

HOW TO USE INDIANA SOILS INFORMATION FOR DRAINAGE PLANNING

The method and intensity of drainage needed depends to a great extent upon the soil type and its characteristics. Table IN-14-1 lists soil names for Indiana along with drainage group numbers and additional information about the soil profile at a depth of 20-40 inches including the unified soil classification, pH range, permeability range in inches per hour (estimated) and shallow depths to bedrock in inches. When the soil name and drainage group is known, use Table IN-14-2 to determine the agricultural drainage recommendations. Table IN-14-3 can be used after the drainage group number is known which gives estimated limitations, suitabilities and properties of soils for urban and residential use.

On some soils there are alternative drainage methods. Most of these are listed in the table. Each landuser can help determine the method or combination of methods that will give the best results for his condition. On nearly all soils needing drainage, a combination of surface and subsurface drainage gives best results.

Recommendations in Table IN-14-2 are for field crops. A more intensive drainage system is usually required for truck crops. An adequate soil conservation program should also be installed on the drained land. Sound management and good agronomic practices improve the efficiency of the drainage system. Tillage, fertility, liming, crop rotations and crop residue management are important.

Unified soil classifications, given in Table IN-14-1, can be used in reference to Table 14-7 for a guide to determine the need for drain filters, envelopes and minimum flow velocities.

Table IN-14-3 contains several terms and limitation ratings that are explained and defined in the following paragraphs.

Shrink-swell behavior is that quality of the soil which determines its volume change with change in moisture content. Building foundations, roads and other structures may be severely damaged by the shrinking and swelling of soil. A volume change of soil is influenced by the amount of moisture change and the amount and the kind of clay. Following are definitions of the shrink-swell classes listed in Table IN-14-3.

Low. Generally includes soils that are silt loam, silty clay loam, clay loam, silty clay, sandy clay and clay, contains mainly kaolinite or other low shrink-swell clay minerals.

Moderate. Generally includes soils that are silty clay, silty clay loam, clay loam, sandy clay loam and clay containing mixed clay minerals that includes some montmorillinite or other high shrink-swell minerals.

High. Generally includes soils that are clay loam, silty clay loam, silty clay, sandy clay and clay and are mainly made up of a large percentage of montmorillinite or other high shrink-swell clay minerals.

Frost action damage results from upward and lateral movement of the soil caused by the formation of segregated ice crystals and ice lenses in the soil and the subsequent loss of strength and collapse on thawing. It may not damage dwellings and buildings, especially if footings extend below the depth of frost penetration but damage may occur in unheated structures of concrete or asphalt floors in cold climate. Unequal heave can crack or tip concrete slabs or shallow footings and may cause bumps or waves in flexible pavements. It causes driveways, patios and sidewalks to heave and crack and disturbs the joints of structures. Thawing causes loss of strength and produces excess free water and cannot drain through the still frozen soil below. The result is a drastic reduction in the strength of the soil. Exposed backslopes and sideslopes of cuts and fills and frost-susceptible soils have a tendency to slough during thawing. Three classes of potential frost action are noted in Table IN-14-3. They are defined as follows:

Low. Soils rarely subject to the formation of ice lenses.

Moderate. Soils susceptible to the formation of ice lenses, resulting in frost heave and subsequent loss of strength.

High. Soils highly susceptible to the formation of ice lenses, resulting in frost heave and subsequent loss of strength.

Limitation ratings in Table IN-14-3 are for soils in their "natural" state, that is, no unusual modification of the soil site or material is made other than that which is considered normal practice for the rated use. Only the most restrictive features are listed. These ratings are defined as follows:

Slight. Slight is the rating given soils that have properties favorable for the use. The degree of limitation is minor and can be overcome easily. Good performance and maintenance can be expected.

Moderate. Moderate is the rating given soils that have properties moderately favorable for the use. The degree of limitation can be overcome or modified by special planning, design or maintenance. During some part of the year, the expected performance of the structure or other planned use is somewhat less desirable than for soils rated slight. Some soils rated moderate require treatment such as artificial drainage, control of runoff to reduce erosion, extended septic tank absorption fields, extra excavation or some modification of certain features through manipulation of the soil. For these soils, modification is needed for those construction plans generally used for soils of slight limitation. Modification may include special design foundations, extra reinforcement of structures, sump pumps and the like.

Severe. Severe is the rating given soils that have one or more properties unfavorable for the rated use, such as steep slopes, bedrock near the surface, flooding, high shrink-swell potential, seasonal high water table or low strength. This degree of limitation generally requires major soil reclamation, special design or intensive maintenance. Some of these soils, however, may be improved by reducing or removing the soil feature that limits use, but in most situations, it is difficult and costly to alter the soil or design a structure so as to compensate for a severe degree of limitation.

TABLE IN-14-1 Alphabetical List of Soils With Drainage Group (Includes Unified Soil Classification, pH Range, Permeability Range, and Depth to Bedrock for 20 to 40 Inch Depth of the Profile)

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
ABINGTON	7	CL	5.6-7.3	0.2-0.6	
ABSCOTA	20	SP	6.1-7.8	6.0-20	
ACKERMAN	8	SM, SP-SM	6.6-8.4	6.0-20	
ADE	29	SP, SM, SP-SM	5.1-6.0	6.0-20	
ADRIAN	3	PT, SP, SM	5.1-8.4	0.2-20	
ALFORD	27	CL	3.6-6.0	0.6-2.0	
ALFORD, GRAV. SUBSTRATUM (Fountain Co.)		CL, ML	4.5-5.5	0.6-2.0	
ALGANSEE VAR. (Starke Co.)	19	SM, SM-SC, SP-SM, CL, CL-ML, ML	5.6-7.3	2.0-20	
ALGIERS	19	CL, ML	6.1-7.8	0.6-2.0	
ALIDA	17	SC, CL, SM-SC	4.5-6.5	0.6-2.0	
ALLISON	20	CL	6.6-7.8	0.6-2.0	
ALVIN	29	SM, SC, CL, ML	4.5-6.0	0.6-6.0	
ARMIESBURG	20	CL, CH	6.1-7.3	0.6-2.0	
ARMIESBURG VAR. (Posey Co.)	20	ML	6.6-7.3	0.6-2.0	
ATKINS	11	CL, ML, SM, SC	4.5-7.3	0.06-2.0	
AUBBEENAUBBEE	16	CL, SC	5.6-7.3	0.2-2.0	
AVA	21	CL, CL-ML	3.6-5.5	<0.06	
AVONBURG	12	CL	4.5-5.5	<0.06	
AYR	26	SM, CL	5.1-6.5	6.0-20	
AYRSHIRE	17	SC, CL, SM-SC	5.1-6.5	0.2-0.6	
BANLIC	12	ML, CL, CL-ML	4.5-6.0	0.06-0.2	
BARTLE	12	CL, CL-ML	4.5-5.5	0.06-2.0	
BAXTER	24	CH, CL, GC, SC	4.5-6.5	0.6-2.0	
BEDFORD	21	CL	3.6-5.0	0.06-2.0	
BELMORE	27	SC, CL, SM-SC, CL-ML, ML	4.5-8.4	2.0-20	
BERKS	23	GM, GC, SM, SC	3.6-6.5	0.6-6.0	33
BERRIEN	29	SM, SP-SM	5.1-5.5	6.0-20	
BERRIEN, MOD. FINE SUBSTR. (Allen Co.)	29	SM	5.6-6.0	6.0-20	
BEWLEYVILLE	24	CL, ML, CL-ML	5.1-6.5	0.6-2.0	
BIRDS	11	CL	5.1-7.8	0.2-0.6	
BIRKBECK	27	CL	5.1-6.5	0.6-2.0	
BLOOMFIELD	29	SM, SP, SP-SM	5.1-6.5	2.0-20	
BLOUNT	15	CH, CL	4.5-8.4	0.06-0.6	
BONNELL	28	CH, CL	4.5-6.5	0.06-0.6	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
BONNIE	11	CL, ML, SM, SC	4.5-7.3	0.2-2.0	
BONO	4	CH, CL	6.1-8.4	<0.2	
BONPAS	4	CH	6.1-7.8	<0.2	
BOONESBORO	20	GM, GC, CL, CL-ML	6.1-7.8	6.0-20	31
BOYER	29	SM, SC, SM-SC, SP, SP-SM, GP, GP-GM	5.6-8.4	2.0-20	
BRADY	9	SM, SM-SC, SC	5.1-8.4	2.0-20	
BREMS	29	SM, SP-SM	4.5-6.0	6.0-20	
BRIDGMAN	29	SM, SP, SP-SM	5.6-7.3	6.0-20	
BRONSON	29	SM, SC, SM-SC, SP-SM	5.1-7.3	2.0-20	
BROOKSTON	6	CL, CH	6.6-7.3	0.6-2.0	
BROOKSTON STONY SUBSTR. (Delaware Co.)	7	CL, CH, SM	6.6-8.4	0.06-6.0	
BURNSIDE	20	SC, GC, SM, GM	4.5-5.5	0.6-2.0	57
CAMDEN	27	CL, ML, SC, SM	5.1-7.3	0.6-2.0	
CAMDEN VARIANT (Clinton Co.)	27	CL, SM, SM-SC	5.1-6.5	0.6-2.0	
CANA	21	CL	4.1-5.0	0.06-2.0	60
CANEYVILLE	23	CH, CL	4.5-6.5	0.2-0.6	34
CANEYVILLE VAR. (Monroe Co.)	23	CH, CL	4.5-7.8	0.2-0.6	30
CARLISLE	1	PT	4.5-7.3	0.2-6.0	
CARMEL	23	CH, CL	4.5-8.4	<0.06	44
CASCO	29	GP, SP, GP-GM, SP-SM	7.4-8.4	>20	
CATLIN	26	CL, CH	5.6-7.3	0.6-2.0	
CELINA	26	CL, ML-CL	4.5-8.4	0.2-0.6	
CHAGRIN	26	ML, SM	5.6-7.3	0.6-2.0	
CHALMERS	6	CL	6.6-7.8	0.6-2.0	
CHEEKTOWAGA	5	SM, SW-SM, CL	5.6-8.4	0.06-20	
CHELSEA	29	SP, SM, SP-SM	5.1-5.5	6.0-20	
CHETWYND	25	SC, CL	4.5-5.5	0.6-2.0	
CINCINNATI	21	CL, CL-ML	4.5-6.5	0.06-2.0	
CLARENCE	14	CH, CL	7.4-8.4	<0.06	
CLERMONT	10	CL	4.5-5.5	<0.06	
CLYDE	5	CL, CH	6.1-7.3	0.06-0.2	
COLOMA	29	SP, SM, SP-SM	5.1-6.0	6.0-20	
COLYER	22	GC, CM	3.6-5.0	0.06-0.2	14
CONOTTON	29	GM, SM, GM-GC, SW-SM	4.5-7.3	6.0-20	
CONOVER	16	CL, CL-ML	5.6-8.4	0.2-2.0	
CONRAD	8	SP-SM, SM	6.6-7.8	>20	
COPE	6	CL, CH	6.6-7.3	0.6-2.0	
CORWIN	26	CL, ML	5.1-8.4	0.06-2.0	
CORY	10	CL	4.5-6.0	0.06-0.2	
CORYDON	22	CL, CH	5.6-7.8	0.2-0.6	15

