INTERPRETING YOUR SOIL EVALUATION
for
Septic System Suitability

Using soil evaluations to assess site suitability for septic systems is becoming more common in Illinois, although many terms and abbreviations used by soil classifiers are unfamiliar to those not in the field of soil science. While soil evaluation reports vary in content and format depending on the author, many common threads are shared by all of these reports. This brochure explains abbreviations and sections often found in soil evaluation reports, and discusses how various soil characteristics affect water flow out of septic systems into the soil.

INTRODUCTION AND BACKGROUND

This section of the report describes the property location, current use, and date of investigation. Some counties require a new soil evaluation after a given amount of years have passed, so attention should be paid to the date of investigation.

METHODS

Many counties utilize the *Private Sewage Disposal Licensing Act and Code* (State Code) issued by the Illinois Department of Public Health as their guidance for methods to conduct soil investigations, although some counties have slightly different requirements based on local ordinances. Portions of the State Code referenced below can be found at the end of this brochure. In general, three or four soil borings or backhoe pits are excavated at least 50 feet apart in the vicinity of a future septic field to a depth of at least 60 inches. Soil characteristics are described from each boring or pit, and are correlated to specifications given in the State Code to determine sewage loading rates in gallons per square foot per day *(Figure 1)*. A table showing how percolation rates correlate to loading rates *(Figure 2)* and a table discussing septic system sizing based on soils *(Figure 3)* are also included in the State Code. In general, the lowest loading rate observed in the upper 30 to 42 inches of the soils examined is used for septic system design and sizing.

RESULTS

Each soil described can be classified to the series level. A soil series is equivalent to a plant or animal species, in that a series represents a specific type of soil that can occur over a large geographic area. Soil series are often named for places near where they were first described (examples include Watseka, Beardstown, Streator, and Gorham). There are roughly 17,000 soil series in the United States, with over 600 found in Illinois. Each series has formed in one or more parent materials. Common parent materials include loess (wind-blown silty sediment), outwash (water-deposited sand and gravel or water-sorted loamy material), alluvium (soils of variable texture formed in and near floodplains), and till (mixture of sand, silt, clay, and coarser fragment deposited by glaciers).

One of the main advantages of a soil evaluation over a percolation test (a traditional method of testing septic field areas) is that layers within the soil that severely limit the function of septic systems can be defined. These limiting layers include bedrock, the seasonal high water table, dense soils with slow permeability, and sandy or gravelly soil with very rapid permeability. The State Code specifies that at least two feet of separation should exist between the bottom of the septic field and the limiting layer (three feet in coarser-textured soils). Installation of curtain drains, importation of fill material, or use of alternative sewage disposal systems are options that can be used where limiting layers occur at shallow depths.

SOIL DESCRIPTIONS

A large amount of information is included in the descriptions of soil profiles. Each part of a typical soil description is discussed in detail below.

Horizon

Layers within the soil that differ in color, clay content, or other ways are divided into horizons. Four to seven horizons are commonly present within the top 60 inches of a soil profile. The surface, or topsoil, is generally called the A horizon. A light-colored E horizon lies near the surface of some soils as well, particularly on land that is or has been wooded. The subsoil, where clay accumulates, blocky and prismatic structure develops, and colors are variable, is called the B horizon. The substratum, which consists of relatively unweathered soil material, is called the C horizon. Each of these master horizons can be subdivided if characteristics within them vary (for example, A1 and A2). Transitional horizons, such as AB or BC are also recognized. Features within each horizon can be recognized with lower case letters. Examples include Bt (clay accumulation in the B horizon), Bg (gray colors in the B horizon indicating poor internal drainage), and Ab (an A horizon that has been covered by fill or alluvial sediment). If parent materials change within the soil, it is signified with a number at the beginning of the horizon designation (examples include 2Bt and 3C).

Depth

The location of each described horizon in inches below the surface is given in this section.

Dominant Color, Munsell

Soil colors are described through use of the Munsell soil color charts. These charts consist of color chips that have been assigned names based on their hue, value, and chroma. Common colors and examples of Munsell designations that would describe these colors are given below:

Black	10YR 2/1 and N 2/0
Brown	10YR 4/3 and 7.5YR 4/4
Gray	2.5Y 6/2 and 5Y 5/1
Yellow/Red	7.5YR 6/6 and 10YR 5/8

Iron is a major coloring agent in the soils of Illinois. Brown, yellowish, or reddish colors are mainly the result of precipitated iron (essentially rust) that coats soil particles. These colors generally indicate good internal soil drainage. When a soil is frequently saturated (poorly drained), the iron is dissolved and leached away, leaving a gray color that is the base color of the soil particles. Poorly drained soils often have a uniform gray or mottled, gray/red color pattern. The black color of topsoil is created by high organic matter content, which masks the coloring effects of iron.

