhat poorly to very poorly drained sites	High Water Table Ecological Group Group #1, Page 6
Shallow or Very Shallow to sand/gravel or weather bedrock (within 20 inches)	Shallow and Very Shallow Ecological Group Group #2, Page 8
Presence of a claypan	Claypan Ecological Group Group #3, Page 10
Surface and subsoil layers form a <1-inch ribbon and soil feels very gritty when excessively wet	Sandy Ecological Group Group #4, Page 12
Subsoil forms a 2-inch or longer ribbon	Clayey Ecological Group Group #5, Page 16
Soils that do not fit the above criteria	Loamy Ecological Group Group #6, Page 18

NOTES:

GROUP #1
High Water Table Ecological Group

Ecological Group Criteria

- Landscape – depressions on uplands or floodplains and drainageways
- Bedrock – very deep
- Carbonates – allowable
- Claypan – allowable
- Drainage – **somewhat poorly to very poorly**
- Flooding – occasional or frequent (*Closed Depression Ecological Site* is ponded)
- Salinity – none to strongly saline
- Texture – NA

Ecological Site Criteria

Review all ecological sites within this group and choose the best match.

Closed Depression Ecological Site **–** the sites are **poorly drained** and occur on **closed upland depressions**. The subsoil layer exhibits **claypan characteristics** and **forms a 2-inch or longer ribbon (silty clay to clay)**. These areas may pond water but do not flood. (MLRA 54)

Limy Subirrigated **–** the sites are **somewhat poorly drained and have strong to violent effervescence in the subsoil**. They are on floodplains, drainage ways, and around or between depressions.

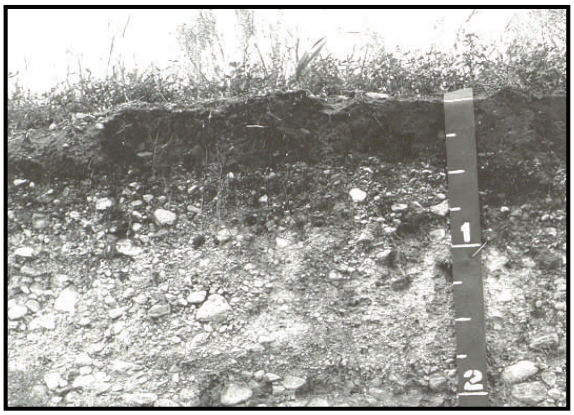
Saline Lowland Ecological Site – the sites are **somewhat poorly to poorly drained and moderately to strongly saline.** The salinity can be observed in the surface or subsoil layers.

Subirrigated Ecological Site – the sites are **somewhat poorly drained** and are on floodplains, drainage ways and alluvial areas.

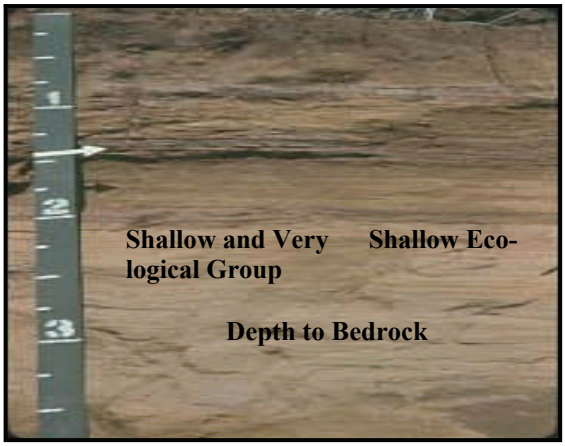
Wet Meadow Ecological Site – the sites are **poorly drained** and in **depressions or floodplains.**

Wet Land Ecological Site – the sites are **very poorly drained.**

GROUP #2
Shallow and Very Shallow Ecological Group



or



Ecological Group Criteria

- Landscape – upland
- **Bedrock – shallow and very shallow**
- Carbonates – none to strong
- Claypan – none
- Drainage – well to somewhat excessive
- Flooding – none
- **Gravel – shallow to very shallow**
- Salinity – none to slight
- Texture – NA

Ecological Site Criteria

Review all ecological sites within this group and choose the best match.

Shallow Clayey Ecological Site – soils are **shallow (10 to 20 inches) to weathered bedrock, shale or strongly cemented silicrete. The subsoil or substratum (not including the weathered bedrock)forms a > 2 inch ribbon (silty clay loam to clay).** The surface layer is from 1 to 6 inches thick.

