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KINROSS CHARTER TOWNSHIP SOIL AND GROUND COVER GUIDE

Aerial photos with soils map overlays

KINROSS CHARTER TOWNSHIP SOIL DEFINITIONS

Soil ID Number	Soil Name
10B	Ontonagon silt loam- 2-6% slope
10D	Ontonagon silt loam- 6-15% slope
10F	Ontonagon silt loam- 25-50% slope
11A	Rudyard silty clay loam- 0-3% slope
12	Pickford silty clay loam
13B	Alcona loamy very fine sand- 0-6% slope
13D	Alcona loamy very fine sand- 6-15% slope
13F	Alcona loamy very fine sand- 25-50% slope
14A	Gaastra silt loam- 0-3% slope
15B	Rousseau fine sand dark subsoil- 0-6% slope
15D	Rousseau fine sand dark subsoil- 6-15% slope
15E	Rousseau fine sand dark subsoil- 15-35% slope
18B	Rubicon sand- 0-6% slope
18D	Rubicon sand- 6-15% slope
18E	Rubicon sand- 15-35% slope
19B	Kalkaska sand- 0-6% slope
19D	Kalkaska sand- 6-15% slope
19F	Kalkaska sand- 35-60% slope
20A	Croswell sand- 0-3% slope
21A	Au Gres sand- 0-3% slope
22	Kinross muck
23	Roscommon muck
25B	Guardlake loam- 0-6% slope
25D	Guardlake loam- 6-15% slope
29A	Solona fine sandy loam- 0-3% slope
32A	Allendale loamy fine sand- 0-3% slope
33	Pits, sand, & gravel
34	Entisols, flooded
35	Histosols & Aquents, ponded
36	Marky & Carbondale mucks
37	Dawson & Loxley peats
39D	Au Gres-Dawson-Rubicon complex- 0-15% slope
40A	Rudyard-Allendale complex- 0-3% slope
44B	Posen stony fine sandy loam- 1-6% slope
44D	Posen stony fine sandy loam- 6-15 % slope
46B	Pence loamy sand- 0-6% slope
46D	Pence loamy sand- 6-15% slope
48E	Wainola-Kinross-Rousseau complex- 0-35% slope
49A	Wainola fine sand- 0-3% slope
50	Deford fine sand

Soil ID Number	Soil Name
52A	Ingalls loamy sand- 0-3% slope
61A	Halfaday sand- 0-3% slope
68	Pinconning mucky loamy sand
79B	Kalkaska-Manistee sands- 0-6% slope
83A	Allendale-Croswell complex- 0-3% slope
85B	Kalkaska-Ocqueoc complex- 0-6% slope
86A	Ingalls-Halfaday complex- 0-3% slope
87B	Rousseau fine sand moderately wet- 0-6% slope
88A	Croswell-Au Gres sands- 0-3% slope
89A	Kinross-Au Gres complex- 0-3% slope
91B	Rousseau fine sand- 0-6% slope
91D	Rousseau fine sand- 6-15% slope
91E	Rousseau fine sand- 15-35% slope
92A	Biscuit very fine sandy loam- 0-3% slope
93F	Ontonagon-Pickford complex- 0-50% slope
94A	Markey-Kinross-Au Gres complex- 0-3% slope
95A	Bowers silt loam- 0-3% slope
98	Ermatinger silt loam
102	Kinross-Dawson complex
112	Soo silty clay loam
116	Udorthents, nearly level
117B	Manistee sand- 0-6% slope
119	Gogomain very fine sandy loam
123B	Ocqueoc fine sand- 0-6% slope
126	Pickford silt loam
128F	Alcona-Markey complex- 0-50% slope
129A	Rudyard silt loam- 0-3% slope
130A	Rudyard-Pickford silty clay loams- 0-3% slope
132B	Sugar very fine sandy loam- 0-6% slope
132F	Sugar very fine sandy loam- 25-50% slope
133	Dora muck
137A	Kinross-Wainola complex- 0-3% slope
138B	Rousseau dark subsoil-Urban land complex- 0-4% slope
143	Burleigh loamy fine sand
145A	Gaastra-Gogomain-Ignalls complex- 0-3% slope
146A	Allendale-Fibre complex- 0-3% slope
149B	Kalkaska sand- 0-6% slopes
150	Fibre muck

Detailed Soil Map Units

The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Manistee sand, 25 to 50 percent slopes, is a phase of the Manistee series.

Some map units are made up of two or more major soils. These map units are called soil complexes or Undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Kinross-Au Gres complex, 0 to 3 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Dawson and Loxley peats are an undifferentiated group in this survey area.

Most map units include small-scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. The map unit Dumps, limestone, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Soil Descriptions

10B—Ontonagon slit loam, 2 to 6 percent slopes

This very deep, moderately well drained, nearly level and undulating soil is on small ridges and knolls. Individual areas are irregular in shape and range from 3 to 200 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The subsoil is about 20 inches thick. The upper part is reddish brown and brown, friable silt loam and silty clay; the next part is reddish brown, firm clay; and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In some places it is stratified with thin bands of silt loam and silty clay loam. In other places it is underlain by gravelly sandy loam till. In some areas the surface layer is loam or silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Rudyard and poorly drained Pickford soils in depressions and drainage ways. These soils make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Ontonagon soil. The available water capacity is moderate. Surface runoff is medium. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 2.5 to 6.0 feet in spring. Most areas are used as cropland or pasture. Some areas are used as woodland.

The major concerns in managing woodland are the equipment limitation, the wind throw hazard, and plant competition. The sticky and plastic qualities of this soil limit the use of equipment in spring and in other excessively wet periods. Operating equipment during these periods can result in surface compaction and damage to tree roots. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Because of the firm subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness. Wind throw can be minimized by harvest methods that do not leave the remaining trees widely spaced. The aspen cover type is dominant on this soil. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The main management needs are measures that control water erosion and maintain the organic matter content and tilth. Examples are grassed waterways, cover crops, crop residue management, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet can cause surface compaction, destroy forage plants, and increase the susceptibility to erosion. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition and prevent excessive erosion.

This soil is poorly suited to building site development because of the high shrink-swell potential. The seasonal high water table is a limitation on sites for buildings with basements. The soil is generally unsuited to septic tank absorption fields because of the very slow permeability and the wetness. It is fairly well suited to sewage lagoons. The lagoon site will require some leveling and banking. On sites for buildings, the foundation trench should be widened and backfilled with suitable coarse textured material, which reduces the shrink-swell potential. If buildings with basements are constructed, the site should be raised and a drainage system should be installed to remove excess water.

The woodland ordination symbol is 2C, the land capability classification is IIIe, and the Michigan soil management group is Oa. The primary habitat type is TAM, and the secondary habitat type is ATD.

10D—Ontonagon silt loam, 6 to 15 percent slopes.

This very deep, moderately well drained, gently rolling and rolling soil is on the sides of ridges and on side slopes along streams and drainage ways. Many areas are dissected by shallow drainage ways. Individual areas are irregularly shaped or elongated and range from 3 to 200 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The subsoil is about 20 inches thick. The upper part is reddish brown and brown, friable silt loam and silty clay; the next part is reddish brown, firm clay; and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In some places it is stratified with thin bands of silt loam and silty clay loam. In other places the surface layer and the next layer are coarser textured. In some areas the surface layer is loam or silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Pickford soils in drainage ways. These soils make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Ontonagon soil. The available water capacity is moderate. Surface runoff is rapid. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 2.5 to 6.0 feet in spring.

Most areas are used as woodland. Some of the acreage is cropland, pasture, or idle grassland.

The major concerns in managing woodland are the equipment limitation, the wind throw hazard, and plant competition. The slope limits the number of sites that are suitable for logging roads and landings. Landings can be located in small nearly level areas in this unit, if available, or in the nearly level adjacent areas. The sticky and plastic qualities of this soil limit the use of equipment in spring and in other excessively wet periods. Operating equipment during these periods can result in surface compaction and damage to tree roots. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Because of the firm subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness. Wind throw can be minimized by harvest methods that do not leave the remaining trees widely spaced. Aspen and, in some areas, northern hardwoods are the dominant cover types. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that control water erosion and maintain the organic matter content and tilth. Grassed waterways, cover crops, and close-growing crops help to control runoff and erosion. Contour farming and contour strip cropping slow runoff. Returning crop residue to the soil, applying a system of conservation tillage, and adding organic material improve tilth and increase the content of organic matter.

This soil is fairly well suited to pasture and hay. Overgrazing or grazing when the soil is wet causes surface compaction, destroys forage plants, and increases the susceptibility to erosion. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates and rotation grazing help to keep the pasture in good condition and prevent excessive erosion.

This soil is poorly suited to building site development because of the high shrink-swell potential. The seasonal high water table is a limitation on sites for buildings with basements. Where it exceeds 8 percent, the slope is a limitation on sites for buildings and septic tank absorption fields. The soil is generally unsuited to septic tank absorption fields because of the wetness and the very slow permeability. It is poorly suited to sewage lagoons because of the slope. The lagoon site will require leveling and banking. On sites for buildings, the foundation trench should be widened and backfilled with suitable coarse textured material, which reduces the shrink-swell potential. The buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.

The woodland ordination symbol is 2C, the land capability classification is IIIe, and the Michigan soil management group is Oa. The primary habitat type is TAM, and the secondary habitat type is ATD.

10F—Ontonagon silt loam, 25 to 50 percent slopes.

This very deep, well drained, steep and very steep soil is on side slopes along streams and drainage ways. Many areas are dissected by shallow drainage ways. Individual areas are irregularly shaped or elongated and range from 3 to 500 acres in size.

Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsoil is about 25 inches thick. The upper part is reddish brown and brown friable silty clay and silt loam, and the lower part is reddish brown and grayish brown, firm clay. The substratum to a depth of about 60 inches is reddish brown and grayish brown, varved clay. In some places it is stratified with thin bands of silt loam and silty clay loam. In other places the surface layer is loam or silty clay loam.

Included with this soil in mapping are small areas of the well-drained Manistee and poorly drained Pickford soils. Manistee soils are sandy in the surface layer and in the upper part of the subsoil. They are in landscape positions similar to those of the Ontonagon soil. Pickford soils are in drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Ontonagon soil. The available water capacity is moderate. Surface runoff is rapid. The shrink-swell potential is high.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, the wind throw hazard, and plant competition. Access is limited by the slope. Special care is needed in laying out logging roads and in operating equipment. The roads can be designed so that they conform to the natural slope of the land. Special logging methods, such as yarding with a cable, may be needed to minimize surface disturbance. Erosion can result from the concentration of runoff on roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping road surfaces, culverts, and drop structures minimizes erosion. Landings should be located on the less sloping nearby soils. Because of the firm subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness. Wind throw can be minimized by harvest methods that do not leave the remaining trees widely spaced. The aspen cover type is dominant on this soil, but some areas support northern hardwoods. The opportunities for planting are limited because of the slope. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally unsuited to building site development, septic tank absorption fields, and sewage lagoons because of the slope.

The woodland ordination symbol is 2R, the land capability classification is VIIe, and the Michigan soil management group is Oa. The primary habitat type is TAM, and the secondary habitat type is ATD.

11A—Rudyard silty clay loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained, nearly level soil is on broad plains. Individual areas are irregular in shape and range from 5 to 900 acres in size.

Typically, the surface layer is brown silty clay loam about 6 inches thick. The subsoil is about 11 inches thick. It is mottled and firm. The upper part is brown and gray silty clay loam and silt loam, and the lower part is reddish brown clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In places it is varved or stratified with thin bands of silt loam and silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Pickford soils in depressions and drainage ways. These soils make up about 10 to 15 percent of the map unit.

Permeability is very slow in the Rudyard soil. The available water capacity is moderate. Surface runoff is slow. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 0.5 foot to 1 .5 feet from late fall to late spring.

Most areas are used as cropland or pasture. Some areas are used as woodland. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. The wetness and the sticky and plastic qualities of the subsoil limit the use of equipment to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed. The use of landing sites is restricted to periods when the soil is dry or frozen. Landings should be stabilized so that they can withstand the repeated use of heavy equipment. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, plant competition can delay natural regeneration.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods, minimize surface compaction, and maintain the organic matter content and tilth. Shallow surface ditches can help to remove excess water if adequate outlets are available. Erosion-control structures may be needed where surface ditches enter outlet drainage ways. Working the soil when it is wet results in surface compaction and the formation of clods. Crop residue management and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface can improve tilth and increase the content of organic matter.

This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet causes surface compaction and destroys forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the wetness and the high shrink-swell potential. It is generally unsuited to septic tank absorption fields because of the wetness and the very slow permeability. It is well suited to sewage lagoons. On sites for buildings, the foundation trench should be widened and backfilled with suitable coarse textured material, which reduces the shrink-swell potential. The building site should be raised, and a drainage system should be installed to remove excess water.

The woodland ordination symbol is 6W, the land capability classification is IIIw, and the Michigan soil management group is Ob. The primary habitat type is
TTP.

12—Pickford silty clay loam.

This very deep, poorly drained, nearly level soil is on broad plains and in drainage ways and depressions. It is frequently ponded. Individual areas are irregular in shape and range from 5 to several thousand acres in size.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer is dark gray, mottled silty clay loam about 2 inches thick. The subsoil is about 14 inches of weak red, mottled, firm and very firm silty clay and clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In some places it is varved or stratified with thin bands of silt loam and silty clay loam. In other places the surface layer is fine sand to fine sandy loam. In some areas the soil has 3 to 8 inches of muck on the surface.

Included with this soil in mapping are small areas of the somewhat poorly drained Rudyard soils on low knolls and ridges. Also included are small areas of the poorly drained Fibre and Gogomain soils in landscape positions similar to those of the Pickford soil. Fibre soils have a sandy surface layer and subsoil. Gogomain soils have a loamy surface layer and subsoil. Included soils make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Pickford soil. The available water capacity is moderate. Surface runoff is very slow or ponded. The shrink-swell potential is moderate. A perched seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.

Most areas are used as cropland or pasture. Some areas are wooded. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. The wetness limits the use of equipment to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, and severe plant competition.

If drained, this soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. In undrained areas it is poorly suited to crops. The major management needs are measures that remove excess water, minimize surface compaction, and maintain tilth. Shallow surface ditches can help to remove excess water if adequate outlets are available. Erosion-control structures may be needed where surface ditches enter drainage ways. Working the soil when it is wet results in surface compaction and the formation of clods. Crop residue management and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface can improve tilth and minimize surface compaction.