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
CORYDON VARIANT (Starke Co.)	8	CL, CH	6.1-7.3	<0.2	16
COUPEE	29	CL, SM, SP-SM, SC	5.1-6.0	0.6-2.0	
CRAIGMILE	8	ML, CL, SM, SC, SP-SM, SP	6.1-7.8	2.0-20	
CRAIGMILE VAR. (Starke Co.)	8	SM, SM-SC, ML, SP, SP-SM	6.1-7.3	2.0-20	
CRANE	17	CL	5.1-7.3	0.2-0.6	
CRIDER	24	CL, ML, CL-ML	5.1-7.3	0.6-2.0	
CROSBY	15	CL, CH, ML, CL-ML	5.1-8.4	0.06-0.6	
CROSBY, STONEY SUBSTR. (Delaware Co.)	17	CL, CH	6.6-8.4	0.06-6.0	
CROSIER	16	CL, ML	5.1-8.4	0.2-0.6	
CUBA	20	CL, ML, CL-ML	4.5-5.5	0.6-2.0	
DANA	26	CL	5.1-7.8	0.6-2.0	
DARROCH	17	CL, CL-ML, SC, SM-SC	4.5-8.4	0.2-2.0	
DARROCH CLAY SUBSTR. (Pulaski Co.)	15	CL, CH	6.1-8.4	0.06-0.6	
DEARBORN	20	CL-ML, CL, GC, SC	7.4-8.4	0.6-2.0	
DEARDURFF	26	SM, CL	5.1-6.5	0.6-20	
DELLA	7	CL, SC	6.6-7.8	0.06-0.2	
DELMAR	16	CL, CH	5.1-7.3	0.2-0.6	
DEL REY	15	CH, CL	6.1-8.4	0.06-0.2	
DICKENSON	29	SM, SC, SM-SC, SP-SM	5.6-6.5	2.0-20	
DILLON	8	SP-SM, SM	4.5-5.5	6.0-20	
DOOR	25	CL, SC, SM-SC, CL-ML, GC, GM-GC	5.1-5.5	0.6-2.0	
DOOR, CLAY LOAM SUBSTR. (Lake Co.)	26	SC, CL	5.1-5.5	0.6-2.0	
DOWAGIAC	25	CL, SC, SM, SM-SC	5.1-6.5	0.6-6.0	
DRESDEN	29	CL	5.6-7.3	0.6-2.0	
DRUMMER	6	CL	5.6-8.4	0.6-2.0	
DUBOIS	12	CL, CL-ML	4.5-5.5	0.06-0.6	
EBAL	24	CH	4.5-6.0	<0.06	61
EDEN	23	MH, CH, CL	5.1-8.4	0.06-0.2	24
EDENTON	23	CL, CH	5.1-7.8	0.06-0.6	38
EDWARDS	3	PT	5.6-7.8	0.2-6.0	32 Marl
EDWARDS VARIANT (Knox Co.)	3	CL, SP, SP-SM	6.6-8.4	0.06-20	
EEL	19	ML, CL	6.1-8.4	0.6-2.0	
ELKINSVILLE	25	CL	4.5-6.0	0.6-2.0	
ELLIOTT	15	CH, CL	5.6-7.8	0.2-0.6	
ELSTON	29	SM, CL, SM-SC, SP-SM, SC	4.5-6.0	2.0-6.0	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
EVANSVILLE	6	CL, CH	6.1-7.8	0.6-2.0	
FABIUS	9	SP, SP-SM, GP, GP-GM	7.9-8.4	>20	
FAIRMOUNT	22	CH, CL	6.6-8.4	0.06-0.6	17
FAIRPOINT	28	GC, CL, CL-ML, SC	5.5-7.3	0.2-0.6	
FINCASTLE	16	CL, CH	5.1-7.3	0.2-0.6	
FLANAGAN	16	CL, CH	5.6-7.3	0.6-2.0	
FOESMAN	27	CL, CL-ML	5.6-7.8	0.6-2.0	
FOESMAN VAR. (Pulaski Co.)	27	SM, SC, CL	5.1-5.5	0.6-20	
FOX	29	CL, SC, SP, SM, GP, GM	5.6-8.4	>0.6	
FOX LIMESTONE SUBSTR. (Madison Co.)	23	CL, CH	6.6-7.3	0.2-0.6	28
FOX LOAMY SUBSTR. (Shelby Co.)	27	SC, CL, SP-SM	6.1-8.4	>0.6	
FOX TILL SUBSTR. (Madison Co.)	27	CL, GM	5.6-8.4	0.6-20	
FREDERICK	24	CL, MH, CH	4.5-5.5	0.6-2.0	
FULTON	14	CH, CL	5.1-7.8	0.06-0.2	
GENESEE	20	ML, CL, CL-ML	6.1-8.4	0.6-2.0	
GENESEE SANDY SUBSTR. (Clinton Co.)	20	ML, CL	6.1-8.4	0.6-2.0	
GENESEE SANDY VARIANT (Allen Co.)	20	ML	6.6-7.3	0.6-6.0	
GENESEE SANDY VARIANT (Hendricks Co.)	29	SM, SW-SM	6.6-7.8	2.0-20	
GENESEE SANDY VARIANT (Shelby Co.)	20	SM	7.9-8.4	2.0-6.0	
GENESEE SANDY VARIANT (Sullivan Co.)	20	SM, SM-SP	6.6-7.3	2.0-6.0	
GENESEE SANDY VARIANT (Vigo Co.)	20	ML, SM, CL	6.6-8.4	0.6-6.0	
GESSIE	20	CL-ML, CL, ML	7.4-8.4	0.6-2.0	
GESSIE VARIANT (Cass Co.)	27	CL-ML, ML, CL, SP, SP-SM	7.4-8.4	0.6-20	
GIBSON	21				
GILFORD	8	SM, SC, SM-SC, SP, SP-SM	5.6-8.4	2.0-20	