Shallow Gravel Ecological Site – soils are **shallow (14 to 20 inches) to sand and gravel.** The substratum contains up to 60 percent gravel and/ or 25 to 75 percent sand.

Shallow Loamy Ecological Site – soils are **shallow (10 to 20 inches) to weathered bedrock, shale or strongly cemented silicrete. Surface and substratum layers form a < 2-inch ribbon (silt loam to clay loam).**

Shallow Sandy Ecological Site – **surface and substratum layers will form a < 1-inch ribbon and feels very gritty when excessively wet or will not ribbon but forms a ball.** These soils are **shallow (10 to 20 inches) to weathered bedrock or hard sandstone bedrock or are shallow (14 to 20 inches) to sand and gravel.**

Very Shallow Ecological Site – soils are **very shallow (< 10 inches) to soft weathered bedrock or very shallow (< 14 inches) to sand and gravel or shallow (10 to 20 inches) to porcellanite.**

GROUP #3
Claypan Ecological Group

Ecological Group Criteria

- Landscape – till plains, uplands, and terraces
- Bedrock – very deep and moderately deep
- Carbonates – none to slight effervescence
- Claypan – **yes**
- Drainage – well or moderately well
- Flooding – none
- Salinity – may be evident (see Ecological Site Criteria)
- Texture – NA

Ecological Site Criteria

Review all ecological sites within this group and choose the best match.

Claypan Ecological Site **–** surface layer ranges from 6 to 14 inches. The subsoil layer exhibits **claypan characteristics** and **forms a 1-inch or longer ribbon (clay loam to clay).** Salinity may be evident at depths > 16 inches.

Thin Claypan Ecological Site **–** surface layer ranges from 0 to 6 inches. The subsoil layer exhibits **claypan characteristics and forms a 2-inch or longer ribbon (silty clay to clay).** Salinity may be evident at depths < 16 inches.

Sandy Claypan Ecological Site **–** subsoil layer exhibits **claypan characteristics** and **forms a < 1-inch ribbon (fine sandy loam).** Salinity may be evident at depths > 16 inches.

GROUP #4
Sandy Ecological Group

Ecological Group Criteria

- Landscape – Uplands (*Sandy Terrace Ecological Sites* are on low terraces/floodplains)
- Bedrock – very deep and moderately deep
- Carbonates – *Thin Limy Ecological Site* has strong effervescence in the subsoil layer
- Claypan – none
- Drainage – well to excessively well
- Flooding – none (*Sandy Terrace Ecological Sites* have none to occasional flooding)
- Salinity – none
- Texture – **Sandy**: surface and subsoil layers form a < 1-inch ribbon (feels very gritty when excessively wet) or forms a ball when squeezed
  Sands: soil may or may not remain in a ball when squeezed

Ecological Site Criteria

Review all ecological sites within this group and choose the best match.

Sandy Ecological Site – **surface and subsoil layers form a < 1-inch ribbon (fine sandy loam or sandy loam - feels very gritty when excessively wet).** These sites are on uplands.

Sandy Terrace Ecological Site – **surface and subsoil layers form a < 1-inch ribbon (fine sandy loam, sandy loam - feels very gritty when excessively wet).** These sites are on low terraces and floodplains and are none to occasionally flooded.

Sands Ecological Site – **surface and subsoil layers do not form a ribbon and may form a ball when squeezed (loamy fine sand to fine sand).** These sites are on uplands.

Limy Sands Ecological Site – **surface and subsoil layers do not form a ribbon and may form a ball when squeezed (loamy fine sand to fine sand).** Typically these sites are calcareous through out the soil profile (**slight to strong effervescence**) and are on uplands.

Continued:

GROUP #4
Sandy Ecological Group (Cont.)

Review all ecological sites within this group and choose the best match.

Subirrigated **– surface and subsoil layers do not form a ribbon and may form a ball when squeezed (loamy fine sand to fine sand)**. These sites are **moderately well drained** and on uplands.

Thin Sands Ecological Site **– surface and subsoil layers do not form a ribbon and may form a ball when squeezed (loamy fine sand to fine sand)**. These sites are on floodplains, lake plains, outwash plains, residual plains and terraces. **Typical landscapes are hummocks and dunes**.