This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet causes surface compaction and destroys forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the ponding and the shrink-swell potential. It is generally unsuited to septic tank absorption fields because of the ponding and the very slow permeability. It is poorly suited to sewage lagoons. It is well suited, however, if the excavation site is properly banked and the lagoon is sealed. Building sites should be raised, and a drainage system should be installed to remove excess water. The foundation trench should be widened and backfilled with suitable coarse textured material, which reduces the shrink-swell potential.

The woodland ordination symbol is 6W, the land capability classification is IIIw, and the Michigan soil management group is 1c. The primary habitat type is TTP, and the secondary habitat type is FE.

13B—Alcona loamy very fine sand, 0 to 6 percent slopes.

This very deep, moderately well drained, nearly level and undulating soil is on upland flats. Individual areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface is covered by about 1 inch of undecomposed hardwood leaf litter. The surface layer is brown loamy very fine sand about 3 inches thick. The subsoil is about 52 inches thick. The upper part is dark reddish brown, yellowish brown, and brownish yellow, very friable very fine sandy

loam and loamy very fine sand, and the lower part is light yellowish brown to strong brown, mottled, very friable loamy fine sand and very fine sandy loam. The substratum to a depth of about 60 inches is yellowish brown and strong brown, mottled, stratified silt, silt loam, very fine sand, and loamy very fine sand. It has thin bands of silty clay loam. In places the soil has 5 to 15 percent cobbles and stones on or below the surface.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska, well-drained Ocqueoc and Rousseau, and somewhat poorly drained Gaastra soils. Kalkaska and Ocqueoc soils are in landscape positions similar to those of the Alcona soil. Kalkaska soils are sand throughout. Ocqueoc soils have a sandy surface layer and subsoil. Gaastra soils are somewhat poorly drained and are in the slightly lower landscape positions. Rousseau soils are fine sand throughout. They are in the slightly higher landscape positions. Included soils make up about 5 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Alcona soil. Surface runoff is slow. A perched seasonal high water table is at a depth of 2.5 to 6.0 feet from late fall to late spring.

Most areas are used as woodland. A small acreage is pasture, cropland, or idle grassland.

The major concerns in managing woodland are the equipment limitation and plant competition. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that control water erosion and soil blowing. Examples are cover crops, grassed waterways, small grain crops, buffer strips, vegetative barriers, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet can cause surface compaction, destroy forage plants, and increase the susceptibility to erosion. Proper stocking rates, rotation grazing, strip grazing, and restricted use during wet periods help to keep the pasture in good condition and prevent excessive erosion.

This soil is well suited to buildings without basements and is fairly well suited to buildings with basements. Buildings with basements can be constructed on well-compacted fill material, which raises the level of the site above the water table. A drainage system helps to lower the water table. The soil is poorly suited to septic tank absorption fields because of the wetness. If a septic tank disposal system is installed, filling or mounding with suitable material can raise the site above the seasonal high water table. The soil is generally unsuited to sewage lagoons because of the wetness and seepage.

The woodland ordination symbol is 3L, the land capability classification is IIe, and the Michigan soil management group is 3a-s. The primary habitat type is ATD, and the secondary habitat type is AVO.

13D—Alcona loamy very fine sand, 6 to 15 percent slopes.

This very deep, moderately well drained, gently rolling and rolling soil is on the sides of ridges, on knolls, and in ravines associated with breaks along streams. Individual areas are irregularly shaped or elongated and range from 5 to 120 acres in size.

Typically, the surface is covered by about 1 inch of undecomposed hardwood leaf litter. The surface layer is brown loamy very fine sand about 3 inches thick. The subsoil is about 52 inches thick. The upper part is dark reddish brown, yellowish brown, and brownish yellow, very friable very fine sandy

loam and loamy very fine sand, and the lower part is light yellowish brown to strong brown, mottled, friable loamy very fine sand and very fine sandy loam. The substratum to a depth of about 60 inches is yellowish brown and strong brown, mottled, stratified silt, silt loam, very fine sand, and loamy very fine sand. It has thin bands of silty clay loam.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska and well-drained Ocqueoc and Rousseau soils. Kalkaska and Ocqueoc soils are in landscape positions similar to those of the Alcona soil. Kalkaska soils are sand throughout. Ocqueoc soils have a sandy surface layer and subsoil. Rousseau soils are fine sand throughout. They are in the slightly higher landscape positions. Included soils make up about 5 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Alcona soil. Surface runoff is slow. A perched seasonal high water table is at a depth of 2.5 to 6.0 feet from late fall to late spring. This soil is used as woodland. The major management concerns are the equipment limitation and plant competition. Traffic ability may be briefly limited in spring, in fall, and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to building site development. It is poorly suited to septic tank absorption fields because of the wetness. Where it exceeds 8 percent, the slope is a limitation on sites for buildings and septic tank absorption fields. The soil is generally unsuited to sewage lagoons because of seepage and the slope. Buildings should be designed so that they conform to the natural slope of the land. A drainage system helps to lower the water table. Special construction methods, such as filling or mounding with suitable material, are needed to raise septic tank absorption fields above the water table. Land shaping and installing the distribution lines across the slope generally helps to ensure that the absorption field functions properly.

The woodland ordination symbol is 3L, the land capability classification is IIIe, and the Michigan soil management group is 3a-s. The primary habitat type is ATD, and the secondary habitat type is AVO.

13F—Alcona loamy very fine sand, 25 to 50 percent slopes.

This very deep, well drained, steep and very steep soil is on the sides of ridges and in ravines associated with breaks along streams.

Individual areas are irregularly shaped or elongated and range from 10 to 300 acres in size.

Typically, the surface is covered by about 1 inch of undecomposed hardwood leaf litter. The surface layer is brown loamy very fine sand about 3 inches thick. The subsoil is about 52 inches of dark reddish brown, yellowish brown, and brownish yellow, very friable very fine sandy loam and loamy very fine sand. The substratum to a depth of about 60 inches is yellowish brown and strong brown, stratified silt, silt loam, very fine sand, and loamy very fine sand. It has thin bands of silty clay loam.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska and well-drained Ocqueoc soils. These soils are in landscape positions similar to those of the Alcona soil. Ocqueoc soils have a sandy surface layer and subsoil. Kalkaska soils are sand throughout. Included soils make up about 5 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Alcona soil. Surface runoff is medium.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and plant competition. Access is limited by the slope. Special care is needed in laying

out logging roads and in operating equipment. The roads can be designed so that they conform to the natural slope of the land. Special logging methods, such as yarding with a cable, may be needed to minimize surface disturbance. Erosion can result from the concentration of runoff on roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping road surfaces, culverts, and drop structures minimizes erosion. Landings should be located on the less sloping nearby soils. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Site preparation and planting are severely limited by the slope.

This soil is generally unsuited to building site development because of the slope. It is generally unsuited to septic tank absorption fields and sewage lagoons because of the slope and seepage.

The woodland ordination symbol is 3R, the land capability classification is VIIe, and the Michigan soil management group is 3a-s. The primary habitat type is ATD, and the secondary habitat type is AVO.

14A—Gaastra silt loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained, nearly level soil is on broad plains and in depressions. Individual areas are irregular in shape and range from 5 to 600 acres in size.

Typically, the surface is covered by about 2 inches of well-decomposed leaf litter and live roots. The surface layer is brown and pinkish gray, mottled silt loam about 8 inches thick. The subsoil is about 33 inches thick. It is mottled and friable. The upper part is reddish brown and strong brown very fine sandy loam, the next part is light reddish brown loamy very fine sand, and the lower part is reddish brown and light reddish brown very fine sandy loam. The substratum to a depth of about 60 inches is light reddish brown and reddish brown, mottled, stratified very fine sandy loam, loamy very fine sand, and very fine sand. In places it is clay or stratified clay.

Included with this soil in mapping are small areas of the moderately well drained Alcona, poorly drained Burleigh, and somewhat poorly drained Ingalls soils. Alcona soils are on low knolls and ridges. Burleigh soils are sandy in the surface layer and in the upper part of the substratum. They are in depressions and drainage ways. Ingalls soils have a sandy surface layer and subsoil. They are in landscape positions similar to those of the Gaastra soil. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderately slow in the Gaastra soil. The available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall to late spring. The potential for frost action is high.

Most areas are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. The high water table limits the use of equipment to periods when the soil is dry or has an adequate snow cover. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed. The use of landing sites is restricted to periods when the soil is dry or frozen. Because of the high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness. The aspen cover type is dominant on this soil. If seedlings are planted, special harvest methods and site preparation may be needed to control undesirable plants.

This soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management concern is excessive wetness. A subsurface drainage system can reduce the wetness if adequate outlets are available. Tile lines should be protected with suitable material and installed on a self cleaning grade so that they do not become clogged with fine sand and silt.

This soil is well suited to pasture and hay. The forage species that are tolerant of wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.
This soil is poorly suited to building site development because of the wetness. It is generally unsuited to septic tank absorption fields because of the wetness and the moderately slow permeability and to sewage lagoons because of the wetness.
The woodland ordination symbol is 3W, the land capability classification is IIw, and the Michigan soil management group is 2.5b. The primary habitat type is
TMC-D.

15B—Rousseau fine sand, dark subsoil, 0 to 6 percent slopes.
This very deep, well-drained, nearly level and undulating soil is on upland flats, ridge tops, and knolls. Individual areas are irregularly shaped or elongated and range from 3 to 1,000 acres in size.
Typically, the surface layer is black fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 3 inches thick. The subsoil is dark reddish brown and strong brown, very friable fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light brown and brown fine sand. In some areas it is mottled in the lower part.
Included with this soil in mapping are small areas of the moderately well drained Alcona and Ocqueoc soils. These soils are in landscape positions similar to those of the Rousseau soil. Ocqueoc soils have a stratified, sandy and loamy substratum. Alcona soils are finer textured throughout than the Rousseau soil. Also included are small areas of the somewhat poorly drained Wainola soils in shallow depressions and along drainage ways. Included soils make up about 3 to 15 percent of the map unit.
Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is slow.
Most areas are used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Northern hardwoods and red pine are the dominant cover types. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that conserve moisture during dry periods, help to control soil blowing, and maintain the organic matter content. Examples are buffer strips, vegetative barriers, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.
This soil is well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing, and restricted use during dry periods help to keep the pasture in good condition.
This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soil is generally unsuited to sewage lagoons because of seepage.
The woodland ordination symbol is 3S, the land capability classification is IIIs, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

15D—Rousseau fine sand, dark subsoil, 6 to 15 percent slopes.

This very deep, well-drained, gently rolling and rolling soil is on the sides of ridges and knolls. Individual areas are irregularly shaped or elongated and range from 3 to 320 acres in size.

Typically, the surface layer is black fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 3 inches thick. The subsoil is dark reddish brown and strong brown, very friable fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light brown and brown fine sand.

Included with this soil in mapping are areas of the moderately well drained Alcona and well drained Ocqueoc soils. These soils are in landscape positions similar to those of the Rousseau soil. Ocqueoc soils have a stratified, sandy and loamy substratum. Alcona soils are finer textured throughout than the Rousseau soil. Included soils make up about 3 to 10 percent of the map unit.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Landings can be located in the nearly level areas that may be included in this unit. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Northern hardwoods and red pine are the dominant cover types. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity and is generally unsuited to sewage lagoons because of seepage and the slope. The slope is the main limitation on building sites. It also is a limitation on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines across the slope generally helps to ensure that the absorption field functions properly.

The woodland ordination symbol is 3S, the land capability classification is IIIe, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

15E—Rousseau fine sand, dark subsoil, 15 to 35 percent slopes.

This very deep, well drained, rolling to steep soil is on ridges and knolls. Individual areas are irregularly shaped or elongated and range from 10 to more than 200 acres in size.

Typically, the surface layer is black fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 3 inches thick. The subsoil is dark reddish brown and strong brown, very friable fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light brown and brown fine sand. In places the lower part of the substratum has loamy bands.

Included with this soil in mapping are areas of the well-drained Alcona soils. These soils are in landscape positions similar to those of the Rousseau soil. They are finer textured throughout than the Rousseau soil. They make up about 3 to 10 percent of the map unit.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and seedling mortality. The use of equipment is limited because of the slope. Logging roads and skid trails should be constructed in the less sloping areas or on ridge tops. Constructing the

roads and skid trails on the contour can minimize erosion. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. The number of suitable landing sites is severely limited by the slope. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The slope hinders site preparation and planting. Northern hardwoods and red pine are the dominant cover types. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally unsuited to building site development because of the slope. It is generally unsuited to septic tank absorption fields and sewage lagoons because of the slope and a poor filtering capacity.

The woodland ordination symbol is 3R, the land capability classification is VIe, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

15F—Rousseau fine sand, dark subsoil, 35 to 60 percent slopes.

This very deep, well-drained, very steep soil is on ridges, knolls, and side slopes. Individual areas are irregularly shaped or elongated and range from 10 to 160 acres in size.

Typically, the surface layer is black fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 3 inches thick. The subsoil is dark reddish brown and strong brown, very friable fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light brown and brown fine sand. In places the lower part of the substratum has loamy bands.

Included with this soil in mapping are small areas of the well-drained Alcona and Ocqueoc soils. These soils are in landscape positions similar to those of the Rousseau soil. They make up about 3 to 10 percent of the map unit.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is medium.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and seedling mortality. Access is limited by the slope. Special care is needed in laying out logging roads and in operating equipment. The roads can be designed so that they conform to the natural slope of the land. Special logging methods, such as less sloping nearby soils. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity, especially on south aspects. Site preparation and planting are severely limited by the slope. Jack pine and red pine are the dominant cover types. Clear cutting is common. Before seedlings are planted, site preparation by mechanical or chemical means generally is needed to control plant competition.

This soil is generally unsuited to building site development because of the slope. It is generally unsuited to septic tank absorption fields and sewage lagoons because of the slope, seepage, and a poor filtering capacity.

The woodland ordination symbol is 3R, the land capability classification is VIe, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

18B—Rubicon sand, 0 to 6 percent slopes.

This very deep, excessively drained, nearly level and undulating soil is on ridges, knolls, and broad plains. Individual areas are irregularly shaped or elongated and range from 10 to several thousand acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is very dark gray sand about 1 inch thick. The subsurface layer is grayish brown sand about 2 inches thick. The subsoil is brown and yellowish brown, very friable and loose sand about 17 inches thick. The substratum to a depth of about 60 inches is light brown sand. In places the soil is mottled in the lower part of the substratum. In some areas, it has 5 to 15 percent gravel and cobbles on or below the surface.