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GILFORD FERRUGIN. VARIANT (Pulaski Co.)	8	SM, ML	5.1-6.5	2.0-20	
GILFORD GRAVELLY SUBSTR. (Cass Co.)	8	SM, SC, SM-SC, SP, SP-SM	5.6-8.4	2.0-20	
GILFORD LIME-STONE SUBSTR. (White Co.)	13	SM, SC, SM-SC	6.1-7.3	2.0-6.0	42
GILPIN	23	GM, GC, ML, CL, CL-ML	3.6-5.5	0.6-2.0	30
GINAT	12	CL	4.5-5.5	<2.0	
GLENHALL	27	CL	4.5-6.0	0.6-2.0	
GLYNWOOD	28	CL, CH	4.5-8.4	0.06-0.2	
GRANBY	8	SP, SM, SP-SM	5.6-8.4	6.0-20	
GRANBY MUCKY SUBSOIL PHASE (Newton Co.)	8	SP, SP-SM	7.4-8.4	6.0-20	
GRANBY VARIANT (Steuben Co.)	8	SP, SP-SM, SM	5.6-8.4	6.0-20	
GRAYFORD	24	CL	4.5-5.5	0.6-2.0	78
GRIFFIN	19	ML, CL, CL-ML	5.6-8.4	0.2-20	
HAGERSTOWN	24	CH, CL	5.1-7.3	0.6-2.0	
HANNA	29	CL-ML, CL, SC, SM-SC, SM, SP-SM	4.5-5.5	0.6-20	
HASKINS	15	SC, CL, CH	5.1-8.4	<2.0	
HAUBSTADT	21	CL	4.5-6.0	0.06-0.2	
HAYMOND	20	ML	5.6-7.3	0.6-2.0	
HAYMOND VAR. (Knox Co.)	20	ML, CL-ML, CL	6.1-7.3	0.6-2.0	
HENNEPIN	26	SC, SM-SC, CL, CL-ML	6.1-8.4	0.06-0.6	
HENSHAW	16	CL, ML	5.1-7.3	0.2-0.6	
HICKORY	26	CL	4.5-5.5	0.6-2.0	
HIGH GAP	23	CL, SC, SM-SC	4.5-6.0	0.6-2.0	34
HILLSDALE	27	SM, SC, SM-SC	4.5-6.5	0.6-6.0	
HOMER	9	SC, SM	5.1-8.4	0.6-2.0	
HOMER LIMESTONE SUBSTR. (Madison Co.)	13	CL, ML	6.1-8.4	0.2-0.6	36
HOOPESTON	9	SM, SC, SM-SC, SP-SM	5.1-7.8	2.0-20	
HOOSIERVILLE	16	CL, CH	4.5-6.0	0.2-0.6	
HOSMER	21	CL	4.5-5.5	<2.0	
HOUGHTON	1	PT	5.6-7.8	0.2-6.0	
HOYTVILLE	4	CH, CL	6.1-7.8	0.2-0.6	
HUNTINGTON	20	ML, CL, CL-ML	5.6-7.8	0.6-2.0	
HUNTSVILLE	20	CL, ML	6.1-7.3	0.6-2.0	