NOTES:

GROUP #5
Clayey Ecological Group

Ecological Group Criteria

- Landscape – uplands, alluvial plains and floodplains
- Bedrock – very deep to moderately deep
- Carbonates – none to slight (surface and subsoil)
- Claypan – none
- Drainage – well or moderately well
- Flooding – none
- Salinity – none to slight
- Texture – **subsoil forms a 2-inch or longer ribbon**

Ecological Site Criteria

Review all ecological sites within this group and choose the best match.

Clayey Ecological Site **-**

1. Surface layer(s) is 5 to 14 inches thick and textures are loam (soil neither dominated by gritty nor smooth) to clay (soil feels neither gritty nor smooth).

2. **Subsoil layer forms a 2-inch or longer ribbon (silty clay to clay).**

GROUP #6
Loamy Ecological Group

Ecological Group Criteria

- Landscape – floodplain, till plains and uplands
- Bedrock – very deep to moderately deep
- Carbonates – Loamy, *Loamy Overflow*, and *Loamy Terrace Ecological Sites* - soils may contain carbonates to the surface (slight effervescence). *Thin Loamy Ecological Site* soils have violent effervescence in the subsoil.
- Claypan – none
- Drainage – well or moderately well
- Flooding – **Frequent:** include in *Loam Overflow Ecological Site*
  Occasional: include in *Loamy Terrace Ecological Site*
- Salinity – none to very slight
- Texture – **Surface layer is 5 to 20 inches thick and textures are loam (soil neither dominated by gritty nor smooth) and silt loam (soil feels very smooth). The subsoils range from silt loam to clay loam.**

Ecological Site Criteria

Review all ecological sites within this group and choose the best match.

Loamy Ecological Site – **surface layer forms a < 2-inch ribbon (silt loam, loam). Subsoil layers form a < 2-inch ribbon (silt loam to clay loam).** These sites are on **uplands**.

Loamy Overflow Ecological Site – **surface layer forms a < 2-inch ribbon (silt loam, loam). Subsoil layer forms a < 2-inch ribbon (silt loam to clay loam).** These sites are in floodplains or swale positions of complex map units on slopes of < 6 percent.
Include soils that are frequently flooded.

Loamy Terrace Ecological Site – **surface layer forms a < 2-inch ribbon (silt loam, loam). Subsoil layer forms a < 2-inch ribbon (silt loam to clay loam).** These sites are on low terraces or floodplains and **may be occasionally flooded.**

Thin Loamy Ecological Site – **surface layer forms a < 2-inch ribbon (silt loam, loam). Subsoil layer forms a < 2-inch ribbon (silt loam to clay loam).** These soils are none to strongly effervescence in the surface layer and strong to violent effervescence in the subsoil. In MLRA 54, soils may be calcareous to the surface (slight to strong effervescence). These sites are on uplands.

GLOSSARY

Bedrock – Most bedrock in North Dakota is soft and weathered. Common types are sandstone, siltstone, and shale. Weathered bedrock has a platy appearance which fractures horizontally. The depth to bedrock is described below:

Depth

- Very Shallow – < 10 inches
- Shallow – 10 to 20 inches
- Moderately deep – 20 to 40 inches
- Deep – 40 to 60 inches
- Very deep – > 60 inches

Calcareous (limy) Soil – Soil containing sufficient free $CaCO_3$ (lime) to effervesce (gaseous response seen as bubbles) visibly when treated with 0.1 *N* hydrochloric acid (HCL) (obtain from soil scientist). Site key will address amounts and depth of carbonates.

- Non Effervescent – no bubbles form
- Slight Effervescent – numerous bubbles form
- Strong Effervescent – bubbles form low foam
- Violent Effervescent – bubbles form a thick foam

Claypan – A dense, compact layer in the subsoil having much higher clay content than the overlying material. It is separated by a sharply defined boundary. In undisturbed areas, the soil structure in the subsoil is columnar in shape. They are vertical elongated soil peds with very distinct and normally rounded tops. They usually impede movement of water, air, and the growth of plant roots.

Drainage—The field key refers to "High Water Table Ecological Groups" which uses drainage classes to distinguish between several sites influenced by ground water. Water tables are determined by the depth to free water and duration (significant periods during the growing season).