Redoximorphic Features (Mottles)
In areas where the water table fluctuates, soil horizons often contain many different colors. This variable color pattern indicates how high the seasonal high water table (SHWT) reaches in a soil, which is important since the SHWT is considered a limiting layer. These contrasting soil colors traditionally are referred to as mottles, or more recently as redoximorphic (redox) features. The term "redox" comes from a combination of the terms "reduction" and "oxidation", which are natural chemical/biological processes that affect iron and other minerals in the soil. The redox features section documents the various colors present in addition to the dominant color, and their abundance and pattern. Munsell colors for redox features may be preceded by a description or code such as c2d. The first part of this code indicates color abundance, with f meaning less than 2% of the total soil matrix, c meaning 2%-20%, and m meaning greater than 20%. The second part of the code is the general size of the redox feature, and includes fine (1), medium (2), and coarse (3). The final portion of the code is how much the color contrasts with the dominant color, and includes faint (f), distinct (d), and prominent (p).

If a soil horizon contains more than 2% redox features (such as a 10YR 4/3 dominant color with c1d 2.5Y 5/2 redox features), it indicates that this horizon is affected by a SHWT. This type of color pattern would suggest that the SHWT is present for only brief periods during wet times of the year, but could still interfere with proper operation of a septic system.

Coatings
Coatings of clay or organic matter are often deposited in the B horizons by water percolating downward. The color of these coatings is determined, preceded by a description or code defining the abundance and contrast of the coatings that is similar to the code used for redox features.

Structure
The structure of a soil is a description of the shapes soil assumes in different parts of its profile over time. Structure is formed largely by cycles of wetting/drying and freezing/thawing, the soil's chemical composition, and the aggregating effect of some soil microbes. Types of structure include granular (gr), which is common in the A horizon; subangular blocky (sbk), angular blocky (abk), and prismatic (pr), which are common in the B horizons; platy (pl) which is found in E horizons of timber soils or where compaction has occurred; and massive (ma) or single grain (sg), which is usually found in C horizons. Well-structured soils have large amounts of interconnected pores, which accelerate water and air movement. Weakly structured soils have less continuous pore space, which slows water and air movement. Structure is ranked on a scale of 0 to 3 (structureless, weak, moderate, strong). Structure size is also determined, and classified as fine (f), medium (m), and coarse (c). Blocky, prismatic, granular, and single grain

structures are generally favorable for septic systems in soils with low to moderate clay contents.

Texture

Texture is a group of terms that describe the amount of sand, silt and clay present in soils. These terms include sand (s), loamy sand (ls), sandy loam (sl), sandy clay loam (scl), loam (l), clay loam (cl), silt loam (sil), silty clay loam (sicl), silty clay (sic), and clay (c). In general, as silt and clay content increases in a soil, the permeability decreases. Silt loam and silty clay loam textures are very common in Illinois, having formed in loess parent material. When clay content in soils exceeds 35% (heavy cl, heavy sicl, sic, or c textures), the soils are generally poorly suited for conventional septic systems because of slow permeability.

Consistence

Consistence is a measure of how easily soil can be crushed between the thumb and forefinger. Classes of consistence include very friable (vfr), friable (fr), firm (fi), very firm (vfi), and extremely firm (xfi). In general, as soil consistence increases in firmness, permeability decreases due to a diminishing volume of pore space within the soil.

Drainage Class

Drainage class describes the relative wetness of a soil prior to modification by drain tile or other means. This designation is not precisely defined, but is broken into 7 classes: very poorly, poorly, somewhat poorly, moderately well, well, somewhat excessively, and excessively. The main factors considered when determining drainage class are soil color patterns, texture, and landscape position. Bright soil colors combined with high and/or sloping landscape position generally indicate a drainage class of moderately well or better. Somewhat excessively and excessively drained soils usually combine these features with high contents of sand and/or gravel. Somewhat poorly and poorly drained soils are common on low flats and floodplains, and are often tile drained to enhance agricultural production. These soils feature gray colors near the surface and often have thick, black surface layers, although some have thin or light-colored surfaces that indicate they were formed under forest vegetation. Very poorly drained soils generally lie in enclosed depressions and are frequently ponded. Peat and muck soils very high in organic matter are usually very poorly drained.