Included with this soil in mapping are small areas of the well-drained Ocqueoc and Pence and somewhat excessively drained Kalkaska soils. These soils are in landscape positions similar to those of the Rubicon soil. Ocqueoc soils have a stratified, sandy and loamy substratum. Pence soils have a loamy mantle underlain by sand and gravel. Also included are small areas of the somewhat poorly drained Au Gres soils in shallow depressions and along drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Red pine and jack pine are the dominant cover types. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It is generally unsuited to sewage lagoons because of seepage. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water.

The woodland ordination symbol is 4S, the land capability classification is VIs, and the Michigan soil management group is 5.3a. The primary habitat type is QAE, and the secondary habitat type is TMV.

18D—Rubicon sand, 6 to 15 percent slopes.

This very deep, excessively drained, gently rolling and rolling soil is on ridges and knolls. Individual areas are irregularly shaped or elongated and range from 10 to 600 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is very dark gray sand about 1 inch thick. The subsurface layer is grayish brown sand about 2 inches thick. The subsoil is brown and yellowish brown, very friable sand about 17 inches thick. The substratum to a depth of about 60 inches is light brown sand. In places, the soil has 5 to 15 percent gravel and cobbles on or below the surface.

Included with this soil in mapping are small areas of the well-drained Ocqueoc and Pence and somewhat excessively drained Kalkaska soils. These soils are in landscape positions similar to those of the Rubicon soil. Ocqueoc soils have a stratified, sandy and loamy substratum. Pence soils have a loamy mantle underlain by sand and gravel. Kalkaska soils are darker in the upper part of the subsoil than the Rubicon soil. Also included are small areas of the somewhat poorly drained Au Gres soils in shallow depressions and along drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Landings can be located in the nearly level areas that may be

included in this unit. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Jack pine and red pine are the dominant cover types. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means generally is needed to control plant competition.

This soil is fairly well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It is generally unsuited to sewage lagoons because of seepage and the slope. The slope is the main limitation on building sites. It also is a limitation on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines across the slope generally helps to ensure that the absorption field functions properly.

The woodland ordination symbol is 4S, the land capability classification is VIs, and the Michigan soil management group is 5.3a. The primary habitat type is QAE, and the secondary habitat type is TMV.

18E—Rubicon sand, 15 to 35 percent slopes.

This very deep, excessively drained, rolling to steep soil is on ridges and knolls. Individual areas are irregularly shaped or elongated and range from 10 to 50 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is very dark gray sand about 1 inch thick. The subsurface layer is grayish brown sand about 2 inches thick. The subsoil is brown and yellowish brown, very friable sand about 17 inches thick. The substratum to a depth of about 60 inches is light brown sand. In places, the soil has 5 to 15 percent gravel and cobbles on or below the surface.

Included with this soil in mapping are small areas of the well-drained Ocqueoc and Pence and somewhat excessively drained Kalkaska soils. These soils are in landscape positions similar to those of the Rubicon soil. Ocqueoc soils have a stratified, sandy and loamy substratum. Pence soils have a loamy mantle underlain by sand and gravel. Kalkaska soils are darker in the upper part of the subsoil than the Rubicon soil. Also included are small areas of the somewhat poorly drained Au Gres soils in shallow depressions and along drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is slow. This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and seedling mortality. The use of equipment is limited because of the slope. Logging roads and skid trails should be constructed in the less sloping areas or on ridge tops. Constructing the roads and skid trails on the contour can minimize erosion. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. The number of suitable landing sites is severely limited by the slope. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The slope hinders site preparation and planting. Red pine and jack pine are the dominant cover types. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally unsuited to building site development because of the slope. It is generally unsuited to septic tank absorption fields and sewage lagoons because of the slope and a poor filtering capacity.
The woodland ordination symbol is 4R, the land capability classification is VIIs, and the Michigan soil management group is 5.3a. The primary habitat type is QAE, and the secondary habitat type is TMV.

19B—Kalkaska sand, 0 to 6 percent slopes.
This very deep, somewhat excessively drained, nearly level and undulating soil is on ridges, knolls, and broad plains. Individual areas are irregularly shaped or elongated and range from 10 to several thousand acres in size.
Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is dark reddish brown sand about 2 inches thick. The subsurface layer is reddish brown sand about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loamy sand, and the lower part is dark brown and strong brown, loose and very friable sand. The substratum to a depth of about 60 inches is yellowish brown sand. In some places, the soil has 5 to 15 percent gravel and cobbles on or below the surface. In other places it is mottled in the lower part of the substratum. In some areas the surface layer is loamy sand.
Included with this soil in mapping are small areas of the well-drained Pence and moderately well drained Manistee and Alcona soils. These soils are in landscape positions similar to those of the Kalkaska soil. Pence soils have a loamy mantle underlain by sand and gravel. Manistee soils have a clayey substratum. Alcona soils are finer textured throughout than the Kalkaska soil. Also included are small areas of the somewhat poorly drained Au Gres soils in depressions. Included soils make up about 5 to 15 percent of the map unit.
Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is slow.
Most areas are used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special planting stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.
This soil is poorly suited to cropland, but such crops as oats, wheat, and a mixture of grasses and legumes can be grown. The major management needs are measures that conserve moisture during dry periods, help to control soil blowing, and maintain the organic matter content. Examples are buffer strips, vegetative barriers, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.
This soil is fairly well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing, and restricted use during dry periods help to keep the pasture in good condition.
This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It is generally unsuited to sewage lagoons because of seepage. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water.
The woodland ordination symbol is 3S, the land capability classification is IVs, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

19D—Kalkaska sand, 6 to 15 percent slopes.

This very deep, somewhat excessively drained, gently rolling and rolling soil is on the sides of ridges and knolls. Individual areas are irregularly shaped or elongated and range from 10 to 700 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is dark reddish brown sand about 2 inches thick. The subsurface layer is reddish brown sand about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loamy sand, and the lower part is dark brown and strong brown, very friable and loose sand. The substratum to a depth of about 60 inches is yellowish brown sand. In some places, the soil has 5 to 15 percent gravel and cobbles on or below the surface. In other places the surface layer is sand.

Included with this soil in mapping are small areas of the moderately well drained Alcona and well drained Pence, Ocqueoc, and Manistee soils. These soils are in landscape positions similar to those of the Kalkaska soil. Alcona soils are finer textured throughout than the Kalkaska soil. Pence soils have a loamy mantle underlain by sand and gravel. Ocqueoc soils have a stratified, sandy and loamy substratum. Manistee soils have a clayey substratum. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Landings can be located in the small nearly level areas that may be included in this unit. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to building site development. The slope is the main limitation on building sites. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity and the slope. It is generally unsuited to sewage lagoons because of seepage and the slope. Buildings should be designed so that they conform to the natural slope of the land. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines across the slope generally helps to ensure that the absorption field functions properly.

The woodland ordination symbol is 3S, the land capability classification is VIs, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

19E—Kalkaska sand, 15 to 35 percent slopes.

This very deep, somewhat excessively drained, rolling to steep soil is on ridges and knolls. Individual areas are elongated or irregular in shape and range from 15 to 300 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is dark reddish brown sand about 2 inches thick. The subsurface layer is reddish brown sand about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loamy sand, and the lower part is dark brown and strong brown, very friable and loose sand. The substratum to a depth of about 60 inches is yellowish brown sand. In some places the soil has 5 to 15 percent gravel and cobbles on or below the surface. In other places the surface layer is loamy sand.

Included with this soil in mapping are small areas of the well-drained Alcona, Pence, Ocqueoc, and Manistee soils. These soils are in landscape positions similar to those of the Kalkaska soil. Alcona soils are finer textured throughout than the Kalkaska soil. Pence soils have a loamy mantle underlain by sand and gravel. Ocqueoc soils have a stratified, sandy and loamy substratum. Manistee soils have a clayey substratum. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is slow or medium.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and seedling mortality. The use of equipment is limited because of the slope. Logging roads and skid trails should be constructed in the less sloping areas or on ridge tops. Constructing the roads and skid trails on the contour can minimize erosion. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The number of suitable landing sites is severely limited by the slope. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The slope hinders site preparation and planting. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. This soil is generally unsuited to building site development because of the slope. It is generally unsuited to septic tank absorption fields and sewage lagoons because of the slope and a poor filtering capacity.

The woodland ordination symbol is 3R, the land capability classification is VIIs, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

19F—Kalkaska sand, 35 to 60 percent slopes.

This very deep, somewhat excessively drained, steep and very steep soil is on ridges and knolls. Individual areas are elongated or irregularly shaped and range from 20 to 500 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is dark reddish brown sand about 2 inches thick. The subsurface layer is reddish brown sand about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loamy sand, and the lower part is dark brown and strong brown, very friable and loose sand. The substratum to a depth of about 60 inches is yellowish brown sand. In some places, the soil has 5 to 15 percent gravel and cobbles on or below the surface. In other places the surface layer is loamy sand.

Included with this soil in mapping are small areas of the well-drained Alcona, Ocqueoc, and Manistee soils. These soils are in landscape positions similar to those of the Kalkaska soil. Alcona soils are finer textured throughout than the Kalkaska soil. Ocqueoc soils have a stratified, sandy and loamy substratum. Manistee soils have a clayey substratum. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is medium.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and seedling mortality. Access is limited by the slope. Special care is needed in laying out logging roads and in operating equipment. The roads can be designed so that they conform to the natural slope of the land. Special logging methods, such as yarding with a cable, may be needed to minimize surface disturbance. Loose sand and the slope can interfere with the traction of wheeled equipment. Erosion can result from the concentration of runoff on roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping road surfaces, culverts, and

drop structures minimizes erosion. Seedling mortality can be a problem during dry periods because of the low available water capacity, especially on south aspects. Site preparation and planting are severely limited by the slope. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting.

This soil is generally unsuited to building site development because of the slope. It is generally unsuited to septic tank absorption fields and sewage lagoons because of the slope and a poor filtering capacity.

The woodland ordination symbol is 3R, the land capability classification is VIIs, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

20A—Croswell sand, 0 to 3 percent slopes.

This very deep, moderately well drained, nearly level soil is on broad plains and low ridges. Individual areas are irregularly shaped or elongated and range from 5 to 1,400 acres in size.

Typically, the surface is covered by about 2 inches of black, partially decomposed leaf litter. The surface layer is brown sand about 2 inches thick. The subsoil is strong brown and yellowish brown, very friable and friable sand about 27 inches thick. The substratum to a depth of about 60 inches is light yellowish brown and brownish yellow, mottled sand. In places the upper part of the subsoil is darker.

Included with this soil in mapping are small areas of the somewhat poorly drained Allendale and Au Gres soils in the slightly lower landscape positions. Allendale soils have a clayey substratum. Also included are small areas of the very poorly drained Markey soils in depressions and small areas of the excessively drained Rubicon soils in the slightly higher landscape positions. Markey soils have layers of muck 16 to 51 inches thick and are underlain by sand. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Croswell soil. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 2 to 4 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Because of the wetness, trees on this soil are shallow rooted. Some may be blown down during periods of high winds.

Red pine and jack pine are the dominant cover types. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means generally is needed to control plant competition.

This soil is poorly suited to cropland, but such crops as oats, wheat, and a mixture of grasses and legumes can be grown. The major management needs are measures that conserve moisture during dry periods, help to control soil blowing, and maintain the organic matter content. Examples are buffer strips, vegetative barriers, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is fairly well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to buildings without basements but is poorly suited to buildings with basements. Buildings with basements can be constructed on well-compacted fill material, which raises the level of the site. A drainage system helps to lower the water table. The soil is poorly suited to septic tank absorption fields because of the high water table and a poor filtering capacity. It readily absorbs

but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. If a septic tank disposal system is installed, filling or mounding with suitable material can raise the site above the seasonal high water table. The soil is generally unsuited to sewage lagoons because of seepage and wetness.

The woodland ordination symbol is 5S, the land capability classification is IVs, and the Michigan soil management group is 5a. The primary habitat type is
TM.

21 A—Au Gres sand, 0 to 3 percent slopes.

This very deep, somewhat poorly drained, nearly level soil is in depressions and swales and on low, broad plains. Individual areas are irregular in shape and range from 3 to more than 300 acres in size.

Typically, the surface is covered by about 1 inch of well-decomposed leaf litter. The surface layer is black sand about 1 inch thick. The subsurface layer is pinkish gray sand about 4 inches thick. The subsoil is mottled sand about 19 inches thick. The upper part is yellowish red and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is brownish yellow and light yellowish brown, mottled sand.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska and excessively drained Rubicon soils on ridges and knobs.

Also included are small areas of the poorly drained Kinross soils in depressions and drainage ways.

Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Au Gres soil. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1 .5 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, seedling mortality, and plant competition. Equipment should be used only during dry summer months or during winter months when the snow cover is adequate. Landings can be used only when the soil is dry or frozen. Because of the high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. Seedling losses may be high during wet spring months and dry summer months. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, plant competition can delay natural regeneration. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cropland, but such crops as oats, wheat, and a mixture of grasses and legumes can be grown. The major management needs are measures that remove excess water during wet periods, conserve moisture during dry periods, help to control soil blowing, and maintain the organic matter content. Cover crops, buffer strips, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface help to control soil blowing. A combination of surface and subsurface drains can lower the seasonal high water table.

This soil is fairly well suited to pasture and hay. The forage species that are tolerant of wetness, such as trefoil-grass mixtures, should be selected for planting. Overgrazing can destroy forage plants. Proper stocking rates and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to building site development because of the wetness. It is generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity and to sewage lagoons because of seepage and the wetness.

The woodland ordination symbol is 6W, the land capability classification is IVw, and the Michigan soil management group is 5b. The primary habitat type is TMC.

22—Kinross muck.

This very deep, poorly drained, nearly level soil is on low plains and in swales and depressions. It is frequently ponded. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is black muck about 5 inches thick. The subsurface layer is brown sand about 5 inches thick. The subsoil is dark brown and brown, mottled, very friable and loose sand about 32 inches thick. The substratum to a depth of about 60 inches is grayish brown sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres and Wainola soils on low knolls and ridges. Also included are small areas of the very poorly drained Dawson and Markey soils. These soils are in landscape positions similar to or slightly lower than those of the Kinross soil. They formed in organic material 16 to 50 inches deep over sand. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kinross soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.