1. Excessively drained—Water table is >5 feet from the soil surface. These soils have very high hydraulic conductivity and low water holding capacity.
2. Somewhat excessively drained-Water table is >5 feet from the soil surface. These soils have high hydraulic conductivity and low water holding capacity.
3. Well drained-Water table is >5 feet from the soil surface. Water is available to plants most of the growing season. Wetness does not inhibit growth of roots.
4. Moderately well drained-Water table is 3.5 to 5 feet below the soil surface. Water is removed somewhat slowly during some periods of the year. Soil is wet for only short time within the rooting depth.
5. Somewhat poorly drained – Water table is 1.5 to 4 feet below the soil surface. Water is removed slowly so that the soil is wet at a shallow depth for significant periods during the growing season.
6. Poorly drained – Water table is 1.0 foot above to 1.5 feet below the soil surface. Water is removed so slowly that the soil is wet at shallow depths periodically during the growing season or remains wet for long periods of time.
7. Very poorly drained – water table is 1.0 foot above to 1.0 feet below the soil surface. Water is removed from the soil so slowly that free water remains at or very near the surface

GLOSSARY (Cont.)

Flooding – The temporary covering of the soil surface by **flowing water**.

1. Frequently Flooded – flooding is likely to occur often under usual weather conditions: more than a 50 percent chance of flooding in any year.

2. Occasional Flooding – flooding is expected infrequently under usual weather conditions: 5 to 50 percent chance of flooding in any year or ground surface during much of the growing season 5 to 50 times in 100 years.

3. Rarely Flooded – flooding is unlikely but possible under unusual weather conditions; 1 to 5 percent chance of flooding in any year or nearly 1 to 5 times in 100 years.

Ponding – The covering of the soil surface by **stagnant water.**

Sand and Gravel – *Shallow and Very Shallow* *Ecological Site* uses the term "shallow and very shallow" to describe the depth of sand and gravel. The depth is described below: The term "gravelly" is used to describe the subsoil material which contains varying percents of sand and gravel.

Depth

- Very Shallow – < 14 inches
- Shallow – 14 to 20 inches

Saline Soil – A soil containing sufficient soluble salts to adversely affect vegetative growth and species adaptation. Salts maybe identified in the soil as threads or spherical concentrations that do not react with 1N hydrochloric acid (HCL). Boundaries are sharp and concentrations are white in color. The salinity levels in the surface layers must be moderately saline (8 - 16 mmhos/cm) or strongly saline (≥ 16 mmhos/cm) to meet criteria of *Saline Lowland Ecological Site.*

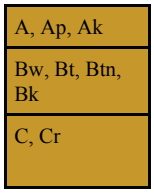
Soil Profile – a vertical section of the soil extending through all its horizons and into the parent material

Typical Soil Horizonation

Surface layer
(e.g., topsoil)

Subsoil

Substratum
or Bedrock



Determining Soil Texture by the "Feel Method"

Texture Classification
C = Coarse
MC = Moderately Coarse
M = Medium
F = Fine

Start

Place approximately one tablespoon of soil in palm. Add water a drop at a time and knead the soil to break down all aggregates. Soil is at the proper consistency when plastic and mobile, like moist putty.

Does soil remain in a ball when squeezed?

NO → Is the soil to dry?

YES ↑ Is the soil to dry?

NO → Is the soil too wet?

YES ↑ Is the soil too wet?

Add dry soil to soak up water.

NO 0 -10% ** → SAND C*

YES

Place ball of soil between thumb and forefinger, gently pushing the soil with the thumb, working it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over the forefinger, breaking from its own weight.

Does the soil form a ribbon?

NO 0 -15% ** → LOAMY SAND C *

YES

Does the soil make a weak ribbon less than 1" long before breaking?

NO → Does the soil make a medium ribbon 1" to 2" long before breaking?

NO → Does the soil make a strong ribbon 2" or longer before breaking?

YES

Excessively wet a small pinch of soil in palm of hand and rub with forefinger.

Does the soil feel very gritty?

YES 0-20% → Sandy Loam MC

NO

Does the soil feel very smooth?

YES 0-27% → Silt or Silt/ Loam M

NO

Neither grittiness nor smoothness predominates.

YES 7-27% → Loam M

Excessively wet a small pinch of soil in palm of hand and rub with forefinger.

Does the soil feel very gritty?

YES 20-35% → Sandy Clay Loam MC

NO

Does the soil feel very smooth?