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IONA	27	CL	5.1-7.3	0.2-0.6	
IONIA	29	CL, SM, SC, SM-SC	5.1-7.3	0.6-6.0	
IPAVA	16	CH	5.6-7.3	0.2-0.6	
IVA	16	CL	5.1-6.5	0.06-0.2	
JASPER	27	SC, CL	5.1-6.0	0.6-2.0	
JENNINGS	21	CL	3.5-5.0	<2.0	60
JENNINGS HEAVY SUBSOIL VAR. (Clark & Floyd Co.)	21	CL, CH	<5.5	0.06-0.2	
JENNINGS HEAVY SUBSTR. (Scott Co.)	21	CL	4.5-5.0	0.2-0.6	65
JENNINGS MIXED SUBSTR. (Scott Co.)	24	CL, CL-ML, ML	5.1-6.0	0.6-2.0	
JOHNSBURG	12	CL, CL-ML	3.6-5.5	<2.0	70
JULIAN	4	CH	6.6-7.8	<0.2	
JULES	20	ML	7.4-8.4	0.6-2.0	
JUNIUS	8	SM	6.1-7.8	6.0-20	
KALAMAZOO	29	SC, CL, SM, SP-SM	5.1-7.8	0.6-20	
KARNAK	5	CL, CH, MH	5.6-7.3	<0.2	
KASKASKIA	20	CL, ML	6.1-7.3	0.6-2.0	
KENDALLVILLE	29	CL, CL-ML, ML, SC, GC	4.5-8.4	0.2-2.0	
KERSTON	2	PT, SM, ML, SP-SM	5.6-8.4	0.2-20	
KEYESPORT	20				
KIBBIE	17	CL, SC, ML, SM, SC	5.6-8.4	0.6-2.0	
KINDERHOOK	22	CL, MH, CH, ML	4.0-5.5	0.06-0.2	28
KINGS	4	CL, CH	6.1-7.3	<0.06	
KOKOMO	5	CL, CH	6.1-7.3	0.06-0.2	
KOKOMO GRAVELLY SUBSTR. (Madison Co.)	7	CL	6.6-7.3	0.06-0.2	
KOKOMO STRATIFIED SUBSTR. (Delaware Co.)	7	CL, CH, SM, ML	6.6-8.4	0.06-6.0	
KOKOMO STRATIFIED SUBSTR. (Madison Co.)	7	CL, CH	6.6-7.3	0.06-0.6	
KOSCIUSKO	27	SM, SM-SC, SC, GM, GC, GM-GC GP, SP, GP-GM, SP-SM	5.1-8.4	>0.6	
LANDES	20	SM, ML, SC, SW-SM	6.1-8.4	6.0-20	
LANDES, GRAV. SUBSTRATUM (Bartholomew Co.)	29	SC, SP-SM	6.6-8.4	>2.0	
LAWRENCE	12	ML, CL, CL-ML	4.5-5.5	0.06-2.0	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
LENAWEE	5	CL, CH, CL-ML	6.1-8.4	0.2-2.0	
LINDSIDE	20	CL, ML, CL-ML	5.1-7.8	0.2-2.0	
LINKVILLE	27	CL, SC	5.1-6.5	0.6-2.0	
LINWOOD	2	PT, CL, ML, SM, SC	4.5-8.4	0.2-6.0	
LONGLOIS	27	CL	4.5-6.0	0.6-2.0	
LORENZO	29	GM, SM, GP-GM, SP-SM	7.4-8.4	>6.0	
LOWELL	23	CL, CH, MH	4.5-7.8	0.2-2.0	53
LUCAS	28	CH, CL	5.1-8.4	0.06-0.2	
LYDICK	27	CL	4.5-6.0	0.6-2.0	
LYLES	7	SM-SC, SC, CL-ML, CL	6.1-7.8	0.6-2.0	
MAHALASVILLE	7	CL, CH	6.6-7.3	0.06-0.2	
MAHALASVILLE CLAYEY SUBSOIL VARIANT (Hendricks Co.)	6	CH	6.6-7.3	0.06-0.2	
MAHALASVILLE LINESTONE SUBSTRATUM (Madison Co.)	13	CL, CH	6.6-8.4	0.06-0.2	33
MARKHAM	28	CL, CH	5.1-7.8	0.06-0.6	
MARKLAND	28	CL, CH	5.1-8.4	0.06-0.2	
MARKTON	16	SP-SM, SM, ML, CL-ML, SM-SC	5.6-7.3	0.6-2.0	
MARTINSVILLE	27	CL, SM, SC, ML	5.1-6.5	0.6-2.0	
MARTINSVILLE GRAV. SUBSTR. (Allen Co.)	27	SC, CL	5.6-6.0	0.2-0.6	
MARTISCO	3	PT	6.1-8.4	0.6-6.0	13 Marl
MASSIE	21				
MATHERTON	9	SC, CL, CL-ML, SM-SC, GP SP, SP-SM, GP-GM	5.6-8.4	0.6-2.0	
MAUMEE	8	SP, SP-SM, SM	6.1-8.4	6.0-20	
MAUMEE FERRIG. VARIANT (Pulaski Co.)	8	SP-SM	6.6-7.3	6.0-20	
MAUMEE MUCKY SUBSOIL PHASE (Newton Co.)	8	SP, SP-SM, SM	7.4-8.4	6.0-20	
MAUMEE VARIANT (LaPorte Co.)	8	SP, SP-SM, PT	6.6-8.4	>2.0	
MAUMEE VARIANT (Starke Co.)	8	SP-SM, SM, SP	6.1-7.8	6.0-20	
MCGARY	14	CL, CH	5.6-7.8	<0.2	
MEDWAY	19	ML, CL, CL-ML, SM, SC	6.1-8.4	0.6-2.0	
MELLOTT	26	CL	5.1-6.0	0.6-2.0	
MERMILL	6	SC, CL, CH	5.6-8.4	<2.0	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
METAMORA	16	SM, SC, ML, CL	5.1-8.4	0.2-6.0	
METEA	26	SP-SM, SM, CL, SC	5.1-7.3	0.6-20	
MIAMI	26	CL, CL-ML, ML	5.6-8.4	0.2-2.0	
MIAMI GRAVELLY SUBSTRATUM (Delaware Co.)	27	CL, CH	5.6-6.0	0.6-2.0	
MIAMI GRAVELLY SUBSTRATUM (Noble Co.)	27	CL, SC	5.1-7.8	0.6-2.0	
MIAMI HEAVY SUBSTRATUM (Delaware Co.)	26	CL, SC	5.6-6.0	0.6-2.0	
MILFORD	5	CH, CL	5.1-6.5	0.06-0.2	
MILFORD SANDY SUBSTRATUM (Lake Co.)	7	CL	5.6-6.0	0.06-0.2	
MILLSDALE	13	CH, CL	6.1-8.4	0.2-0.6	31
MILTON	23	CL, CH	4.5-7.8	0.2-2.0	29
MONITOR	17	CL, SC	4.5-6.5	0.2-0.6	
MONTGOMERY	4	CH, CL	6.1-8.4	< 0.2	
MONTGOMERY GRAV. SUBSTR. (Decatur Co.)	4	CL, CH, SC, GC	6.1-8.4	0.06-2.0	
MONTMORENCI	26	CL, CL-ML	5.6-8.4	0.2-0.6	
MORLEY	28	CL, CH	5.6-8.4	0.06-0.6	
MORLEY GRAV. SUBSTR. (Delaware Co.)	27	CL, CH	5.6-7.8	0.06-0.6	
MOROCCO	9	SM, SP-SM	4.5-6.0	6.0-20	
MUNDELEIN	16	CL, SC, SM, ML	5.6-8.4	0.2-2.0	
MUREN	27	CL	5.1-6.0	0.2-0.6	
MUSKEGO	2	PT, OH, OL	5.6-8.4	0.06-6.0	
MUSKINGUM	23	GM, SM, ML, CL	4.5-5.5	0.6-2.0	35
MUSSEY	8	SP, SP-SM	7.4-7.8	6.0-20	
NAPPANEE	14	CL, CH	5.1-8.4	< 0.06	
NEGLEY	25	SM, SC, ML, GM	4.5-6.0	0.6-20	
NEWARK	19	ML, CL, CL-ML	5.6-7.8	0.6-2.0	
NEWTON	8	SP-SM, SM	4.5-5.5	6.0-20	
NICHOLSON	21	CL, ML, CL-ML, CH	4.5-7.8	0.06-2.0	
NINEVEH	29	CL, SC, GC, SP, GP, SP-SM, GP-GM	6.6-8.4	> 0.6	
NOLIN	20	ML, CL, CL-ML	5.6-8.4	0.6-2.0	
OAKTOWN	29	SP, SM, SP-SM	5.1-5.5	6.0-20	
OAKVILLE	29	SM, SP, SP-SM	5.6-7.3	> 20	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
OAKVILLE WET SUBSTR. (White Co.)	29	SM, SP, SP-SM	5.6-7.3	>20	
OCKLEY	27	CL, SC, GC	4.5-6.5	0.6-2.0	
OCKLEY LOAMY SUBSTR. (Hendricks Co.)	26	CL	5.6-6.5	0.6-2.0	
OCKLEY LOAMY SUBSTR. (Howard Co.)	26	CL, SC	5.5-6.5	0.6-2.0	
OCTAGON	27	CL	5.6-8.4	0.6-2.0	
ODELL	16	CL, ML	5.6-8.4	0.2-0.6	
OKEE	29	SM, SP-SM, SC, ML, CL	5.6-8.4	0.6-6.0	
ONARGA	29	SC, CL, SM-SC, CL-ML	5.1-6.5	0.6-6.0	
ORMAS	29	SM, SW-SM, SP-SM, SM-SC	5.1-6.5	2.0-6.0	
ORMAS VARIANT (Starke Co.)	29	SM, SP-SM, SW-SM, SC, SM-SC	5.1-6.5	2.0-20	
ORRVILLE	19	CL, CL-ML, ML, SM, SC	5.1-7.3	0.6-6.0	
OSHTEMO	29	SM, SC, SM-SC, SP-SM	5.1-7.3	2.0-20	
OSHTEMO LOAMY SUBSTR. (Allen Co.)	27	ML	5.1-8.4	0.6-6.0	
OSHTEMO LOAMY SUBSTR. (Pulaski Co.)	27	SM, SM, CL	5.6-6.5	2.0-20	
OTWELL	20	CL, CL-ML	4.5-5.5	<0.2	
OTWELL, CALC. SUBSTRATUM (Owen Co.)	20	ML, CL	4.5-8.4	0.2-0.6	
OWOSSO	26	SM, SC, SM-SC, CL, CL-ML	5.1-8.4	0.2-6.0	
PALMS	2	PT, CL-ML, CL	5.1-8.4	0.2-6.0	
PALMS SANDY SUBSTRATUM (LaPorte Co.)	2	PT, CL-ML, CL	5.1-8.4	0.2-6.0	
PARKE	25	CL, SC	4.5-5.5	0.6-2.0	
PARR	26	CL, ML, CL-ML	5.6-8.4	0.6-2.0	
PATE	28	CL, CH	5.6-8.4	<0.6	72
PATTON	6	CL, CH, ML, MH	6.1-8.4	0.6-2.0	
PATTON BEDROCK SUBSTRATUM (Hamilton Co.)	6	CL, CH	6.1-7.8	0.6-2.0	52
PATTON LOAMY SUBSTRATUM (Howard Co.)	6	CL, ML	6.1-8.4	0.2-2.0	
PEKIN	21	CL, CL-ML	4.5-6.0	<2.0	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
PELLA	6	CL	7.4-8.4	0.6-2.0	
PELLA TILL SUBSTRATUM (White Co.)	6	CL, CH, ML, MH	6.6-7.3	0.2-0.6	
PEOGA	10	CL	4.5-5.5	0.06-0.2	
PEOGA VARIANT (Knox Co.)	10	CL, CH	4.5-6.0	0.06-0.2	
PERRIN	9	SM, SC, SM-SC, SP, SP-SM, GP, GP-GM	5.6-8.4	>2.0	
PETROLIA	11	CL, ML	6.1-7.8	0.2-0.6	
PETTIT	20	CL, ML	6.1-7.3	0.6-2.0	
PEWAMO	5	CL, CH	5.6-7.8	0.2-0.6	
PEWAMO CALC. VARIANT (Lake Co.)	5	CH	7.4-7.8	0.06-0.2	
PEWAMO STRATIF. SUBSTRATUM (Delaware Co.)	7	CL, CH	6.6-7.3	0.06-0.2	
PHILO	18	ML, SM, CL-M	4.5-6.0	0.6-2.0	
PIKE	27	CL	4.5-5.5	0.6-2.0	
PINHOOK	9	SC, CL, SM, ML	4.5-5.5	2.0-6.0	
PLAINFIELD	29	SP	4.5-6.5	6.0-20	
PLAINFIELD LOAMY SUBSTR. (Starke Co.)	29	SP-SM, SM	5.6-6.0	6.0-20	
PLAINFIELD MOD. FINE SUBSTR. (Allen Co.)	29	SM	5.6-6.0	6.0-20	
PLAINFIELD VAR. (Posey Co.)	29	SP	5.6-7.3	6.0-20	
PLANO	27	CL	5.6-7.3	0.6-2.0	
POPE	20	ML, SM, SM-SC, GM	3.6-5.5	0.6-6.0	
POPE CHANNERY SUBSOIL VAR. (Perry Co.)	29	GM	5.1-5.5	6.0-20	
PRINCETON	27	SC, SM-SC, CL, CL-ML	5.1-7.3	2.0-6.0	
PROCHASKA	8	SP, SP-SM, SM	5.6-7.3	6.0-20	
PROCTOR	27	CL	5.6-6.5	0.6-2.0	
QUINN	9	CL, ML, SM, SC	4.5-5.5	0.6-2.0	
RAGSDALE	6	CL	6.1-7.3	0.06-0.2	
RAGSDALE TILL SUBSTRATUM (Fountain Co.)	6	CL	6.6-7.3	0.06-0.2	
RAHM	19	CL, CH	4.5-7.3	0.06-2.0	
RANDOLPH	13	CL, CH, GC, SM-SC, SC, GM-GC	5.1-8.4	0.2-0.6	34