Aspect/Slope

The slope of a soil is measured with a clinometer, and expresses how many feet the ground surface falls over a distance of 100 feet as a percentage. A 2 percent slope indicates a ground surface that falls 2 feet in 100 feet. Slopes often change rapidly over a short distance. Aspect is the direction that the measured slope is facing as one looks downhill.

Soil Group and Loading Rate

The Soil Group is determined by referring to Figure 1, where each soil horizon's texture, structure, consistence, and parent material are used to assign a sewage loading rate in gallons per square foot per day. For example, a friable (fr) silty clay loam (sicl) formed in loess with moderate, medium subangular blocky structure (2msbk) would fall into Soil Group 6D with a loading rate of 0.62 gallons per square foot per day. In general, the lowest loading rate observed in the upper 30 to 42 inches of the soils examined is used for septic system design and sizing.

Perc Rate

Approximate percolation rates of each horizon can be correlated to loading rates by using Figure 2. This information can help you correlate perc rates that may be more familiar to you with soils information.

If you have further questions or would like to learn more details about soils and their interpretations, please feel free to contact any member of the Illinois Soil Classifiers Association. A list of current members and their contact information is available at http://www.illinoissoils.org.

Figure 1, Figure 2, and *Figure 3* (below) are from the Title 77: Public Health, Chapter I: Department of Public Health, Subchapter r: Water and Sewage, Part 905 Private Sewage Disposal Code, Section 905.Appendix A Illustrations and Exhibits Section

Figure 1 -- Section 905.APPENDIX A Illustrations and Exhibits Section 905.EXHIBIT B Key for Determining Sewage Loading Rates (Gallons/Square Feet/Day) (1)

Structure and Parent Material	Single grain; Granular; Platy (2)	Angular and Subangular Blocky; Prismatic									Structureless or Massive			
		Loess; Outwash,						Till; Lacustrine			Loess; Outwash		Till (3)	
		Weak		Moderate		Strong		Moderate; Strong						
Moist Consistence	lo; vfr; fr	lo; vfr	fr; fi	fr	fi	fr	fi	fr	fi	vfi	vfr	fr	vfr, fr	fi, vfi
Texture	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1.Fragmental; Ext. or Very gravelly sand; Gravelly sand; Coarse sand; Gravelly loamy sand	>1.00 (4)	N/A (5)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2.Medium sand; Sand; Loamy course sand; Loamy sand; Coarse loamy sand	1.00	1.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.00	N/A	N/A	N/A
3.Fine sand; Loamy fine sand	0.84	0.91	0.84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.91	0.84	N/A	N/A
4.Sandy loam; Fine sandy loam; Gravelly sandy loam; Gravelly loam; Gravelly silt loam	0.75	0.84	0.75	0.75	N/A	N/A	N/A	N/A	N/A	N/A	0.84	0.75	0.75	0.52
5.Loam, Silt loam; Very fine sandy loam; Sandy clay loam; Silt; Very fine sand; Loamy very fine sand	0.62	0.75	0.69	0.75	0.69	N/A	N/A	0.62	0.52	0.45 (6)	0.69	0.52	0.45 (6)	0.27 (6)
6.Silty clay loam (< 35% clay)Clay loam (<35% clay)	0.52	N/A	.45 (6)	0.62	0.52	0.69	0.52 (6)	0.45 (6)	0.40 (6)	0.27 (6)	0.52	0.45 (6)	0.27 (6)	0.00 (6)
7.Silty clay loam (>35% clay)Clay loam (>35% clay); Sandy clay (<40% clay)	0.45 (6)	N/A	N/A	0.45 (6)	0.40 (6)	0.45 (6)	0.40 (6)	N/A	0.27 (6)	0.20 (6)	0.27 (6)	0.20 (6)	0.00 (6)	0.00 (6)
8.Sandy clay (>40% clay) Silty clay	0.40 (6)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.20 (6)	0.00 (6)	N/A	N/A	N/A	0.00 (6)
9.Clay; Organics; Fragic Fragipan; Lithic; Paralithic	SOIL PROPERTIES HAVE VERY SEVERE LIMITATATIONS: SUBSURFACE DISPOSAL NOT RECOMMENDED													

FOOTNOTES:

1) Disturbed soils are highly variable and require special on-site investigations.
2) Moderate or strong platy structures for the soil textures in Groups 5 have a loading rate of 0.40 g/d/sq. ft. Platy structure having firm or very firm consistence and/ or caused by mechanical compaction has a loading rate of 0.00 g/d/sq. ft.
3) Weakly structure BC horizons and basal glacial tills structured by geogenic processes have the same loading rates as structureless glacial till.
4) This soil group is estimated to have very rapid permeability and exceeds the maximum established rate in Section 905. Illustration H, Exhibit A of this part.
5) N/A means not applicable.
6) These soil groups are estimated to have moderately slow to very slow permeability and are less than the minimum established rate in Section 905. Illustration H, Exhibit A of this part.