This soil is used as woodland. Some areas support wetland grasses. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Equipment should be used only during dry summer months or during winter months when the snow cover is adequate. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The swamp conifer cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. The opportunities for planting are limited on this soil because of the wetness, severe seedling mortality, and plant competition.

This soil is generally unsuited to building site development because of the ponding. It is generally unsuited to septic tank absorption fields because of the ponding and a poor filtering capacity and to sewage lagoons because of seepage, excess humus, and the ponding.

The woodland ordination symbol is 2W, the land capability classification is VIw, and the Michigan soil management group is 5c. The primary habitat type is TTS, and the secondary habitat type is TMC.

23—Roscommon muck.

This very deep, poorly drained, nearly level soil is along drainage ways, in depressions and swales, and on low plains. It is frequently ponded. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the upper part of the surface layer is about 1 inch of partially decomposed leaf litter. The lower part is black muck about 8 inches thick. The substratum to a depth of about 60 inches is grayish brown and yellowish brown, mottled sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres soils on low ridges and knolls. Also included are areas of the very poorly drained Markey soils in landscape positions similar to or slightly lower than those of the Roscommon soil. Markey soils formed in organic material 16 to 50 inches deep over sand. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Roscommon soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness and the instability of the organic surface layer, trees can be logged only during periods in winter when logging roads are frozen. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. The swamp conifer cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Because of the high water table, the trees are shallow rooted. Many may be blown down during periods of high winds. Trees generally are not planted on this soil because of severe seedling mortality, the wetness, and severe plant competition.

This soil is generally unsuited to building site development because of the ponding. It is generally unsuited to septic tank absorption fields because of the ponding and a poor filtering capacity and to sewage lagoons because of seepage, excess humus, and the ponding.

The woodland ordination symbol is 6W, the land capability classification is VIw, and the Michigan soil management group is 5c. No habitat type is assigned.

25B—Guardlake loam, 0 to 6 percent slopes.

This very deep, well-drained, nearly level and undulating soil is on upland flats. Individual areas are irregular in shape and range from 5 to 600 acres in size.

Typically, the surface layer is black loam about 5 inches thick. The subsoil is about 11 inches of dark reddish brown and reddish brown, friable gravelly sandy loam and very gravelly sandy loam. The substratum to a depth of about 60 inches is brown and pale brown very gravelly sand and very gravelly coarse sand. In some places the subsoil is loamy sand. In other places the surface layer is sandy loam, fine sandy loam, or the gravelly or cobbly analogs of those textures.

Included with this soil in mapping are areas of the somewhat excessively drained Kalkaska soils in landscape positions similar to those of the Guardlake soil. These soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the upper part of the Guardlake soil and very rapid in the lower part. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. There are no major management concerns. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management concern is conserving moisture. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface can conserve moisture.

This soil is well suited to pasture and hay. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to building site development. The content of coarse fragments is a limitation on sites for buildings. The coarse fragments should be removed. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not

adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soil is generally unsuited to sewage lagoons because of seepage.
The woodland ordination symbol is 3A, the land capability classification is IIIs, and the Michigan soil management group is Ga. The primary habitat type is
AVO.

25D—Guardlake loam, 6 to 15 percent slopes.
This very deep, well-drained, gently rolling and rolling soil is on ridges and knolls. Individual areas are irregularly shaped or elongated and range from 10 to 100 acres in size.
Typically, the surface layer is black loam about 5 inches thick. The subsoil is about 11 inches of dark reddish brown and reddish brown, friable gravelly sandy loam and very gravelly sandy loam. The substratum to a depth of about 60 inches is brown and pale brown very gravelly sand and very gravelly coarse sand. In some places the subsoil is loamy sand. In other places the surface layer is sandy loam, fine sandy loam, or the gravelly or cobbly analogs of those textures.
Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska soils in landscape positions similar to those of the Guardlake soil. These soils formed in deep deposits of sandy material. They make up about 5 to 15 percent of the map unit.
Permeability is moderate in the upper part of the Guardlake soil and very rapid in the lower part. The available water capacity is low. Surface runoff is slow.
Most areas are used as woodland. The major management concern is the equipment limitation on landing sites. Landings can be located in the small nearly level areas that may be included in this unit. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.
This soil is fairly well suited to building site development. The slope and the content of coarse fragments are the main limitations on building sites. The soil is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity. It is generally unsuited to sewage lagoons because of seepage and the slope. Buildings should be designed so that they conform to the natural slope of the land. The coarse fragments should be removed from building sites. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines across the slope generally helps to ensure that the absorption field functions properly.
The woodland ordination symbol is 3A, the land capability classification is IIIs, and the Michigan soil management group is Ga. The primary habitat type is AVO.

27B—Emmet sandy loam, 1 to 6 percent slopes.
This very deep, well-drained, nearly level and undulating soil is on knolls and broad plains. Individual areas are irregular in shape and range from 10 to more than 800 acres in size.
Typically, the surface layer is black sandy loam about 6 inches thick. The subsoil is brown and reddish brown, friable sandy loam about 23 inches thick. The substratum to a depth of about 60 inches is reddish brown sandy loam that has thin lenses of brown loamy sand. In places the surface layer is fine sandy loam.
Included with this soil in mapping are small areas of the well-drained Longrie and Menominee soils. These soils are in landscape positions similar to those of the Emmet soil. Longrie soils have limestone bedrock at a depth of 20 to 40 inches. Menominee soils are sandy textured in the upper part. Included soils make up about 5 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Emmet soil. Surface runoff is slow.
Most areas are used as pasture or cropland. Some areas are wooded.
The major concerns in managing woodland are the equipment limitation and plant competition. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.
This soil is well suited to such crops as oats, wheat, barley, and a mixture of grasses and legumes. The major management needs are measures that control water erosion, maintain tilth, and help to control soil blowing. Examples are buffer strips, vegetative barriers, field windbreaks, crop residue management, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.
This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is too wet can cause surface compaction, destroy forage plants, and increase the susceptibility to erosion. Proper stocking rates, rotation grazing, strip grazing, and restricted use during wet periods can help to keep the pasture in good condition and control excessive erosion.
This soil is well suited to building site development. It is only fairly well suited to septic tank absorption fields because of the moderately slow permeability. Special construction methods, such as enlarging the absorption fields or installing alternating drain fields, can help to overcome this limitation. The soil is generally unsuited to sewage lagoons because of seepage.
The woodland ordination symbol is 3L, the land capability classification is IIe, and the Michigan soil management group is 3a. The primary habitat type is AVO-A.

28B—Longrie sandy loam, 1 to 6 percent slopes.
This moderately deep, well-drained, nearly level and undulating soil is on ridges, benches, and broad plains. Individual areas are irregular in shape and range from 5 to 50 acres in size.
Typically, the surface layer is black sandy loam about 4 inches thick. The subsurface layer is reddish gray sandy loam about 5 inches thick. The subsoil is dark reddish brown and reddish brown, friable fine sandy loam about 18 inches thick. The substratum is light brown gravelly loam about 4 inches thick. Limestone bedrock is at a depth of about 31 inches. In some places the depth to bedrock is more than 40 inches or less than 20 inches. In other places the surface layer is fine sandy loam, silt loam, or loam.
Included with this soil in mapping are small areas of the somewhat excessively drained Duel and somewhat poorly drained Ensign soils. Duel soils formed in sandy deposits over limestone bedrock. They are in landscape positions similar to those of the Longrie soil. Ensign soils are in depressions. Included soils make up about 5 to 15 percent of the map unit.
Permeability is moderate in the Longrie soil. The available water capacity is low. Surface runoff is slow.
Most areas are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. The bedrock interferes with road construction in some areas. Traffic ability is briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Because of the bedrock, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, wheat, barley, and a mixture of grasses and legumes. The major management needs are measures that help to control soil blowing and water erosion. Examples are cover crops, buffer strips, vegetative barriers, field windbreaks, grassed waterways, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is fairly well suited to pasture. Maintaining an adequate vegetative cover by preventing overgrazing helps to control surface runoff and erosion.

This soil is fairly well suited to buildings without basements but is poorly suited to buildings with basements. The depth to bedrock is the major limitation. Because of the depth to bedrock and seepage, the soil is poorly suited to septic tank absorption fields and is generally unsuited to sewage lagoons. Buildings with basements can be constructed on well-compacted fill material, which raises the level of the site. If a septic tank disposal system is installed, mounding the absorption field with suitable material can raise the site above the bedrock and reduce the hazard of seepage.

The woodland ordination symbol is 2D, the land capability classification is IIe, and the Michigan soil management group is 3/Ra. The primary habitat type is AVO.

29A—Solona fine sandy loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained, nearly level soil is on low knolls and flats. Individual areas are irregular in shape and range from 3 to 400 acres in size.

Typically, the surface layer is black fine sandy loam about 3 inches thick. The subsoil is friable fine sandy loam about 22 inches thick. The upper part is dark brown, and the lower part is dark yellowish brown and brown and is mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled gravelly fine sandy loam.

Included with this soil in mapping are small areas of the well-drained Posen soils on ridges and knolls. These soils make up about 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Solona soil. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet from late fall to late spring. The potential for frost action is high.

Most areas are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. Equipment should be used only during dry summer months or during winter months when the snow cover is adequate. Year-round logging roads require a gravel base. Culverts are needed to maintain the natural drainage system. Landings can be used only when the soil is dry or frozen. Because of the high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. Lowland hardwoods and aspen are the dominant cover types. After the trees are cut, plant competition can delay natural regeneration. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods and that maintain good tilth. A subsurface drainage system can help to lower the water table. Additions of organic material and a system of conservation tillage that does not invert the soil and that leaves crop residue on the surface help to maintain good tilth.

This soil is well suited to pasture. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the wetness. It is generally unsuited to septic tank absorption fields because of the wetness and to sewage lagoons because of the wetness and seepage.
The woodland ordination symbol is 3W, the land capability classification is IIw, and the Michigan soil management group is 3b. No habitat type is assigned.

32A—Allendale loamy fine sand, 0 to 3 percent slopes.
This very deep, somewhat poorly drained, nearly level soil is on broad plains, low knolls, and upland flats along streams. Individual areas are irregularly shaped or elongated and range from 3 to 500 acres in size.
Typically, the surface layer is black loamy fine sand about 5 inches thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark reddish brown, very friable loamy fine sand; the next part is strong brown and yellowish brown, mottled, very friable fine sand; and the lower part is reddish brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is light reddish brown, mottled silty clay that has thin strata of yellowish brown silt loam and silty clay loam. In places the surface layer is fine sand or loamy sand.
Included with this soil in mapping are small areas of the poorly drained Soo and Fibre soils in depressions and drainage ways. Also included are the somewhat poorly drained Rudyard soils in landscape positions similar to those of the Allendale soil. Soo soils formed in stratified, loamy and clayey material. Rudyard soils formed in deep deposits of clayey material. Included soils make up about 5 to 15 percent of the map unit.
Permeability is moderately rapid and rapid in the sandy upper part of the Allendale soil and very slow in the clayey lower part. The available water capacity is moderate. Surface runoff is slow. A perched seasonal high water table is at a depth of 1 to 2 feet from late fall to late spring.
Most areas are used as woodland. Some areas are used as cropland or pasture.
The major concerns in managing woodland are the equipment limitation, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Year-round logging roads should be graveled. Culverts are needed to maintain the natural drainage system. Landings can be used only when the soil is dry or frozen. Because of the high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, plant competition can delay natural regeneration. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.
This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods, maintain the organic matter content, and help to control soil blowing. A subsurface drainage system can help to lower the water table. Additions of organic matter and a system of conservation tillage that does not invert the soil and that leaves crop residue on the surface help to control soil blowing and maintain the organic matter content.
This soil is well suited to pasture. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be used. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.
This soil is poorly suited to building site development because of the wetness. It is generally unsuited to septic tank absorption fields because of the wetness, a poor filtering capacity in the sandy upper part of

the profile, and the very slow permeability in the clayey lower part. The soil is generally unsuited to sewage lagoons because of the wetness and seepage.
The woodland ordination symbol is 4W, the land capability classification is IIIw, and the Michigan soil management group is 4/1 b. The primary habitat type is TMC-D, and the secondary habitat type is TMC.

33—Pits, sand and gravel.
These areas are open excavations from which sand and gravel have been removed. Some have been excavated to a depth below the water table. The outer edges of the excavations have steep vertical side slopes. The exposed material supports little or no vegetation. Individual areas range from 3 to 100 acres in size.
Onsite investigation is needed to determine specific soil properties.
No interpretive groups are assigned.

34—Entisols, flooded.
These deep, nearly level, poorly drained and very poorly drained soils formed in alluvial deposits. They are on flood plains along rivers and streams and are frequently flooded. The water table is at or above the surface during most of the year, except for unusually dry periods. Individual areas of this unit are elongated or irregular in shape and range from 40 to 800 acres in size.
The texture of these stratified, alluvial soils generally ranges from sand to clay. In places the surface layer is muck.
Included with these soils in mapping are small areas of the poorly drained Kinross and Pickford soils. These included soils are in landscape positions similar to or slightly higher than those of the Entisols. Also included are small areas of the well-drained Ontonagon soils on side slopes. Kinross soils are sandy throughout. Ontonagon and Pickford soils are clayey throughout. Included soils make up about 5 to 15 percent of the map unit.
Most areas are marshland and beaver floodings, but a few areas are wooded. These soils are well suited to wetland wildlife habitat. They are generally unsuited to most other uses. Onsite investigation is essential for proper evaluation of the potential for specific uses.
No interpretive groups are assigned.

35—Histosols and Aquents, ponded.
This map unit consists of deep, nearly level, very poorly drained, organic soils and very poorly drained, sandy or loamy soils. These soils are in drainage ways and depressions and along lakeshores. The water table is at or above the surface during most or all of the year, except for unusually dry periods. Individual areas of this unit are elongated or irregularly shaped and range from 3 to 800 acres in size. Some are made up entirely of either Histosols or Aquents, and others are made up of both soils. The two soils are used and managed so similarly that separating them in mapping is not practical.
Included with these soils in mapping are small areas of open water and small areas of the somewhat poorly drained Au Gres and Wainola soils on low ridges and low knolls. Also included are small areas of the excessively drained Rubicon and well-drained Rousseau soils on knolls and ridges. The included soils formed in sandy deposits. They make up about 5 to 15 percent of the map unit.
Most areas of the Histosols and Aquents are marshland, but a few areas include wooded beaver floodings. These soils are well suited to wetland wildlife habitat (fig. 6). They are generally unsuited to most other uses. No interpretive groups are assigned.