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
RANDOLPH VAR. (Hamilton Co.)	13	CL, CH	5.1-8.4	0.2-0.6	41
RARDEN	23	CH	3.6-5.5	0.06-0.2	38
RAUB	16	CL, CH	5.1-7.3	0.2-0.6	
RAWSON	26	SC, CL, CH	5.6-7.8	<2.0	
REESVILLE	16	CL, CL-ML	5.1-8.4	0.2-2.0	
RENSSELAER	7	CL, SC	6.1-7.8	0.6-2.0	
RENSSELAER CALC. SUBSOIL VAR. (Lake Co.)	6	CL	6.6-7.8	0.2-2.0	
RENSSELAER CLAY LOAM SUBSTR. (Posey Co.)	6	CL	6.6-7.3	0.06-0.2	
RENSSELAER SANDY SUBSTRATUM (Lake Co.)	7	CL	6.6-7.3	0.2-0.6	
RENSSELAER SANDY SUBSTRATUM (White Co.)	6	SC, SM-SC	7.4-7.8	2.0-6.0	
RENSSELAER TILL SUBSTRATUM (Cass Co.)	6	CL, CL-ML, ML, SC	6.6-7.3	0.6-2.0	
RENSSELAER VAR. (White Co.)	7	SM-SC, SC	5.1-6.0	2.0-6.0	
RIDDLES	26	CL, SC	5.1-7.3	0.6-2.0	
RIMER	14	SM, SM-SC, SC, CH, CL	5.1-8.4	0.06-20	
ROBINSON	10	CL	4.5-5.0	<0.06	
ROCKCASTLE	22	CL, MH, CH, ML	4.0-5.5	0.06-0.2	28
RODMAN	29	SP, SP-SM, GP, GP-GM	7.4-8.4	>20	
ROMNEY	5	CL, CH	6.1-7.3	0.06-0.2	
ROMNEY GRAVELLY SUBSTRATUM (Fountain Co.)	7	CL	6.6-7.3	0.2-0.6	
ROSS	20	ML, CL, CL-ML, SM, GM	6.1-8.4	0.6-6.0	
ROSS VARIANT (Shelby Co.)	29	SM, SP-SM	7.9-8.4	>2.0	
ROSSMOYNE	21	CL, ML	4.5-5.5	0.06-2.0	
RUNNYMEDE	8				
RUSH	27	CL, SC	5.1-7.3	0.6-2.0	
RUSSELL	26	CL	4.5-7.3	0.6-2.0	
RYKER	27	CL	4.5-7.3	0.6-2.0	
SABLE	6	CL, OH, CH, OL	5.6-7.8	0.6-2.0	
SABLE TILL SUBSTRATUM (Vermillion Co.)	7	CL	5.6-7.3	0.6-2.0	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
ST. CLAIR	28	CH, MH	5.6-8.4	< 0.2	
SARANAC	5	CL, CH	6.6-8.4	0.06-0.6	
SAUGATUCK	8	SP-SM, SM, SP	4.5-6.5	0.06-20	
SCIOTOVILLE	21	CL, CL-ML	4.5-6.0	0.06-2.0	
SEAFIELD	9	SM-SC, SC, CL-ML, CL, SM	5.1-7.3	> 2.0	
SEAFIELD VAR. (White Co.)	24	SM-SC, SC, CL-ML	5.1-7.8	2.0-6.0	42
SEBEWA	8	SC, CL, SP, SP-SM, GP, GP-GM	6.1-8.4	0.6-20	
SEBEWA SHALY SANDY SUBSTRATUM (LaPorte & Porter Co.)	8	SC, CL, SP, SP-SM, GP, GP-GM	6.1-8.4	0.6-20	
SELFRIDGE	16	SM, SP-SM, SM-SC, SC, CL	5.6-8.4	0.06-20	
SELMA	7	CL, SC, SM-SC, CL-ML	6.1-8.4	0.6-6.0	
SEWARD	28	SM, ML, CH, CL	5.1-8.4	0.06-20	
SHADELAND	13	CL	5.1-6.0	0.2-0.6	33
SHIPSHE	29	GC, GW-GM, SW-SM, SC, SW, GW	5.6-8.4	> 2.0	
SHOALS	19	CL, CL-ML, ML	6.1-7.8	0.6-2.0	
SIDELL	26	CL	5.1-7.8	0.6-2.0	
SLEETH	17	CL	5.6-8.4	0.6-2.0	
SLEETH LOAMY SUBSTRATUM (Madison Co.)	16	CL	5.1-6.0	0.2-0.6	
SLEETH LOAMY SUBSTRATUM (Parke Co.)	16	CL, SC	5.1-7.3	0.2-2.0	
SLOAN	19	CL	6.1-8.4	0.2-2.0	
SLOAN CALC. VARIANT (Pulaski Co.)	19	ML-OL	7.4-8.4	0.6-2.0	
SLOAN SANDY SUBSTRATUM (Hamilton Co.)	17	CL, CL-ML, ML	6.1-8.4	0.2-2.0	
SPARTA	26	SM, SP-SM, SP	5.1-6.5	6.0-20	
STARKS	17	CL, SC, CL-ML, SM-SC	5.1-7.3	0.2-2.0	
STEFF	18	ML, CL, CL-ML	4.5-5.5	0.6-2.0	
STENDAL	18	CL, CL-ML	4.5-5.5	0.6-2.0	
STOCKLAND	29	SM-SC, SC, CL, SM, SP-SM, GP-GM	5.6-8.4	2.0-20	
STOCKWELL	29				
STONELICK	20	SM, SP-SM	7.4-8.4	2.0-6.0	
STOY	12	CL	4.5-5.5	0.06-0.2	
STROLE	14	CL, CH	5.6-7.8	0.06-0.2	
SUMAN	19	CL, SM, SP-SM	6.1-7.8	0.2-20	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
SUMNER	20				
SUNBURY	16	CL, CH	5.6-7.8	0.6-2.0	
SWITZERLAND	28	CL, CH	4.5-7.8	< 2.0	60
SWYGERT	14	CH, CL	6.1-8.4	0.06-0.2	
SYLVAN	27	CL, CL-ML	5.6-8.4	0.6-2.0	
TAGGART	16	CL, CH	4.5-5.5	0.06-0.2	
TAMA	27	CL	5.1-6.0	0.6-2.0	
TAWAS	3	PT, SP, SM, SP-SM	4.5-8.4	0.2-20	
TEDROW	9	SM, SP	6.1-7.8	6.0-20	
TILSIT	21	CL, CL-ML	3.6-5.5	0.06-2.0	65
TIPPECANOE	27	CL, SC	5.1-6.5	0.6-2.0	
TOLEDO	4	CH, CL, ML, MH	6.1-7.8	0.06-0.2	
TORONTO	16	CL	4.5-6.5	0.2-0.6	
TOTO	3	PT, OH, OL, Marl	5.6-8.4	0.06-2.0	
TRACY	29	ML, SM, SC, CL	4.5-5.0	0.6-2.0	
TRACY SILTY CLAY LOAM SUBSTR. (Lake Co.)	26	CL	4.5-5.5	0.6-2.0	
TRAPPIST	23	CL, MH, CH, GC	3.6-5.5	0.06-2.0	35
TREATY	6	CL	6.1-7.8	0.6-2.0	
TROXEL	20	CL, ML	5.6-6.5	0.6-2.0	
TYNER	29	SM, SP-SM	4.5-6.5	6.0-20	
UNIONTOWN	26	CL, ML	5.1-8.4	0.2-2.0	
VARNA	28	CL, CH	5.6-8.4	0.06-0.6	
VIGO	12	CL, CH	4.5-5.5	< 0.06	
VINCENNES	7	CL, SC	4.5-5.5	0.06-0.2	
VINCENNES GRAV. SUBSTR. (Knox Co.)	7	CL	5.1-6.0	0.06-0.2	
VOLINA	29	CL, SC, SM, SP-SM	4.5-6.5	0.6-20	
WABASH	4	CH	5.6-7.3	< 0.06	
WAKELAND	19	ML	5.6-7.3	0.6-2.0	
WALLKILL	1	CL, CL-ML, SM-SC, SC, PT	5.1-7.8	0.6-20	
WALLKILL CLAYEY SUBSTR. (Knox Co.)	3	PT, CL, CH	5.1-7.8	0.06-6.0	
WARNERS	19	ML, CL, CL-ML, Marl	7.4-8.4	0.2-2.0	24 Marl
WARSAW	29	SC, CL, GC, SP, GP, SP-SM GP-GM	5.1-8.4	> 0.6	
WASEPI	9	SM, SC, SM-SC, SP, SP-SM, GP, GP-GM	5.6-7.8	> 2.0	
WASHTENAW	6	CL, ML	6.1-7.3	0.06-2.0	
WATSEKA	9	SP, SM, SP-SM	5.1-7.3	6.0-20	
WATSEKA VAR. (Lake Co.)	15	SM, CL	6.6-7.8	0.2-20	