Figure 2
Section 905.APPENDIX A Illustrations and Exhibits
Section 905.ILLUSTRATION H Subsurface Seepage System Size Determination
Section 905.EXHIBIT A Gravel System

Time (minutes) required for last 6 inches of water to fall	FOR RESIDENTIAL USE Required Absorption Area (sq ft)/bedroom)	FOR INSTITUTIONAL OR COMMERCIAL USE Allowable application rate (GPD/sq ft) (5)	Recommended depth from bottom of the trench to the limiting layer
18 - 60	200	1.0	
90	210	.95	3 feet
120	235	.85	
150	265	.75	
180	290	.69	
240	320	.62	
300	350	.57	2 feet
360	385	.52	

NOTE:

1. Absorption area is figured as trench bottom area in absorption trenches and bottom area in seepage beds.
2. Seepage beds require 1½ times the seepage field absorption area specified.
3. Over 360 is unsuitable for subsurface seepage systems.
4. Under 18 is unsuitable for subsurface seepage systems.
5. Divide the required total gallons per day by this number to get the number of square feet required

Figure 2 (continued)
Section 905.APPENDIX A Illustrations and Exhibits
Section 905.ILLUSTRATION H Subsurface Seepage System Size Determination
Section 905.EXHIBIT B Gravelless System

Time (minutes) required for last 6 inches of water to fall	FOR RESIDENTIAL USE Required Absorption Area (sq ft)/bedroom)		FOR INSTITUTIONAL OR COMMERCIAL USE Allowable application rate (GPD/sq ft) (5)		Recommended depth from bottom of the trench to the limiting layer
	8 inch	10 inch	8 inch	10 inch	
18 – 60	100	70	2.00	3.00	
90	105	70	1.90	2.86	3 feet
120	120	80	1.66	2.50	
150	135	90	1.48	2.22	
180	145	100	1.38	2.00	
240	160	110	1.25	1.82	
300	175	120	1.14	1.66	2 feet
360	195	130	1.0	1.54	

NOTE:

1. Over 360 is unsuitable for subsurface seepage systems.
2. Under 18 is unsuitable for subsurface seepage systems.
3. Divide the required total gallons per day by this number to get the number of lineal feet required.

Figure 3
Section 905.EXHIBIT A Loading Rates in Square Feet Per Bedroom and Gallons/Square Feet/Day

Design Group	Soil Group (Most limiting Layer)	Minimum Separation To Limiting Layer [(1)]	Permeability Range	Size of System	
				Residential Reg. Absorption (ft^2/bedroom)	Institutional/Commercial Allowable Application Rate (GPD/ft^2
I	1A	N/A	Very Rapid	N/A	N/A
II	2A; 2B; 2K	3 feet	Rapid	200	1.0
III	3B; 3K	3 feet	High Moderately Rapid	220	0.91
IV	3A; 3C; 3L; 4B; 4K	3 feet	Low Moderately Rapid	240	0.84
V	4A; 4C; 4D; 4L; 4M; 5B; 5D	3 feet	Very High Moderate	265	0.75
VI	5C; 5E; 5K; 6F	3 feet	High Moderate	290	0.69
VII	5A; 5H; 6D	2 feet	Moderate	325	0.62
VIII	4N; 5I; 5L 6A; 6E; 6G;6K	2 feet	Low Moderate	385	0.52
IX[(2)]	5J; 5M; 6C; 6H; 6L; 7A; 7D; 7F	2 feet	High Moderately Slow	445	0.45
X[(2)]	6I; 7E; 7G; 8A	2 feet	Low Moderately Slow	500	0.40
XI[(2)]	5N; 6J; 6M; 7I; 7K	2 feet	Slow	740	0.27
XII[(2)]	7J; 7L; 8I	2 feet	Very Slow	1000	0.20
XII[(2)]	6N; 7M; 7N; 8J; 8N	N/A	N/A	N/A	0.00
XIII	9	**SUBSURFACE DISPOSAL NOT RECOMMENDED**			

NOTES:

[(1)] Limiting layers include fragipans; bedrock; compact glacial tills; seasonal high water table or other soil profile features that will materially affect the absorption of liquid from the disposal field.

[(2)] Soils in this group are less than the minimum percolation rate established in Section 905.Illustration H of this Part as suitable for subsurface seepage systems.