36—Markey and Carbondale mucks.

These very deep, nearly level, very poorly drained, organic soils are in broad depressions, swamps, and drainage ways. They are frequently ponded. Individual areas are oval or elongated and range from 5 to several thousand acres in size. Some are made up of only one of these soils, and others are made up of both soils. The two soils are used and managed so similarly that separating them in mapping is not practical.

Typically, the Markey soil has a surface layer of dark reddish brown mucky peat about 3 inches thick. Below this is black, dark brown, and dark reddish brown muck about 30 inches thick. The substratum to a depth of about 60 inches is brown sand. In some places the soil has less than 16 inches of organic material. In other places the substratum is very fine sand or silt. In some areas the surface layer is mucky peat.

Typically, the Carbondale soil has a surface layer of black muck about 14 inches thick. The underlying layers to a depth of about 60 inches are dark reddish brown muck and dark reddish brown and very dark grayish brown mucky peat.

Included with these soils in mapping are small areas of the somewhat poorly drained Au Gres and Wainola soils on low ridges and knolls. Also included are the poorly drained Kinross soils in landscape positions similar to or slightly higher than those of the Markey and Carbondale soils. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic layers of the Markey soil and rapid in the sandy substratum. It is moderately slow to moderately rapid in the Carbondale soil. The available water capacity is high in both soils. The water table is 1 foot above to 1 foot below the surface from fall to summer and seldom drops below a depth of 1 foot. Surface runoff is very slow or ponded. The potential for frost action is high.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness and the instability of the muck, trees can be logged only during periods in winter when logging roads are frozen. Because of the wetness, the trees are shallow rooted. Many may be blown down during periods of high winds. The swamp conifer cover type is dominant on these soils. Clear cutting and strip cutting are common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on these soils because of severe seedling mortality, the wetness, and severe plant competition. These soils are generally unsuited to building site development because of the ponding, subsidence, and low strength. They are generally unsuited to septic tank absorption fields and sewage lagoons because of seepage, the ponding, excess humus, and the slow permeability.

The woodland ordination symbols are 2W and 5W, the land capability classification is VIw, and the Michigan soil management groups are M/4c and Mc. The primary habitat type is TTS.

37—Dawson and Loxley peats.

These very deep, nearly level, very poorly drained, organic soils are in swamps and bogs. They are frequently ponded. Individual areas are oval or elongated and range from 5 to several thousand acres in size. Some are made up of only one of these soils, and others are made up of both soils. The two soils are used and managed so similarly that separating them in mapping is not practical.

Typically, the Dawson soil has a surface layer of yellowish brown sphagnum moss about 6 inches thick. Below this is dark reddish brown muck about 12 inches thick. The upper part of the substratum is dark brown and pinkish gray fine sand about 1 inch thick. The lower part to a depth of about 60 inches

is dark reddish brown and dark brown loamy fine sand and fine sand. In places the muck is less than 16 inches thick. In some areas very fine sand and silty material underlie the organic deposits.

Typically, the Loxley soil has a surface layer of dark yellowish brown sphagnum moss about 5 inches thick. Below this is black muck about 55 inches thick.

Included with these soils in mapping are small areas of the moderately well drained Croswell, somewhat poorly drained Au Gres, and poorly drained Kinross soils. Croswell and Au Gres soils are on low ridges and knolls. Kinross soils are along the edges of the unit, in landscape positions similar to or slightly higher than those of the Dawson and Loxley soils. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic layers of the Dawson soil and rapid in the sandy substratum. It is moderately slow to moderately rapid in the Loxley soil. The available water capacity is high in both soils. The water table is 1 foot above to 1 foot below the surface from fall to early summer and seldom drops below a depth of 1 foot. Surface runoff is very slow or ponded. The potential for frost action is high.

These soils support native bog vegetation and widely scattered black spruce. The extremely acid organic material and wetness limit tree growth. The opportunities for logging are limited because of the very small number of trees and the instability of the muck. The trees can be logged only during periods in winter when logging roads are frozen.

These soils are generally unsuited to building site development because of the ponding, subsidence, and low strength. They are generally unsuited to septic tank absorption fields and sewage lagoons because of seepage, the ponding, excess humus, and the restricted permeability.

The woodland ordination symbol is 2W, the land capability classification is VIIw, and the Michigan soil management group is Mc-a. The primary habitat type is PCS.

38F—Deer Park-Kinross complex, 0 to 50 percent slopes.

This map unit consists of a very deep, nearly level to very steep, excessively drained Deer Park soil on ridges, knolls, and side slopes and a deep, nearly level, poorly drained Kinross soil in swaies and depressions between the ridges. The Kinross soil is frequently ponded. Individual areas of this unit are irregular in shape and range from 50 to 1,000 acres in size. They are 40 to 60 percent Deer Park soil and 30 to 50 percent Kinross soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Deer Park soil has a surface layer of very dark gray fine sand about 1 inch thick. The subsurface layer is light brownish gray fine sand about 7 inches thick. The subsoil is yellowish brown and reddish yellow, loose fine sand about 43 inches thick. The substratum to a depth of about 60 inches is light brown sand. In places the soil is mottled in the lower part of the substratum.

Typically, the Kinross soil has a surface layer of black muck about 5 inches thick. The subsurface layer is brown sand about 5 inches thick. The subsoil is dark brown and brown, mottled, very friable and loose sand about 32 inches thick. The substratum to a depth of about 60 inches is grayish brown sand. In places the upper part of the subsoil does not have the dark brown color.

Included with these soils in mapping are small areas of the somewhat poorly drained Au Gres and Wainola soils. These included soils are slightly higher on the landscape than the Kinross soil. Also included are small areas of Dawson and Markey soils. These soils formed in organic material 16 to 50 inches deep over sand. They are in landscape positions similar to or slightly lower than those of the Kinross soil. Included soils make up about 15 to 25 percent of the map unit.

Permeability is rapid in the Deer Park and Kinross soils, and the available water capacity is low. Surface runoff is slow on the Deer Park soil and very slow or ponded on the Kinross soil. The Kinross

soil has a seasonal high water table above the surface or within a depth of 1 foot from fall to early summer.

These soils are used as woodland. The major management concerns are the equipment limitation, the erosion hazard, seedling mortality, the wind throw hazard, and plant competition. The use of equipment is limited by the slope and the wetness. Where possible, logging roads and skid trails should be located on the higher, drier sites. The roads should be designed so that they conform to the natural slope of the land. Erosion on the ridges can result from the concentration of runoff on roads, in the tracks of wheeled equipment, and on landings. Fill material and culverts are needed if the roads are built in the depressions and swales. In low areas equipment can be used only during dry summer months or during periods in winter when logging roads are frozen. Suitable sites for log landings are limited to the more nearly level areas at the base of ridges. Jack pine and red pine are the dominant cover types on the higher ridges. The swamp conifer cover type is dominant in the swales. Seedling mortality is a problem because of the low available water capacity on the ridges. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Some replanting may be necessary. Trees in the swales are shallow rooted because of the high water table. Some may be blown down during periods of high winds. After the over story is removed, plant competition is severe in the low areas.

Because of the complex nature of this map unit, onsite investigation is needed to determine the suitability for building site development, septic tank absorption fields, and sewage lagoons.

The woodland ordination symbols are 4R and 2W, the land capability classification is VIIs, and the Michigan soil management groups are 5.3a and 5c. The primary habitat type is PVC, and the secondary habitat type is TTS.

39D—Au Gres-Dawson-Rubicon complex, 0 to 15 percent slopes.

This map unit consists of a very deep, nearly level, somewhat poorly drained Au Gres soil; a very deep, nearly level, very poorly drained Dawson soil; and a very deep, gently rolling and rolling, excessively drained Rubicon soil. The Au Gres soil is on low ridges and in depressions. The Dawson soil is in swales and depressions and is frequently ponded. The Rubicon soil is on ridges. Individual areas of this unit are elongated or irregularly shaped and range from 10 to 1,000 acres in size. They are 20 to 40 percent Au Gres soil, 20 to 40 percent Dawson soil, and 15 to 30 percent Rubicon soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Au Gres soil is covered by about 1 inch of well-decomposed leaf litter. The surface layer is black sand about 1 inch thick. The subsurface layer is pinkish gray sand about 4 inches thick. The subsoil is mottled sand about 19 inches thick. The upper part is yellowish red and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is brownish yellow and light yellowish brown, mottled sand.

Typically, the Dawson soil has a surface layer of yellowish brown sphagnum moss about 6 inches thick. Below this is dark reddish brown muck about 12 inches thick. The upper part of the substratum is dark brown and pinkish gray fine sand about 1 inch thick. The lower part to a depth of about 60 inches is dark reddish brown and dark brown loamy fine sand and fine sand. In places the organic layers are more than 51 inches thick.

Typically, the Rubicon soil is covered by about 1 inch of partially decomposed leaf litter. The surface layer is very dark gray sand about 1 inch thick. The subsurface layer is grayish brown sand about 2 inches thick. The subsoil is brown and yellowish brown, very friable and loose sand about 17 inches thick. The substratum to a depth of about 60 inches is light brown sand. In places the soil is mottled in the lower part.

Included with these soils in mapping are small areas of the poorly drained Kinross and very poorly drained Markey soils. These included soils are in landscape positions similar to those of the Dawson soil. Markey soils are less acid than the Dawson soil. Included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the Au Gres and Rubicon soils. It is moderately slow to moderately rapid in the organic layers of the Dawson soil and rapid in the sandy lower part. The available water capacity is low in the Au Gres and Rubicon soils and high in the Dawson soil. Surface runoff is slow on the Au Gres and Rubicon soils and very slow or ponded on the Dawson soil. The Au Gres soil has a seasonal high water table at a depth of 0.5 foot to 1.5 feet from late fall to late spring. The water table in the Dawson, soil is above the surface or within a depth of 1 foot from fall to early summer. It seldom drops below a depth of 2 feet. The potential for frost action is high in the Dawson soil.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Where possible, logging roads and skid trails should be located on the higher, drier sites. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Landings should be located in the less sloping, drier areas. In low areas access is limited to the dry summer months or to winter months when logging roads and skid trails are frozen. Jack pine and red pine are the dominant cover types on the higher ridges. Aspen and swamp conifers are the dominant cover types in the lower areas. The organic areas support scattered black spruce and native bog vegetation. Seedling mortality is a problem because of the low available water capacity on the ridges. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Trees in low areas are shallow rooted because of the high water table. Some may be blown down during periods of high winds. After the over story is removed, plant competition is severe in the low areas.

Because of the complex nature of this map unit, onsite investigation is needed to determine the suitability for building site development, septic tank absorption fields, and sewage lagoons.

The woodland ordination symbols are 6W, 2W, and 4S; the land capability classification is IVw; and the Michigan soil management groups are 5b, Mc-a, and 5.3a. The primary habitat type is TMC, and the secondary habitat type is PCS.

40A—Rudyard-Allendale complex, 0 to 3 percent slopes.

These very deep, nearly level, somewhat poorly drained soils are on broad, low plains. Individual areas are irregular in shape and range from 10 to 100 acres in size. They are 50 to 70 percent Rudyard soil and 20 to 40 percent Allendale soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rudyard soil has a surface layer of brown, silty clay loam about 6 inches thick. The subsoil is about 11 inches thick. It is mottled and firm. The upper part is brown silty clay loam and gray and grayish brown silt loam. The lower part is reddish brown clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In places it is varved or stratified with thin bands of silt loam and silty clay loam.

Typically, the Allendale soil has a surface layer of black loamy fine sand about 5 inches thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark reddish brown, very friable loamy fine sand; the next part is strong brown and yellowish brown, mottled, very friable fine sand; and the lower part is reddish brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is light reddish brown, mottled silty clay that

has thin strata of yellowish brown silt loam and silty clay loam. In places the surface layer is fine sand or loamy sand.

Included with these soils in mapping are small areas of the moderately well drained Halfaday and poorly drained Pickford and Fibre soils. Halfaday soils are on low ridges and knolls. Pickford and Fibre soils are in depressions and drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Rudyard soil. It is moderately rapid and rapid in the sandy upper part of the Allendale soil and very slow in the clayey lower part. The available water capacity is moderate in both soils. Surface runoff is medium. From fall to late spring, a perched seasonal high water table is at a depth of 0.5 foot to 1.5 feet in the Rudyard soil and at a depth of 1 to 2 feet in the Allendale soil. The Rudyard soil has a high shrink-swell potential.

Most areas are used as woodland. Some are used as cropland or pasture.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to periods when the soils are dry or have an adequate snow cover. When the soils in the clayey areas are wet, unsurfaced logging roads are slippery and ruts form easily. In the sandy areas, loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Landings can be used only when the soils are dry or frozen. Landings should be stabilized so that they can withstand the repeated use of heavy equipment. Year-round logging roads should be graveled. Culverts are needed to maintain the natural drainage system. Because of the wetness, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on these soils.

Clear cutting is common. The mortality of planted seedlings can be expected because of the wetness. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Furrowing before planting also can increase the seedling survival rate. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods, maintain tilth, and help to control soil blowing. Shallow surface ditches and subsurface drains can help to remove excess water if adequate outlets are available. Erosion-control structures may be needed where surface ditches enter outlet drainage ways. In the clayey areas, working the soils when they are wet results in surface compaction and the formation of clods. Additions of organic material and a system of conservation tillage that does not invert the soil and that leaves the crop residue on the surface can minimize crusting and soil blowing and increase the rate of water infiltration. Planting small grain crops or hay improves soil structure and permeability and helps to control soil blowing. Buffer strips, vegetative barriers, and field windbreaks help to control soil blowing.

These soils are well suited to pasture. Overgrazing or grazing when the soil is wet can cause surface compaction and destroy forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

Because of the complex nature of this map unit, onsite investigation is needed to determine the suitability for building site development, septic tank absorption fields, and sewage lagoons.

The woodland ordination symbols are 6W and 4W, the land capability classification is IIIw, and the Michigan soil management groups are Ob and 4/lb. The primary habitat type is TTP, and the secondary habitat type is TMC-D.