YES 27-40% → Silty Clay Loam F

NO

Neither grittiness nor smoothness predominates

YES 27-40% → Clay Loam F

Excessively wet a small pinch of soil in palm of hand and rub with forefinger.

Does the soil feel very gritty?

YES 35-55% → Sandy Clay MC

NO

Does the soil feel very smooth?

YES 40-60% → Silty Clay F

NO

Neither grittiness nor smoothness predominates

YES 40-100% → Clay F

* Sand Particle size should be estimated (very fine, fine, medium, coarse) for these textures. Individual grains of very fine sand are not visible without magnification and there is a gritty feeling to a very small sample ground between the teeth. Some fine sand particles may be just visible. Medium sand particles are easily visible. Examples of sand size descriptions where one size is predominant are; very fine sand, fine sandy loam, loamy coarse sand.

** Clay percentage range.

Modified from: Thien, Steven J., Kansas state University, 1979 Jour. Agronomy education.

This table indicates the Ecological Site Descriptions (ESD) presently identified in North Dakota by Major Land Resource Areas (MLRA), the accepted abbreviation for the ecological site and the correlation to the previous range site name (if any). ESDs are not completed for all MLRAs. For MLRAs without approved ESDs, use the existing range site description.

Ecological Site (abbreviation)	MLRA								Original Range Site name
	53A	53B	54	55A	55B	56	58C	58D	
Clayey (Cy)	yes	yes	yes	yes	yes	yes	yes	yes	Clayey
Clayey Terrace (CyT)	no	no	yes	no	no	no	yes	no	1
Claypan (Cp)	yes	yes	yes	yes	yes	yes	yes	yes	Claypan
Closed Depression (CD)	yes	yes	yes	no	no	no	no	yes	Closed Depression
Limy Sands (LSa)	no	no	yes	no	no	no	yes	yes	1
Limy Subirrigated (LSb)	yes	yes	yes	yes	yes	yes	no	no	Limy Subirrigated
Loamy (Ly)	yes	yes	yes	yes	yes	yes	yes	yes	Silty
Loamy Overflow (LyOv)	yes	yes	yes	yes	yes	yes	yes	yes	Overflow
Loamy Terrace (LyT)	no	no	yes	no	no	no	yes	yes	1
Saline Lowland (SL)	yes	yes	yes	yes	yes	yes	yes	yes	Saline Lowland
Sands (Sa)	yes	yes	yes	yes	yes	yes	yes	yes	Sands
Sandy (Sy)	yes	yes	yes	yes	yes	yes	yes	yes	Sandy
Sandy Claypan (SyCp)	yes	yes	yes	yes	yes	yes	yes	yes	Sandy Claypan
Sandy Terrace (SyT)	no	no	yes	no	no	no	yes	yes	1
Savannah (Sv)	no	no	no	yes	no	no	no	no	Savannah
2	no	yes	no	yes	yes	no	yes	yes	Shallow
Shallow Clayey (SwCy)	no	no	yes	no	yes	no	yes	yes	Shallow Clay
Shallow Loamy (SwLy)	no	no	yes	no	no	no	yes	yes	1
Shallow Sandy (SwSy)	no	no	yes	no	no	no	yes	no	1
Shallow Gravel (SwG)	yes	yes	yes	yes	yes	yes	yes	no	Shallow to Gravel
Subirrigated (Sb)	yes	yes	yes	yes	yes	yes	no	no	Subirrigated
Subirrigated Sands (SbSa)	no	no	no	yes	yes	yes	no	no	Subirrigated Savannah
Thin Clayey (TCy)	no	no	yes	no	no	no	no	no	1
Thin Claypan (TCp)	yes	yes	yes	yes	yes	yes	yes	yes	Thin Claypan
Thin Loamy (TLy)	yes	yes	yes	yes	yes	yes	yes	yes	Thin Upland
Thin Sands (TSa)	yes	yes	yes	yes	yes	yes	yes	yes	Thin Sands
Very Shallow (VS)	yes	yes	yes	yes	yes	yes	yes	yes	Very Shallow
Wet Land (WL)	yes	yes	yes	yes	yes	yes	no	yes	Wetland
Wet Meadow (WM)	yes	yes	yes	yes	yes	yes	yes	no	Wet Meadow

1 No range site assigned. Soils in this ecological site were originally included in other range sites.

2 Soils in Shallow range site are now separated into Shallow Loamy, Shallow Sandy and Shallow Clayey ESD