SOIL NAME	DRAINAGE GROUP NO.	UNIFIED SOIL CLASSIFICATION	pH RANGE	PERM. RANGE IN/HR	DEPTH TO BEDROCK (IN)
WAUSEON	5	SM, CH, CL, MH, ML	6.6-8.4	< 20	
WAWASEE	26	SC, CL	6.1-7.3	0.6-2.0	
WEA	27	CL	5.1-6.5	0.6-2.0	
WEIKERT	22	GM, GP-GM	4.5-6.0	2.0-6.0	18
WEINBACH	12	CL	4.5-5.5	< 2.0	
WEISS	9	SM, SP	6.1-7.8	6.0-20	
WELLSTON	24	CL, CL-ML, SC, SM-SC	4.5-6.0	0.6-2.0	45
WESTLAND	7	CL	5.6-7.3	0.6-2.0	
WESTLAND LOAMY SUBSTRATUM (Fountain Co.)	7	CL, ML	6.6-7.3	0.06-2.0	
WESTLAND LOAMY SUBSTRATUM (Parke Co.)	6	CL, SC	6.6-7.3	0.2-2.0	
WESTLAND SHALLOW VAR. (Sullivan Co.)	13	CL	6.6-7.3	0.06-6.0	30
WESTLAND THIN SOLUM VARIANT (Fountain Co.)	13	SM	6.6-7.3	0.6-2.0	25
WHEELING	25	ML, CL, SM	5.1-6.0	0.6-2.0	
WHEELING VAR. (Posey Co.)	25	CL	5.1-6.0	0.2-0.6	
WHITAKER	17	CL	5.1-6.0	0.6-2.0	
WHITCOMB	12	CL	4.5-5.5	0.06-0.2	
WHITSON	16	CL, CH	5.1-6.5	0.06-0.6	
WILBUR	19	CL, CL-ML	5.6-7.3	0.6-2.0	
WILLETTE	2	PT, CL, CH	6.1-8.4	0.06-6.0	
WINGATE	27	CL, CH	5.1-6.0	0.2-0.6	
WOODMERE	20	CL, CH	4.5-7.3	0.2-0.6	
WOOTEN	8	SP-SM, SM	6.6-7.8	> 20	
WOLCOTT	6	CL, CL-ML	6.1-8.4	0.6-2.0	
WYNN	23	CL, CH	6.1-8.4	0.06-0.6	33
XENIA	26	CL	5.1-7.3	0.2-0.6	
ZANESVILLE	21	ML, CL, CL-ML	4.5-5.5	0.06-2.0	60
ZIPP	4	CL, CH	6.1-7.3	< 0.2	

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations ^{1/}
VERY POORLY DRAINED, DARK COLORED FLATS AND DEPRESSIONS				
1.	Deep, very poorly drained, rapidly permeable organic soils more than 50 inches thick in depressions. Slopes less than 1%.	Carlisle Houghton Walkill	Poor outlets, high water table.	Use surface field laterals spaced 200 ft. and 3 ft. deep -- side slopes 1:1, first 3 to 5 years until initial subsidence has occurred. Use diversion to cut off upland runoff. Controlled drainage usually profitable and practical by holding the water table 30"-36" below surface for field crops. Subsurface drainage recommended although pumping may be required where gravity outlet is not available. Plastic tubing or 24" length of tile should be used. Minimum size - see recommendations for subsurface drainage in muck soils. Depth of tile 48"-60", spacing 80'-200'.
2.	Moderately deep, very poorly drained, moderately permeable, organic soils in depressions and along streams. Kerston soils have interbedded organic and sand layers. Palms has 16 to 50 inches of organic material over silty clay or clay. Slopes less than 1%.	Kerston Muskego Palms Willette	Same as Group 1	Same as Group 1. However, length of tile would be dependent on whether placed in the muck soil or an underlying mineral soil. Depth 36"-48", spacing 65'-100'.
3.	Moderately deep, very poorly drained organic soils in depressions, rapidly permeable in the organic layer and slowly to very rapidly permeable in the underlying material. Adrian soils have 16 to 50 inches of organic material over sand. Edwards soils have 16 to 50 inches of organic material over marl. Martisco soils have 8 to 16 inches of organic material over marl. Toto soils have 16-24 inches of organic materials over coprogenous earth over marl, all overlying sand at about 40 inches. Slopes less than 1%.	Adrian Edwards Martisco Tawas Toto Warners	Same as Group 1..	Use diversions to cut off upland runoff. Use surface field laterals spaced 200' and 3' deep -- side slopes 1:1. Pumping may be required if a gravity outlet is not available. Control water table with control structures. Subsurface drainage is usually not recommended except Adrian and Tawas soils where organic layer is less than 2' and subsurface drainage placed in sand. Same as Group 2 except encase subsurface drains with filter materials. High cost investment in draining other soils is usually not warranted.

^{1/} The wider spacings are permitted as depths are increased. Maximum feasible depth based upon underlying material should be used.

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations ^{1/}
4.	Very poorly drained, slowly to very slowly permeable, clayey soils in depressions. Clay content ranges from 40 to 55 percent in the subsoil. Slopes less than 1%.	Hoytville Kings Montgomery	High water table. Very slow drainage in subsoil; surface water occasionally impounded.	A well designed complete surface drainage system, including land smoothing, is highly recommended. Use diversions to cut off upland runoff. Use subsurface drainage to supplement the surface drainage systems. Tile or tubing may be needed as random lines along grassed waterways or surface drains. In some cases a complete system may be justified. Blind and/or surface inlets to the subsurface drainage. Depth 36"-42", spacing 40'-80'.
5.	Very poorly drained, slowly or moderately slowly permeable clayey soils in depressions or on floodplains. Clay content ranges from 35 to 45 percent in the subsoil. Slopes less than 1%.	Kokomo Milford Pewamo	High water table and surface ponding.	Random shallow surface drainage. Use diversions to cut off upland runoff. Surface drainage recommended supplemented by subsurface drainage. Blind and/or surface inlets to subsurface drainage. Depth 36"-42", spacing 50'-80'.
6.	Very poorly drained, moderate to moderately slowly permeable, loamy soils in depressions and broad flats. Clay content of the sub-soil ranges from 25 to 35 percent. No major stratification of materials.	Brookston Chalmers Evansville Patton Ragsdale Treaty	Same as Group 5.	Same as Group 5. Depth 36"-42", spacing 70'-120'.
7.	Very poorly drained, moderately to moderately slowly permeable loamy soils in depressions and broad flats. Materials below a depth of about 40 inches are stratified and contain some coarse layers such as sand or gravelly sand.	Lyles Mahalasville Rensselaer Westland	Same as Group 5.	Same as Group 5. In addition, sands and gravel may be a hazard to installing drains deeper than 40" due to unstable trench walls. Depth 36"-42", spacing 70'-120'.

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations ^{1/}
8.	Very poorly drained soils in depressions and on broad flats, moderate to rapidly permeable in the subsurface layers and rapidly to very rapidly permeable below depths ranging from 20 to 40 inches. Sandy or loamy above 40 inches and sand or gravelly sand below. Saugatuck soils have slow permeability in the iron pan horizons. Slopes less than 1%.	Gilford Maumee Newton Saugatuck Sebewa	High water table Siltation of drains	Use field laterals for water table control spaced 660' and 2.5'-4' deep -- bottom width 4' -- side slopes 2:1 or flatter. Since over-drainage may make these soils droughty, consider controlling the water table depth at 24"-36" for crop production. Depth 36"-48", spacing 100'-150'. Encase subsurface drains with filter materials.
SOMEWHAT POORLY AND POORLY DRAINED, MODERATELY DARK OR LIGHT COLORED, NEARLY LEVEL				
9.	Somewhat poorly and poorly drained soils on level slopes with moderate to rapidly permeable subsurface layers and rapidly to very rapidly permeable layers below depths of 20 to 40 inches. Loamy or sandy soils underlain with sand or gravelly sand at depths of 20 to 40 inches or more. Slopes are less than 1%.	Brady Homer Morocco Pinhook Quinn	Same as Group 8.	Same as Group 8. Depth 36"-48", spacing 100'-150'.
10.	Poorly drained soils on nearly level slopes with slowly or very slowly permeable subsoils. These strongly acid loamy soils have dense, compact silt loam or silty clay loam subsoils and are on upland and terraces. Locally often called "gray flats". Slopes are less than 1%.	Clermont Cory Peoga	Very slow subsoil drainage. Siltation of drains. Limited grade for laterals.	A well designed parallel ditch system of surface drainage is highly recommended. On the sloping areas, cross slope drains should be used. Land smoothing is recommended with these systems. Use grassed waterways on erosive slopes. Use subsurface drainage where needed to supplement the surface drainage systems (i.e., along surface drains). Depth 36"-42", spacing 40'-60'. Complete subsurface systems not normally recommended. Minimum grade of 0.25% should be maintained if possible. Use blind inlets to flush drains where feasible at ends of laterals.