41 D—Summerville-Rock outcrop complex, 1 to 15 percent slopes.

This map unit occurs as areas of a shallow, well drained, nearly level to rolling Summerville soil and exposed limestone bedrock on benches, ridge tops, and broad plains. The Rock outcrop occurs as flat areas or vertical drops of 5 to 15 feet. Individual areas of this unit are irregular in shape and range from Figure 7. -Rock outcrop in an area of Summerville-Rock outcrop complex, 1 to 15 percent slopes. The exposed bedrock can hinder the use of equipment.

10 to 1,000 acres in size. They are 30 to 70 percent Summerville soil and 20 to 70 percent Rock outcrop. The Summerville soil and Rook outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Summerville soil has a surface layer of very dark grayish brown loam about 3 inches thick. The subsoil is dark yellowish brown, very friable very tine sandy loam about 10 inches thick. Limestone bedrock is at a depth of about 13 inches. In some areas the subsoil has 5 to 35 percent gravel, cobbles, or flagstones.

Included with this unit in mapping are small areas of the well-drained Posen and somewhat poorly drained Ensign soils. Posen soils are deep. They are in landscape positions similar to those of the Summerville soil. Ensign soils are in depressions. Also included are areas of the stony or bouldery Summerville soils. Included soils make up about 5 to 15 percent of the map unit. Permeability is moderate in the Summerville soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. A small acreage is idle grassland.

The major concerns in managing woodland are the equipment limitation, seedling mortality, and the wind throw hazard. The bedrock and the Rock outcrop can interfere with the construction of logging roads and log landings and with harvesting (fig. 7). The use of equipment is limited by the exposed bedrock. Landings can be located in the nearly level areas. Traffic ability is briefly limited in spring and in other excessively wet periods. When the Summerville soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on the Summerville soil. Species preference can be managed by selective cutting. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Furrowing before planting also can increase the seedling survival rate. Because of the bedrock, the trees are shallow rooted. Many may be blown down during periods of high winds.

The Summerville soil is generally unsuited to building site development and septic tank absorption fields because of the shallowness to bedrock.

The woodland ordination symbol assigned to the Summerville soil is 2D, the land capability classification is ye, and the Michigan soil management group is Ra. The primary habitat type is TM, and the secondary habitat type is ATD.

41F—Summerville-Rock outcrop complex, 15 to 45 percent slopes.

This map unit occurs as areas of a shallow, well drained, rolling to very steep Summerville soil and exposed limestone bedrock on benches and the sides of ridges. The Rock outcrop occurs as flat areas or vertical drops of 5 to 25 feet. In some areas, particularly Marblehead on Drummond Island, the vertical drops are as much as 60 feet. Individual areas of this unit are elongated and range from 10 to 100 acres in size. They are 30 to 70 percent Summerville soil and 20 to 70 percent Rock outcrop. The Summerville soil and Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Summerville soil has a surface layer of very dark grayish brown loam about 3 inches thick. The subsoil is dark yellowish brown, very friable very fine sandy loam about 10 inches thick. Limestone bedrock is at a depth of about 13 inches. In some areas the subsoil has 25 to 35 percent gravel, cobbles, or flag stones.

Permeability in the Emmet soil, a poor filtering capacity in the Kalkaska soil, and the slope are limitations. The soils are generally unsuited to sewage lagoons because of seepage and the slope. Buildings should be designed so that they conform to the natural slope of the land. The Kalkaska soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Special construction methods, such as enlarging the absorption fields or installing alternating drain fields, can help to overcome the restricted permeability of the Emmet soil. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

The woodland ordination symbols are 3L and 3S, the land capability classification is IIIe, and the Michigan soil management groups are 3a and 5a. The primary habitat type is AVO-A, and the secondary habitat type is
ATD.

44B—Posen stony fine sandy loam, 1 to 6 percent slopes.

This very deep, well-drained, nearly level and undulating soil is on broad plains and the tops of ridges. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are irregular in shape and range from 3 to more than 600 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is very dark gray stony fine sandy loam about 3 inches thick. The subsoil is about 13 inches of dark brown and brown, friable stony silt loam and silt loam. The substratum to a depth of about 60 inches is brown very gravelly fine sandy loam. In places the surface layer is gravelly fine sandy loam or the gravelly or cobbly analogs of loam or silt loam.

Included with this soil in mapping are small areas of the well-drained Longrie and somewhat poorly drained Shelter soils. Longrie soils have limestone bedrock at a depth of 20 to 40 inches. They are in landscape positions similar to those of the Posen soil. Shelter soils are in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the Posen soil. The available water capacity also is moderate. Surface runoff is slow.

Most areas are used as woodland. The major management concerns are the equipment limitation and plant competition. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict Iaterai drainage, expose tree roots, and alter soil structure.

Large stones on the surface can hinder harvesting and planting and can result in equipment damage. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. If seedlings are planted, site preparation by mechanical or chemical means generally is needed to control plant competition. Species preference can be managed by selective cutting.

This soil is poorly suited to building site development and septic tank absorption fields because of the large stones on the surface and coarse fragments. The coarse fragments should be removed. The soil is generally unsuited to sewage lagoons because of the coarse fragments.

The woodland ordination symbol is 2X, the land capability classification is IIIs, and the Michigan soil management group is 3a. The primary habitat type is AVO.

44D—Posen stony fine sandy loam, 6 to 15 percent slopes.

This very deep, well-drained, gently rolling and rolling soil is on the sides of ridges and knolls. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are irregularly shaped or elongated and range from 5 to 80 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is very dark gray stony fine sandy loam about 3 inches thick. The subsoil is about 13 inches of dark brown and brown, friable stony and very cobbly silt loam. The substratum to a depth of about 60 inches is brown very gravelly fine sandy loam. In places the surface layer is gravelly fine sandy loam or the gravelly or cobbly analogs of loam or silt loam.

Included with this soil in mapping are small areas of the well-drained Longrie soils. These soils are in landscape positions similar to those of the Posen soil.

They have limestone bedrock at a depth of 20 to 40 inches. They make up about 5 to 15 percent of the map unit.

Permeability is moderate in the Posen soil. The available water capacity also is moderate. Surface runoff is slow.

Most areas are used as woodland. The major management concerns are the equipment limitation and plant competition. Trafficability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery. Large stones on the surface can hinder harvesting and planting and can result in equipment damage. Year-round logging roads should be graveled. Landings can be located in the small nearly level areas that may be included in this unit. The northern hardwoods cover type is dominant on this soil. If seedlings are planted, site preparation by mechanical or chemical means generally is needed to control plant competition. Species preference can be managed by selective cutting.

This soil is poorly suited to building site development because of the large stones on the surface. It is poorly suited to septic tank absorption fields because of the large stones and the slope. The large stones can cause construction problems and should be removed. Buildings should be designed so that they conform to the natural slope of the land. Retaining walls may be needed. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The woodland ordination symbol is 2X, the land capability classification is VIs, and the Michigan soil management group is 3a. The primary habitat type is AVO.

44E—Posen stony fine sandy loam, 15 to 35 percent slopes.

This very deep, well drained, rolling to steep soil is on the sides of ridges and knolls. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are elongated and range from 5 to 40 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is very dark gray stony fine sandy loam about 3 inches thick. The subsoil is about 13 inches of dark brown and brown, friable stony and very cobbly silt loam. The substratum to a depth of about 60 inches is brown very gravelly fine sandy loam. In places, the surface layer is gravelly fine sandy loam or the gravelly or cobbly analogs of loam or silt loam.

Included with this soil in mapping are small areas of the well-drained Longrie soils. These soils are in landscape positions similar to those of the Posen soil. They have limestone bedrock at a depth of 20 to 40 inches. They make up about 5 to 15 percent of the map unit.

Permeability is moderate in the Posen soil. The available water capacity also is moderate. Surface runoff is medium.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and plant competition. The use of equipment is limited because of the slope. Logging roads and skid trails should be constructed in the less sloping areas or on ridge tops. Establishing logging roads and skid trails on the contour can minimize erosion. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery. Large stones on the surface can hinder harvesting and planting and can result in equipment damage. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. If seedlings are planted, site preparation by mechanical or chemical means generally is needed to control plant competition. Species preference can be managed by selective cutting.

This soil is generally unsuited to building site development and septic tank absorption fields because of the slope and the large stones.

The woodland ordination symbol is 2R, the land capability classification is VIIs, and the Michigan soil management group is 3a. The primary habitat type is AVG.

46B—Pence loamy sand, 0 to 6 percent slopes.

This very deep, well-drained, nearly level and undulating soil is on upland flats and broad plains. Individual areas are irregular in shape and range from 3 to 1,000 acres in size.

Typically, the surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is 24 inches thick. The upper part is dark reddish brown and dark brown, very friable sandy loam. The lower part is strong brown, loose sand and coarse sand. The substratum to a depth of about 60 inches is strong brown gravelly coarse sand.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska and moderately well drained Alcona soils. These soils are in landscape positions similar to those of the Pence soil. Kalkaska soils are sandy throughout. Alcona soils are finer textured throughout than the Pence soil. Also included are areas of cobbly or stony Pence soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderately rapid and rapid in the upper part of the Pence soil and rapid in the lower part. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. A few are used as cropland or pasture.

The major management concern for woodland is the equipment limitation. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that control erosion, conserve moisture, and help to control soil blowing. Examples are buffer strips, vegetative barriers, field windbreaks, grassed waterways, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing and restricted use during dry periods help to keep the pasture in good condition and prevent excessive erosion.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The

poor filtering capacity can result in the pollution of ground water. The soil is generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 3S, the land capability classification is lie, and the Michigan soil management group is 5a. The primary habitat type is ATD.

46D—Pence loamy sand, 6 to 15 percent slopes.

This very deep, well-drained, gently rolling and rolling soil is on ridges and knolls. Individual areas are irregular in shape and range from 3 to 400 acres in size.

Typically, the surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is 24 inches thick. The upper part is dark reddish brown and dark brown, very friable sandy loam. The lower part is strong brown, loose sand and coarse sand. The substratum to a depth of about 60 inches is strong brown gravelly coarse sand.

Included with this soil in mapping are small areas of the moderately well drained Alcona and somewhat excessively drained Kalkaska soils. These soils are in landscape positions similar to those of the Pence soil. Alcona soils are finer textured throughout than the Pence soil. Kalkaska soils are sandy throughout. Also included are areas of cobbly or stony Pence soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderately rapid and rapid in the upper part of the Pence soil and rapid in the lower part. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concern is the equipment limitation. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting.

This soil is fairly well suited to building site development. The slope is the main limitation. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity. It is generally unsuited to sewage lagoons because of seepage and the slope. Buildings should be designed so that they conform to the natural slope of the land. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water.

The woodland ordination symbol is 3S, the land capability classification is IVe, and the Michigan soil management group is 5a. The primary habitat type is ATD.

46E—Pence loamy sand, 15 to 35 percent slopes.

This very deep, well drained, rolling to steep soil is on ridges and knolls. Individual areas are irregularly shaped or elongated and range from 3 to 300 acres in size.

Typically, the surface layer is black loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 3 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown and dark brown, very friable sandy loam. The lower part is strong brown, loose sand and coarse sand. The substratum to a depth of about 60 inches is strong brown gravelly coarse sand.

Included with this soil in mapping are small areas of the well-drained Alcona and somewhat excessively drained Kalkaska soils. These soils are in landscape positions similar to those of the Pence soil. Alcona soils are finer textured throughout than the Pence soil. Kalkaska soils are sandy throughout. Also included are areas of the cobbly or stony Pence soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderately rapid and rapid in the upper part of the Pence soil and rapid in the lower part. The available water capacity is low. Surface runoff is medium.

This soil is used as woodland. The major management concerns are the equipment limitation and the erosion hazard. The use of equipment is limited because of the slope. Logging roads and skid trails should be constructed in the less sloping areas or on ridge tops. Constructing the roads and skid trails on the contour can minimize erosion. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting.

This soil is generally unsuited to building site development because of the slope. It is generally unsuited to septic tank absorption fields and sewage lagoons because of the slope and seepage.

The woodland ordination symbol is 3R, the land capability classification is VIIe, and the Michigan soil management group is 5a. The primary habitat type is ATD.

48E—Wainola-Kinross-Rousseau complex, 0 to 35 percent slopes.

This map unit consists of a very deep, nearly level, somewhat poorly drained Wainola soil; a very deep, nearly level, poorly drained Kinross soil; and a very deep, hilly and steep, well-drained Rousseau soil. The Wainola soil is in swales and depressions. The Kinross soil is in low swales, depressions, and drainage ways and is frequently ponded. The Rousseau soil is on ridges. Individual areas of this unit are elongated or irregularly shaped and range from 10 to 600 acres in size. They are 30 to 50 percent Wainola soil, 20 to 30 percent Kinross soil, and 15 to 25 percent Rousseau soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Wainola soil is covered with about 3 inches of black, partially decomposed leaf litter. The surface layer is grayish brown fine sand about 5 inches thick. The subsoil is dark reddish brown, strong brown and yellowish brown, mottled, friable fine sand about 19 inches thick. The substratum to a depth of about 60 inches is brown fine sand.

Typically, the Kinross soil has a surface layer of black muck about 3 inches thick. The subsurface layer is dark gray fine sand about 7 inches thick. The subsoil is dark brown and brown, mottled, loose fine sand about 15 inches thick. The substratum to a depth of about 60 inches is brown fine sand.

Typically, the Rousseau soil is covered by well-decomposed leaf litter about 1 inch thick. The surface layer is dark brown and brown fine sand about 1 inch thick. The subsurface layer is brown fine sand about 3 inches thick. The subsoil is fine sand about 22 inches thick. The upper part is dark brown and strong brown and very friable. The lower part is yellowish brown and loose. The substratum to a depth of about 60 inches is brownish yellow fine sand.

Included with these soils in mapping are small areas of the very poorly drained Markey soils. These included soils are in landscape positions similar to those of the Kinross soil. They formed in organic material 16 to 51 inches deep over sand and fine sand. They make up about 5 to 10 percent of the map unit.

Permeability is rapid in the Wainola, Kinross, and Rousseau soils, and the available water capacity is low. Surface runoff is very slow or ponded on the Kinross soil and slow on the Wainola and Rousseau soils. The Kinross soil has a seasonal high water table 1 foot above to 1 foot below the surface from fall to early summer. The Wainola soil has one at a depth of 0.5 foot to 1.5 feet from late fall to late spring.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Where possible, logging roads, skid trails, and landings should be located on the higher, drier sites. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. Loose sand in heavily

traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Landings should be located in the less sloping, drier areas. In low areas, access is limited to the dry summer months or to winter months when logging roads and skid trails are frozen. Jack pine and red pine are the dominant cover types on the higher ridges. Aspen and swamp conifers are the dominant cover types in the lower areas. Seedling mortality is a problem because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Trees in low areas are shallow rooted because of the high water table. Some may be blown down during periods of high winds. Special harvest methods and site preparation may be needed to control plant competition.

Because of the complex nature of this map unit, onsite investigation is needed to determine the suitability for building site development, septic tank absorption fields, and sewage lagoons.

The woodland ordination symbols are 6W, 2W, and 5R; the land capability classification is IIIw; and the Michigan soil management groups are 5b, 5c, and 4a.

The primary habitat type is TMC, and the secondary habitat type is TTS.

49A—Wainola fine sand, 0 to 3 percent slopes.

This very deep, somewhat poorly drained, nearly level soil is on low plains and in depressions. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface is covered with about 3 inches of black, partially decomposed leaf litter. The surface layer is grayish brown fine sand about 5 inches thick. The subsoil is dark reddish brown, strong brown and yellowish brown, mottled, friable fine sand about 19 inches thick. The substratum to a depth of about 60 inches is brown fine sand.

Included with this soil in mapping are small areas of the moderately well drained Rousseau and poorly drained Deford soils. Rousseau soils are on low ridges. Deford soils are in depressions and drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Wainola soil. The available water capacity is low. Surface runoff is stow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, seedling mortality, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Landings can be used only when the soil is dry or frozen. Because of the high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling modality rate. Furrowing before planting also can increase the seedling survival rate. After the trees are cut, plant competition can delay natural regeneration. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods, conserve moisture during dry periods, and help to control soil blowing. A combination of surface and subsurface drains can lower the seasonal high water table if drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter the drainage ways. Tile lines should be protected with suitable material to prevent their filling with fine sand. Conservation tillage, small grain crops, and additions of organic material can conserve moisture and help to control soil blowing. Buffer strips, vegetative barriers, and field windbreaks help to control soil blowing.

This soil is well suited to pasture. The forage species that are tolerant of wetness, such as trefoil-grass mixtures, should be selected for planting. Overgrazing can destroy forage plants. Proper stocking rates and restricted grazing during wet periods help to keep the pasture in good condition.
This soil is generally unsuited to building site development because of the wetness. It is generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity. It is generally unsuited to sewage lagoons because of seepage and the wetness.
The woodland ordination symbol is 6W, the land capability classification is IIIw, and the Michigan soil management group is 5b. The primary habitat type is TMC, and the secondary habitat type is TMC-V.

50—Deford fine sand.
This very deep, poorly drained, nearly level soil is on low plains and in depressions. It is frequently ponded. Individual areas are irregular in shape and range from 5 to more than 200 acres in size.
Typically, the surface layer is very dark gray and dark brownish gray fine sand about 4 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, pale brown and grayish brown, mottled fine sand. In some places, the surface layer is loamy fine sand, mucky loamy tine sand, or mucky fine sand. In other places, a thin organic layer overlies the surface layer.
Included with this soil in mapping are small areas of the somewhat poorly drained Wainola and very poorly drained Markey soils. Wainola soils are in the slightly higher landscape positions. Markey soils formed in organic material 16 to 51 inches deep over sand. They are in landscape positions similar to or slightly lower than those of the Deford soil. Included soils make up about S to 10 percent of the map unit.
Permeability is rapid in the Deford soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.
This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The swamp conifer cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, plant competition, and low productivity.
This soil is generally unsuited to building site development because of the ponding. It is generally unsuited to septic tank absorption fields because of the ponding and a poor filtering capacity and to sewage lagoons because of seepage and the ponding.
The woodland ordination symbol is 4W, the land capability classification is Vw, and the Michigan soil management group is 5c. No habitat type is assigned.

52A—Ingalls loamy sand, 0 to 3 percent slopes.
This very deep, somewhat poorly drained, nearly level soil is on low plains and knolls and in swales. Individual areas are irregular in shape and range from 5 to 350 acres in size.
Typically, the surface is covered by about 3 inches of leaf litter. The surface horizon is brown loamy sand about 7 inches thick. The subsoil is about 33 inches thick. It is mottled. The upper part is dark brown, friable loamy sand and sand, and the lower part is brown, very friable loamy fine sand. The

substratum to a depth of about 60 inches is dark yellowish brown and brown, mottled, stratified loamy fine sand and silt loam.

Included with this soil in mapping are small areas of the moderately well drained Ocqueoc soils in the slightly higher landscape positions. Also included are small areas of the somewhat poorly drained Allendale and poorly drained Deford soils. Allendale soils have a clayey substratum. They are in landscape positions similar to those of the Ingalls soil. Deford soils are in depressions and along drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the upper part of the Ingalls soil and moderately slow in the stratified lower part. The available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Landings can be used only when the soil is dry or frozen. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Furrowing before planting also can increase the seedling survival rate. Because of the high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, plant competition can delay natural regeneration. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods and that control soil blowing. A subsurface drainage system can help to lower the water table. Tile lines should be protected with suitable material and installed on a self-cleaning grade so that they do not become clogged with fine sand and silt. Conservation tillage, buffer strips, vegetative barriers, field windbreaks, and additions of organic material conserve moisture and help to control soil blowing.

This soil is well suited to pasture. The forage species that are tolerant of wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to building site development because of the wetness and to septic tank absorption fields because of the wetness, the moderately slow permeability in the lower part of the profile, and a poor filtering capacity in the upper part. It is generally unsuited to sewage lagoons because of the wetness and seepage.

The woodland ordination symbol is 4W, the land capability classification is IIIw, and the Michigan soil management group is 4/2b. No habitat type is assigned.

53B—Menominee loamy sand, 0 to 6 percent slopes.

This very deep, moderately well drained, nearly level and undulating soil is on broad plains and knolls and on the tops of ridges. Individual areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is very dark gray loamy sand about 5 inches thick. The subsurface layer is grayish brown loamy sand about 6 inches thick. The subsoil is about 23 inches thick. The upper part is dark reddish brown, friable loamy sand about 2 inches thick. The next part is strong brown, friable sand. The lower part is reddish brown, mottled, friable clay loam and sandy loam. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska and well-drained Emmet and Longrie soils. These soils are in landscape positions similar to those of the Menominee soil. Kalkaska soils are sandy throughout. Emmet soils are loamy throughout. Longrie soils are underlain by limestone bedrock at a depth of 20 to 40 inches. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the upper part of the Menominee soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is slow. A perched seasonal high water table is at a depth of 2.5 to 4.0 feet from late fall to spring. The potential for frost action is high.

Most areas are used as woodland. Some are used as cropland. Some of the acreage is idle grassland.

Most areas are used as woodland. There are no major management concerns. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, wheat, silage corn, and a mixture of grasses and legumes. The major management needs are measures that conserve moisture, help to control soil blowing, and maintain the organic matter content. Examples are buffer strips, vegetative barriers, field windbreaks, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing, and restricted grazing during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to building site development. The wetness is a limitation on sites for buildings with basements. These buildings can be constructed on well-compacted fill material, which raises the level of the site. A drainage system helps to lower the seasonal high water table. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity in the upper part of the profile and moderately slow permeability in the lower part. It readily absorbs but does not adequately filter the effluent in the upper part of the profile. Special construction methods, such as enlarging the absorption fields or installing alternating drain fields, can help to overcome the restricted permeability. The wetness can be a limitation. Filling or mounding the absorption field with suitable material can raise the site above the seasonal high water table. The soil is generally unsuited to sewage lagoons because of seepage in the upper pail of the profile.

The woodland ordination symbol is 6A, the land capability classification is IIIs, and the Michigan soil management group is *412a.* No habitat type is assigned.

56A—Ensign silt loam, 0 to 3 percent slopes, rocky.

This shallow, somewhat poorly drained, nearly level soil is on broad plains and low knolls and in depressions. Limestone bedrock makes up 1 to 10 percent of this map unit. The rock outcrops are generally flat areas of exposed bedrock, but vertical drops of 5 to 10 feet can occur. Individual areas of this unit are irregular in shape and range from 5 to more than 600 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The next layer is very dark gray and light olive brown, mottled silt loam about 4 inches thick. The subsoil is light olive brown, mottled, friable silt loam about 5 inches thick. Limestone bedrock is at a depth of about 13 inches. In some places, the limestone bedrock is below a depth of 20 inches. In other places, the soil has a thin surface layer of muck. In some areas, the surface layer and subsoil have 25 to 35 percent gravel, cobbles, and flagstones.

Included with this soil in mapping are small areas of the well drained Summerville, somewhat poorly drained Shelter, and poorly drained Ruse soils. Summerville soils are on low knolls and benches. Shelter soils do not have bedrock within a depth of 40 inches. They are in landscape positions similar to

those of the Ensign soil. Ruse soils are in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the Ensign soil. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 to 1.0 foot from late fall to late spring.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Bedrock and rock outcrops can hinder road construction, harvesting, and planting. Landings can be used only when the soil is dry or frozen. Because of the bedrock and the high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Aspen and swamp conifers are the dominant cover types. Trees generally are not planted on this soil. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally unsuited to building site development because of the wetness and the limited depth to bedrock. It is generally unsuited to septic tank absorption fields and sewage lagoons because of the wetness, the limited depth to bedrock, and seepage in the material above the bedrock.

The woodland ordination symbol is 2W, the land capability classification is VIIw, and the Michigan soil management group is Rbc. No habitat type is assigned.

57B—Summerville-Longrie complex, 1 to 6 percent slopes, rocky.

This map unit consists of a nearly level and undulating, shallow, well drained Summerville soil and a moderately deep, well-drained Longrie soil on the top of ridges and on knolls, benches, and broad plains. Individual areas are irregular in shape and range from 8 to 500 acres in size. They are 30 to 60 percent Summerville soil, 30 to 60 percent Longrie soil, and 1 to 10 percent exposed limestone bedrock. The exposed bedrock occurs as flat areas or as vertical drops of 5 to 15 feet. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Summerville soil has a surface layer of very dark grayish brown loam about 3 inches thick. The subsoil is dark yellowish brown, very friable very fine sandy loam about 10 inches thick. Limestone bedrock is at a depth of about 13 inches.

Typically, the Longrie soil has a surface layer of black sandy loam about 4 inches thick. The subsurface layer is reddish gray sandy loam about 5 inches thick. The subsoil is dark reddish brown and reddish brown, friable fine sandy loam about 18 inches thick. The substratum is light brown gravelly loam about 4 inches thick. It is underlain by limestone bedrock at a depth of about 31 inches. In some places, the depth to bedrock is more than 40 inches. In other places the surface layer is fine sandy loam, silt loam, or loam.

Included with these soils in mapping are small areas of the deep, well-drained Posen soils. These included soils are in landscape positions similar to those of the Summerville and Longrie soils. Also included are small areas of the somewhat poorly drained Ensign soils in depressions and areas of the stony and bouldery Summerville and Longrie soils. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the Summerville and Longrie soils. The available water capacity is low in the Summerville soil and moderate in the Longrie soil.

Surface runoff is slow on both soils.

Most areas are used as woodland. A few are idle grassland.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. The bedrock interferes with road construction in a few areas. Traffic ability is briefly limited in spring and in other excessively wet periods. When the soils are wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on these soils. Because of the shallowness to bedrock, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. Species preference can be managed by selective cutting. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Furrowing before planting also can increase the seedling survival rate. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

The Longrie soil is fairly well suited to buildings without basements but is poorly suited to buildings with basements. The limited depth to bedrock is the main limitation. The Summerville soil is generally unsuited to building site development because of the limited depth to bedrock. Both soils are generally unsuited to septic tank absorption fields and sewage lagoons because of the limited depth to bedrock and seepage.

The woodland ordination symbol is 2D, the land capability classification is IIIs, and the Michigan soil management groups are Ra and 3/Ra. No habitat type is assigned.

61A—Halfaday sand, 0 to 3 percent slopes.

This very deep, moderately well drained, nearly level soil is on broad plains, low ridges, and knolls. Individual areas are irregular in shape and range from 5 to more than 200 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is black sand about 1 inch thick. The subsurface layer is brown sand about 6 inches thick. The subsoil is sand about 30 inches thick. The upper part is dark reddish brown, dark brown, and strong brown and is very friable. The next part is dark brown and brownish yellow, mottled, and very friable. The lower part is yellowish brown, mottled, and loose. The substratum to a depth of about 60 inches is brownish yellow, mottled sand. In places, the soil is mottled below a depth of 60 inches.

Included with this soil in mapping are small areas of the well-drained Manistee and somewhat poorly drained Au Gres soils. Manistee soils have a clayey substratum. They are in landscape positions similar to or slightly higher than those of the Halfaday soil. Au Gres soils are in depressions. Included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the Halfaday soil. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 2 to 3 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Northern hardwoods and red pine are the dominant cover types on this soil. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means generally is needed to control plant competition.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that conserve moisture, help to control soil blowing, and maintain the organic matter content. Examples are buffer strips, vegetative field barriers, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture. Overgrazing during dry periods can destroy the plant cover. The major management concern is droughtiness. Proper stocking rates, rotation grazing, strip grazing and restricted use during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to building site development, but wetness is a limitation on sites for buildings with basements. Buildings with basements can be constructed on well-compacted fill material, which raises the level of the site. A drainage system helps to lower the water table. The soil is poorly suited to septic tank absorption fields because of the high water table and a poor filtering capacity. It is generally unsuited to sewage lagoons because of seepage and the high water table. If a septic tank absorption field is used, filling or mouncling is needed to raise the site above the seasonal high water table. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The woodland ordination symbol is 3S, the land capability classification is IIIs, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TMC-D.

67B—Duel-Rock outcrop complex, 1 to 6 percent slopes.

This map unit consists of a moderately deep, nearly level and undulating, well drained Duel soil and exposed limestone bedrock on benches, ridges, and broad upland flats. The Rock outcrop occurs as flat areas or vertical drops of 5 to 15 feet. Individual areas of this unit are irregular in shape and range from 5 to 100 acres in size. They are 60 to 80 percent Duel soil and 10 to 35 percent Rock outcrop. The Duel soil and Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Duel soil has a surface layer of black sand about 3 inches thick. The subsurface layer is brown loamy sand about 6 inches thick. The subsoil is about 21 inches of dark reddish brown and dark brown loose loamy sand and loamy coarse sand. The substratum is pale brown very gravelly very fine sandy loam about 8 inches thick. Limestone bedrock is at a depth of about 38 inches. In places, the depth to bedrock is more than 40 inches.