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations ^{1/}
11.	Poorly drained, moderately slowly or slowly permeable silty clay loam and silt loam soils on overflow bottom lands. Birds and Petrolia are neutral. Bonnie is strongly acid in the subsoil. Slopes less than 1%.	Birds Bonnie Petrolia	Impounded upland runoff and/or flood water. Outlets may back up during flood periods.	Random or parallel shallow surface drains are recommended. Use diversions to cut off upland runoff. Use interceptor drains at base of slopes to intercept seepage water. These soils are very low in productivity and cost investment to drain is usually not warranted. Depth 30"-36", spacing 45'-60'.
12.	Somewhat poorly drained, slowly or very slowly permeable soils with compact (fragipans) silt loam or silty clay loam subsoils. These soils have strongly acid subsoils and are on nearly level and gently sloping upland and terraces. Slopes range from 0 to 4 percent.	Avonburg Bartle Dubois Johnsburg Vigo Weinbach	Slow subsoil drainage. Siltation of drains	Cross slope drains and terracing supplemented as needed with subsurface drainage may be adopted on the steeper slopes. Depth 36"-42", spacing 50'-80'. Complete subsurface systems not normally recommended.
13.	Moderately deep, somewhat poorly and very poorly drained moderately slowly permeable soils. These loamy soils have silty clay loam or clay loam subsoils and bedrock occurs within a depth of 20 to 40 inches. Millsdale is a dark colored soil in depressions. Randolph and Shadeland are on convex nearly level to gentle slopes.	Millsdale Randolph Shadeland	Slow subsoil drainage and impounded water.	Shallow surface drainage where necessary. Subsurface drainage generally not recommended because of shallow depth to rock. Tile mains may cross these soils to get to an outlet. Thorough investigation along the route of the tile line is required for bedrock depth.
14.	Somewhat poorly drained, slowly permeable, clayey, nearly level and gently sloping soils on upland and terraces. Clay content 40 to 60% in the subsoil. Convex, 0 to 4 percent slopes.	Fulton McGary Nappanee	Very slow subsoil drainage; surface water occasionally impounded on the adjoining depressional soils.	Same as Group 4. Terracing may be used for water disposal and erosion control. Depth 36"-42", spacing 40'-80'.

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations ^{1/}
15.	Somewhat poorly drained, slowly or moderately slowly permeable, clayey, nearly level and gently sloping soils on uplands and terraces. Clay content 35 to 45 percent in the subsoil. Convex, 0 to 4 percent slopes.	Blount Crosby Del Rey Selfridge	Same as Group 12.	Grassed waterways, terraces, and diversions where needed. Subsurface drainage recommended. Only random lines may be needed on the upper slope limits. Depth 36"-42", spacing 40'-80'.
16.	Somewhat poorly drained, moderately, slow to moderately permeable, loamy, nearly level and gently sloping soils on uplands and terraces. Clay content 25 to 35 percent in the subsoil. Convex, 0 to 4 percent slopes.	Crosier Fincastle Flanagan Iva Odell Reesville Marks	Same as Group 15 but subsoil drainage easier to achieve	Same as Group 15. Depth 36"-42", spacing 70'-120'.
17.	Somewhat poorly drained, moderately and moderately slowly permeable, loamy, nearly level and gently sloping soils on terraces and uplands. These soils have stratified silt and sand, sand, or sand and gravel below depth of about 40 or 50 inches. Convex, 0 to 4 percent slopes.	Ayrshire Darroch Sleeth Whitaker	Same as Group 15 but subsoil drainage easier to achieve.	Same as Group 15. Depth 36"-42", spacing 50'-120'.
18.	Somewhat poorly and moderately well drained, moderately permeable, silt loam soils on overflow bottomland. These soils have very strongly acid subsoils and are on 0 to 2 percent slopes.	Steff Stendal	Same as Group 11.	Use random or parallel shallow surface drainage, supplemented with subsurface drainage, to remove impounded water. Use interceptor drains at base of slopes to intercept seepage water. Depth 36"-42", spacing 50'-120'.

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations ^{1/}
19.	Moderately well and somewhat poorly drained, moderately permeable, loamy soils on overflow bottomland. Medium acid to neutral. Slopes less than 1%.	Eel Shoals Wakeland Wilbur	Same as Group 11.	Same as Group 18. Depth 36"-42", spacing 50'-120'.
WELL AND MODERATELY WELL DRAINED-LIGHT TO DARK COLORED-LEVEL TO VERY STEEP				
20.	Bottomlands-well drained, moderately or moderately rapidly permeable loamy soils on overflow bottomlands. Strongly acid to neutral. Slopes less than 1%.	Cuba Genesee Haymond Huntington Ross	None for agricultural uses. Subject to flooding.	Surface and subsurface drainage usually not needed. Drainage mains may cross these soils to get to an outlet.
21.	Moderately well and well drained, slowly permeable soils with fragipans. These are nearly level to strongly sloping soils on upland and terraces. Very strongly acid subsoils. Slopes are commonly 1 to 18 percent.	Ava Bedford Cincinnati Hosmer Jennings Rossmoyne Zanesville	None for agricultural uses.	Grassed waterways and terraces on land slope up to 8-10 percent for water disposal and erosion control. Subsurface drainage usually not needed. Drainage mains may cross these soils to get to an outlet.
22.	Shallow to bedrock, well drained slowly to moderately permeable, clayey and loamy soils with bedrock within a depth of 20 inches. Slopes are dominantly more than 25 percent but a few are less.	Colyer Corydon Fairmount Weikert	None for agricultural uses.	Seldom used as cropland.

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations
23.	Moderately deep to bedrock, moderately to moderately slowly permeable, loamy and clayey upland soils. Bedrock is at a depth ranging from 20 to 40 inches. These sloping to very steep soils are on slopes dominantly of more than 25 percent but a few are less.	Berks Gilpin Muskingum	None for agricultural uses.	Same as Group 21. Thorough investigation is required along the route of a tile main for bedrock depth.
24.	Deep over bedrock, well drained, moderately to moderately slowly permeable clayey and loamy soils. Depth to bedrock is dominantly 4 to 8 feet with an overall range of 3 1/2 to 12 feet. These gently sloping to steep soils are on uplands.	Baxter Hagerstown Wellston	None for agricultural uses.	Same as Group 21. Terraces may also be used for water disposal and erosion control. Cleanup of surfaced small rock fragments will be required after terrace cut and fill operations.
25.	Silty and loamy terraces-deep, well drained moderately permeable silty and loamy soils. These are nearly level to sloping soils except for Negley which is steep to very steep. Underlying materials are stratified and range from sand and gravelly sand to loam and sandy loam. They are strongly acid in the subsoil and underlying materials. Slopes commonly range from 1 to 6 percent. Negley has slopes usually over 25 percent.	Negley Parke Wheeling	None for agricultural uses.	Same as Group 21. Terraces may also be used for water disposal.

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations
26.	Deep, well drained, moderately to moderately slowly, permeable, loamy soils. Nearly level to moderately steep soils except for the Hennessee and Hickory which are steep to very steep. They are on upland. Underlying materials are moderately alkaline (calcareous) loamy till. Slopes commonly range from 1 to 18 percent. Hennessee and Hickory are on slopes usually greater than 18 percent.	Hennessee Hickory Miami Parr	Same lateral seeps on lower slopes of the more clayey soils.	Subsurface drainage usually not needed. Use grassed waterways and terraces on land slope up to 8-10 percent for water disposal and erosion control. Interceptor drains may be needed to intercept seepage water.
27.	Deep well and moderately well drained, moderately permeable, silty and loamy soils. These are commonly nearly level to moderately steep soils. Underlying materials are moderately to very rapidly permeable, silts, silts and sands or sands and gravel, and are neutral to moderately alkaline. Slopes commonly range from 1 to 18 percent but a few are steeper.	Alford Martinsville Ockley	Same as Group 26.	Same as Group 26.
28.	Deep, well and moderately well drained, moderately slow to slowly permeable clayey soils. These are commonly sloping to moderately steep soils. They are on terraces, lacustrine plains and on colluvium from shales and uplands. Underlying materials are slowly or very slowly permeable, are clayey and moderately alkaline. Slopes commonly range from 6 to 18 percent.	Markham Markland Morley St. Clair	Same as Group 26.	Grassed waterways and low-intensity crop rotations needed for water disposal and erosion control. Interceptor drains may be needed to intercept seepage water.

TABLE IN 14-2 AGRICULTURAL DRAINAGE RECOMMENDATIONS

Drainage Group No.	Description of Soil Group	Representative Soil Types	Principal Drainage Problems	Drainage Recommendations
29.	<p>Eolian sands and sand-gravel terraces. Deep and moderately deep well and excessively drained, moderately to very rapidly permeable sandy and loamy soils. Materials below about 40 inches are rapidly to very rapidly permeable sand and gravelly sand. These are commonly nearly level to sloping soils but a few are steeper. Slopes commonly range from 1 to 12 percent.</p>	<p>Bloomfield Chelsea Fox Oshtemo Plainfield Warsaw</p>	None for agricultural use.	Droughty soils. Drainage mains may cross these soils to get to an outlet.

Table IN 14-3. Estimated Limitations, Suitabilities or Properties of Soils for Urban and Residential Use

Drainage Group No.	Representative Soil Types	Estimated Physical Properties Affecting Use of Soils			Dwellings with Basement 1/ 3/	Dwellings w/o Basement 1/ 3/	Shallow Excavations 1/ 3/	Septic Tank Absorption Fields 1/ 3/	Roads and Streets 1/ 3/
		Shrink-Swell Potential ^{1/}	Frost Action Potential ^{1/}	Permeability ^{2/} (In./Hr.)					
1	Carlisle, Wallkill, Houghton	Low	Low	.2-6.	Severe 1,6,8,10	Severe 1,6,8,10	Severe 1,6,10	Severe 1,10	Severe 1,6,8,10
2	Kerston, Palms, Willette, Muskego	Low to Moderate	Low to Moderate	.06-20.	Severe 1,6,8,10	Severe 1,6,8,10	Severe 1,7	Severe 1,10	Severe 1,6,8,10
3	Adrian, Edwards, Martisco, Tawas, Toto	Low	Low	0.6-20.	Severe 1,6,8,10	Severe 1,6,8,10	Severe 1,6,10	Severe 1,10	Severe 1,6,8,10
4	Hoytville, Kings, Montgomery, Zipp	High	High	<.06-.6	Severe 1,3,5,8	Severe 1,3,5,8	Severe 1,7,10	Severe 1,4,10	Severe 1,3,5,8
5	Kokomo, Milford, Pewamo	Moderate	High	<.06-.6	Severe 1,3,8,10	Severe 1,3,8,10	Severe 1,7,10	Severe 1,4,10	Severe 1,3,8,10
6	Brookston, Evansville, Chalmers, Patton, Ragsdale, Treaty	Moderate	High	.06-2.	Severe 1,10	Severe 1,10	Severe 1,10	Severe 1,4,10	Severe 1,3,8,10
7	Lyles, Westland, Mahalaville, Rensselaer, Vincennes	Low	High	.06-2.	Severe 1,10	Severe 1,10	Severe 1,7,10	Severe 1,4,10	Severe 1,3,8,10
8	Gilford, Sebewa, Maumee, Newton, Saugatuck	Low	Low	2.-20.	Severe 1,10	Severe 1,10	Severe 1,7,10	Severe 1,2,10	Severe 1,10
9	Brady, Homer, Morocco, Quinn, Pinhook	Low	Moderate	6.-20	Severe 1	Moderate 1	Severe 1,7	Severe 1,2	Moderate 1,3

^{1/} For definition of terms see pages 14-113 and 14-114.

^{2/} Wide range in permeabilities results from ranges in permeabilities between horizons and soil series included in the drainage group.

See Table IN14-1 for specific values. For limitations as it relates to a specific soil in the group, refer to the soil interpretation record for that particular soil series in the local field office.

^{3/} For key to numbers in this column see page 14-140.

Table IN 14-3. Estimated Limitations, Suitabilities or Properties of Soils for Urban and Residential Use

Drainage Group No.	Representative Soil Types	Estimated Physical Properties Affecting Use of Soils			Dwellings with Basement		Dwellings w/o Basement		Shallow Excavations		Septic Tank Absorption Fields		Roads and Streets	
		Shrink-Swell Potential ^{1/}	Frost Action Potential ^{1/}	Permeability ^{2/} (In./Hr.)	1/	3/	1/	3/	1/	3/	1/	3/	1/	3/
10	Clermont, Cory, Peoga	Low to Moderate	High	.2-2.	Severe 1		Severe 1		Severe 1		Severe 1,4		Severe 1,3	
11	Birds, Bonnie, Petrolia	Low	High	.06-2.	Severe 1,10		Severe 1,10		Severe 1,10		Severe 1,10		Severe 1,3,10	
12	Avonburg, Vigo, Bartle, Dubois, Johnsbury, Weinbach	Moderate	High	<.06-.2	Severe 1,4		Moderate 4		Moderate 4		Severe 1,4		Severe 3,8	
13	Millsdale, Randolph, Shadeland	High	High	.2-.6	Severe 1,5,11		Severe 1,5		Severe 1,7,11		Severe 1,4,11		Severe 3,8	
14	Fulton, Rimer, McGary, Strole, Nappanee	High	Moderate	<.06-.2	Severe 1,5,8		Severe 5,8		Severe 1,7		Severe 1,4		Severe 5,8	
15	Blount, Del Rey, Crosby, Selfridge	Moderate	High	<.06-.6	Severe 1,5,8		Moderate 1,5,8		Moderate 1,7		Severe 1,4		Severe 3,8	
16	Crosier, Odell, Flanagan, Marks, Reeseville, Ira	Moderate	High	.06-2.	Severe 1		Moderate 1,5,8		Severe 1		Severe 1,4		Severe 3,8	
17	Ayrshire, Sleeth, Darroch, Whitaker	Moderate	High	.2-2.0	Severe 1		Moderate 5,8		Severe 1		Severe 1,4		Severe 3	
18	Staff, Stendal	Low	High	.6-2.0	Severe 10		Severe 10		Severe 1,10		Severe 10		Severe 3,10	

Table IN 14-3. Estimated Limitations, Suitabilities or Properties of Soils for Urban and Residential Use

Drainage Group No.	Representative Soil Types	Estimated Physical Properties Affecting Use of Soils			Dwellings with Basement 1/ 3/	Dwellings w/o Basement 1/ 3/	Shallow Excavations 1/ 3/	Septic Tank Absorption Fields 1/ 3/	Roads and Streets 1/ 3/
		Shrink-Swell Potential ^{1/}	Frost Action Potential ^{1/}	Permeability ^{2/} (In./Hr.)					
19	Eel, Wilbur, Wakeland, Shoals	Low	High	.6-2.0	Severe 10	Severe 10	Severe 1,10	Severe 10	Severe 3,10
20	Genesee, Ross Huntington, Haymond	Low	Moderate	.6-2.0	Severe 10	Severe 10	Severe 10	Severe 10	Severe 10
21	Ava, Bedford, Cincinnati, Ross-moyne, Hosmer, Jennings, Otwell, Zanesville	Low	High	0.6-0.2	Slight or Moderate 9	Slight or Moderate 9	Slight or Moderate 1,9	Severe 4	Severe 3
22	Colyer, Weikert, Fairmount	Low	Moderate	.06-2.0	Severe 9,11	Severe 9,11	Severe 9,11	Severe 9,11	Slight to Severe 9
23	Berks, Gilpin, Muskingum	Low	Low	.6-2.0	Severe 11	Moderate to Severe 9,11	Severe 11	Severe 9,11	Slight to Severe 9
24	Baxter, Hagerstown, Wellston	Low to Moderate	Moderate to High	0.6-2.0	Moderate 5,8	Moderate 5,8	Moderate 7	Moderate to Severe 4,16	Severe 3,8
25	Negley, Parke Wheeling	Low	Moderate to High	0.6-2.0	Severe 9	Severe 9	Severe 9	Severe 9	Severe 9
26	Hickory, Parr Miami	Moderate	Moderate	.2-2.0	Moderate 5,8,9	Moderate 5,8,9	Slight or Moderate 7	Moderate or Severe 4,9	Moderate or Severe 3,5,8,9

Table IN 14-3. Estimated Limitations, Suitabilities or Properties of Soils for Urban and Residential Use

Drainage Group No.	Representative Soil Types	Estimated Physical Properties Affecting Use of Soils			Dwellings with Basement 1/ 3/	Dwellings w/o Basement 1/ 3/	Shallow Excavations 1/ 3/	Septic Tank Absorption Fields 1/ 3/	Roads and Streets 1/ 3/
		Shrink-Swell Potential ^{1/}	Frost Action Potential ^{1/}	Permeability ^{2/} (In./Hr.)					
27	Alford, Ockley Martinsville	Moderate	Moderate or High	.6-2.0	Moderate 5,9	Moderate 5,9	Slight or Moderate 9	Slight or Moderate 9	Moderate or Severe 3,5,8,9
28	Markham, Morley, Markland, St. Clair	Moderate or Severe	Moderate or High	.06-.6	Moderate or Severe 5,9	Moderate or Severe 5,9	Moderate or Severe 7,9	Severe 4	Severe 3,5,8
29	Bloomfield, Fox, Chelsea, Warsaw, Oshtemo, Plainfield	Low	Low	6.-20.	High or Moderate 9	Moderate 9	Severe 12	Moderate 2,9	Slight to Moderate 9

KEY TO TABLE IN 14-3
PRINCIPAL SOIL LIMITATIONS

- | | |
|---|--|
| 1. Soil wet during period of use. | 7. Too clayey. |
| 2. Possible contamination of ground water. | 8. Not enough strength to adequately support the load. |
| 3. Structural damage caused by freezing and thawing. | 9. Slope is too great. |
| 4. Water moves through the soil too slowly. | 10. Soil floods by stream overflow, ponding of runoff. |
| 5. Soil expands significantly on wetting and shrinks on drying. | 11. Shallow to bedrock. |
| 6. Contains too much organic matter. | 12. Walls of cuts are not stable. |