Included with this unit in mapping are small areas of the deep, somewhat excessively drained Kalkaska and moderately deep, well-drained Longrie soils. These soils are in landscape positions similar to those of the Duel soil. Longrie soils are loamy and are underlain by limestone bedrock. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate to rapid in the Duel soil. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. The bedrock interferes with road construction and the use of equipment in some areas. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Northern hardwoods and aspen are the dominant cover types. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control plant competition.

This soil is fairly well suited to buildings without basements but is poorly suited to buildings with basements. The depth to bedrock is the main limitation. The soil is poorly suited to septic tank absorption fields because of the depth to bedrock and a poor filtering capacity. It is generally unsuited to sewage lagoons because of the depth to bedrock and seepage. Buildings with basements can be constructed on well-compacted fill material, which raises the level of the site. The soil readily absorbs

but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water.

The woodland ordination symbol assigned to the Duel soil is 2D, the land capability classification is IVs, and the Michigan soil management group is 4/Ra. The primary habitat type is TM.

68—Pinconning mucky loamy sand.

This very deep, poorly drained, nearly level soil is in depressions and on low, broad plains. It is frequently ponded. Individual areas are irregular in shape and range from 5 to more than 500 acres in size.

Typically, the surface layer is black mucky loamy sand about 8 inches thick. The substratum is mottled. The upper part is yellowish brown and grayish brown sand about 13 inches thick, and the lower part of the substratum to a depth of about 60 inches is reddish gray and reddish brown silty clay and clay.

Included with this soil in mapping are small areas of the poorly drained Roscommon and Pickford and somewhat poorly drained Allendale soils. Roscommon and Pickford soils are in landscape positions similar to those of the Pinconning soil. Roscommon soils have a sandy substratum. Pickford soils are clayey throughout. Allendale soils are on low knolls. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the upper part of the Pinconning soil and slow or very slow in the lower part. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is 1 toot above to 1 foot below the surface from fall to early spring.

This soil is used as woodland. Some areas support lowland brush.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The swamp conifer cover type is dominant on this soil. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. The wetness can result in the loss of seedlings. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, severe plant competition, and low productivity.

This soil generally is unsuitable as a site for buildings because of the ponding. It is generally unsuited to septic tank absorption fields because of the ponding, seepage in the sandy material and the very slow permeability in the clayey material. The soil is generally unsuited to sewage lagoons because of the ponding and the seepage.

The woodland ordination symbol is 3W, the land capability classification is Vw, and the Michigan soil management group is 4/ic. No habitat type is assigned.

78B—Waiska sandy loam, 0 to 6 percent slopes.

This very deep, excessively drained, nearly level and undulating soil is on glacial lake benches, stream terraces, and outwash plains. Individual areas are irregularly shaped or elongated and range from 5 to 100 acres in size.

Typically, the surface is covered with partially decomposed leaf litter about 1 inch thick. The surface layer is reddish gray sandy loam about 2 inches thick. The subsoil is about 29 inches thick. The upper part is dark reddish brown and dark brown, very friable gravelly sandy loam; the next part is dark brown, loose very gravelly loamy coarse sand; and the lower part is strong brown, loose very gravelly

coarse sand. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown very gravelly coarse sand. In places the surface layer is sand, loamy sand, loam, the gravelly or very gravelly analogs of those textures, or gravelly or very gravelly sandy loam.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska and moderately well drained Ocqueoc soils. These soils are in landscape positions similar to those of the Waiska soil. Kalkaska soils have a lower content of coarse fragments than the Waiska soil. Ocqueoc soils have a stratified, sandy and loamy substratum. Included soils make up about 5 to 15 percent of the map unit.

Permeability is very rapid in the Waiska soil. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. There are no major management concerns. The northern hardwoods cover type is dominant. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It is generally unsuited to sewage lagoons because of seepage. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water.

The woodland ordination symbol is 3A, the land capability classification is VIs, and the Michigan soil management group is 5a. No habitat type is assigned.

79B—Kalkaska-Manistee sands, 0 to 6 percent slopes.

This map unit consists of a very deep, nearly level and undulating, somewhat excessively drained Kalkaska soil and a very deep, moderately well drained Manistee soil. The Kalkaska soil is on ridges and knolls, and the Manistee soil is in the more nearly level areas. Individual areas of this unit are irregular in shape and range from 10 to 250 acres in size. They are 50 to 70 percent Kalkaska soil and 15 to 30 percent Manistee soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Kalkaska soil is covered by about 1 inch of partially decomposed leaf litter. The surface layer is dark reddish brown sand about 2 inches thick. The subsurface layer is reddish brown sand about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, triable loamy sand, and the lower part is dark brown and strong brown, very friable and loose sand. The substratum to a depth of about 60 inches is yellowish brown sand. In some places, the soil has 5 to 15 percent gravel and cobbles on or below the surface. In other places, the surface layer is loamy sand.

Typically, the Manistee soil is covered by about 3 inches of well-decomposed leaf litter. The surface layer is pinkish gray sand about 9 inches thick. The subsoil is about 26 inches thick. It is firm. The upper part is dark reddish brown sand; the next part is dark brown, mottled sand; and the lower part is reddish brown and pinkish gray, mottled silty clay loam and loamy sand. The substratum to a depth of about 60 inches is reddish brown clay.

Included with these soils in mapping are small areas of the well-drained Superior and moderately well drained Alcona and Ocqueoc soils. These included soils are in landscape positions similar to those of the Kalkaska and Manistee soils. Superior soils are loamy in the surface layer and in the upper part of the subsoil. Alcona soils formed in stratified, sandy and loamy deposits. Ocqueoc soils have a stratified, sandy and loamy substratum. Also included are small areas of the somewhat poorly drained Au Gres soils in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kalkaska soil. It is rapid in the upper part of the Manistee soil and very slow in the lower part. The available water capacity is low in both soils. Surface runoff is slow. The Manistee soil has a perched seasonal high water table at a depth of 2.5 to 4.0 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on these soils. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are poorly suited to cropland, but such crops as oats, barley, wheat, and a mixture of grasses and legumes can be grown. The major management needs are measures that conserve moisture, help to control soil blowing, and maintain the organic matter content. Examples are buffer strips, vegetative barriers, field windbreaks, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

These soils are fairly well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing, and restricted grazing during dry periods help to keep the pasture in good condition.

The Kalkaska soil is well suited to building site development, and the Manistee soil is fairly well suited. The wetness and the shrink-swell potential of the Manistee soil are limitations on sites for buildings with basements. In areas of the Manistee soil, buildings with basements can be constructed on well-compacted fill material, which raises the level of the site. A drainage system helps to sower the water table in the Manistee soil. The soils are poorly suited to septic tank absorption fields because of a poor filtering capacity in the Kalkaska soil and in the upper part of the Manistee soil. The Manistee soil also is limited by wetness and by the very slow permeability in the lower part of the profile. The Kalkaska soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soils are generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 3S, the land capability classification is IVs, and the Michigan soil management groups are 5a and 4/la. The primary habitat type is ATD.

79D—Kalkaska-Manistee sands, 6 to 15 percent slopes.

This map unit consists of a very deep, gently rolling and rolling, somewhat excessively drained Kalkaska soil and a very deep, well drained Manistee soil. The Kalkaska soil is on ridges and knolls, and the Manistee soil is on side slopes and flats. Individual areas of this unit are elongated or irregularly shaped and range from 10 to 50 acres in size. They are 40 to 60 percent Kalkaska soil and 20 to 40 percent Manistee soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Kalkaska soil is covered by about 1 inch of partially decomposed leaf litter. The surface layer is dark reddish brown sand about 2 inches thick. The subsurface layer is reddish brown sand about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loamy sand, and the lower part is dark brown and strong brown, very friable and loose sand. The substratum to a depth of about 60 inches is yellowish brown sand. In some places, the soil has 5 to 15 percent gravel and cobbles on or below the surface. In other places, the surface layer is loamy sand.

Typically, the Manistee soil is covered by about 3 inches of well-decomposed leaf litter. The surface layer is pinkish gray sand about 9 inches thick. The subsoil is about 26 inches thick. It is firm. The upper part is dark reddish brown and dark brown sand, and the lower part is reddish brown and pinkish gray silty clay loam and loamy sand. The substratum to a depth of about 60 inches is reddish brown clay.

Included with these soils in mapping are small areas of the well-drained Superior, Alcona, and Ocqueoc soils. These included soils are in landscape positions similar to those of the Kalkaska and Manistee soils. Superior soils are loamy in the surface layer and in the upper part of the subsoil. Alcona soils formed in stratified, sandy and loamy deposits. Ocqueoc soils have a stratified, sandy and loamy substratum. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kalkaska soil. It is rapid in the upper part of the Manistee soil and very slow in the lower part. The available water capacity is low in both soils. Surface runoff is slow.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be located in the small nearly level areas that may be included in this unit. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on these soils. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are fairly well suited to building site development. The slope is the main limitation. The Kalkaska soil is poorly suited to septic tank absorption fields because of a poor filtering capacity and the slope, and the Manistee soil is poorly suited because of a poor filtering capacity in the upper part of the profile, the very slow permeability in the lower part, and the slope. The soils are generally unsuited to sewage lagoons because of seepage and the slope. Buildings should be designed so that they conform to the natural slope of the land. The soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines across the slope generally helps to ensure that the absorption field functions properly.

The woodland ordination symbol is 3S, the land capability classification is VIs, and the Michigan soil management groups are 5a and 4/la. The primary habitat type is ATD.

80B—Superior fine sandy loam, 1 to 6 percent slopes.

This very deep, well-drained, nearly level and undulating soil is on the tops of ridges and broad flats. Individual areas are irregular in shape and range from 5 to 400 acres in size.

Typically, the surface is covered by undecomposed leaf litter about 2 inches thick. The surface layer is pinkish gray fine sandy loam about 2 inches thick. The subsoil is about 34 inches thick. In sequence downward, it is dark reddish brown and brown, very friable fine sandy loam; brown and reddish brown, friable fine sandy loam and clay loam; reddish brown and light reddish brown, firm silty clay and fine sandy loam; and reddish brown, very firm clay. The substratum to a depth of about 60 inches is reddish brown clay. In some places the surface layer is sandy loam or loam. In other places, the upper part of the subsoil is finer textured.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska, moderately well drained Manistee and Ocqueoc, and somewhat poorly drained Allendale soils.

Kalkaska soils are sandy throughout. They are in landscape positions similar to or slightly higher than those of the Superior soil. Manistee and Allendale soils are sandy in the surface layer and in the upper part of the subsoil. Ocqueoc soils are sandy in the upper part of the profile and have a stratified, sandy and loamy substratum. Manistee and Ocqueoc soils are in landscape positions similar to those of the Superior soil. Allendale soils are in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Superior soil and very slow in the lower part. The available water capacity is moderate. Surface runoff is slow. The shrink-swell potential is high.

This soil is used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. Traffic ability is briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Because of the firm subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management concern is controlling water erosion. Cover crops, close-growing crops, grassed waterways, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface help to control water erosion. When the soil is wet, ruts form easily and the load-bearing capacity is low.

This soil is well suited to pasture. Maintaining an adequate vegetative cover by preventing overgrazing helps to control surface runoff and erosion.

This soil is poorly suited to building site development because of the shrink-swell potential. It is generally unsuited to septic tank absorption fields because of the very slow permeability. It is poorly suited to sewage lagoons because of seepage. Lagoon sites may require some leveling and banking. Sealing the lagoon helps to prevent seepage. On sites for buildings, the foundation trench should be widened and backfilled with suitable coarse textured material.

The woodland ordination symbol is 6D, the land capability classification is IIe, and the Michigan soil management group is 1a. No habitat type is assigned.

83A—Allendale-Croswell complex, 0 to 3 percent slopes.

This map unit consists of a very deep, nearly level, somewhat poorly drained Allendale soil in depressions and a very deep, moderately well drained Croswell soil on low knolls and ridges. Individual areas are irregular in shape and range from 10 to 100 acres in size. They are 40 to 60 percent Allendale soil and 30 to 50 percent Croswell soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Allendale soil has a surface layer of black loamy fine sand about 5 inches thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark reddish brown, very friable loamy fine sand; the next part is strong brown and yellowish brown, mottled, very friable fine sand; and the lower part is reddish brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is light reddish brown, mottled silty clay that has thin strata of yellowish brown silt loam and silty clay loam. In places the surface layer is fine sand or loamy sand.

Typically, the Croswell soil is covered by about 2 inches of black, partially decomposed leaf litter. The surface layer is brown sand about 2 inches thick. The subsoil is strong brown and yellowish brown,

very friable and friable sand about 27 inches thick. The substratum to a depth of about 60 inches is light yellowish brown and brownish yellow, mottled sand. In places, part or all of the soil is fine sand.

Included with these soils in mapping are small areas of the somewhat poorly drained Au Gres, poorly drained Fibre, and somewhat excessively drained Kalkaska soils. Au Gres soils are sandy throughout. They are in landscape positions similar to those of the Allendale soil. Fibre soils formed in sandy material underlain by clay. They are in depressions and drainage ways. Kalkaska soils are on ridges and knolls. Included soils make up about 5 to 20 percent of the map unit.

Permeability is moderately rapid and rapid in the upper pad of the Allendale soil and very slow in the clayey lower part. It is rapid in the Croswell soil. The available water capacity is moderate in the Allendale soil and low in the Croswell soil. Surface runoff is slow on both soils. From late fall to late spring, the Allendale soil has a seasonal high water table at a depth of 1 to 2 feet and the Croswell soil has one at a depth of 2 to 4 feet.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The best sites for landings are the low ridges. Year-round logging roads in the lower areas should be graveled. Culverts are needed to maintain the natural drainage system. Because of the high water table, trees in the lower areas are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on these soils. The mortality of planted seedlings can be expected during dry periods. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Furrowing before planting also can increase the seedling survival rate. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods, conserve moisture during dry periods, and help to control soil blowing. A subsurface drainage system can help to lower the water table. Conservation tillage, additions of organic material, buffer strips, vegetative barriers, field windbreaks, and small grain crops can conserve moisture and help to control soil blowing.

These soils are well suited to pasture. The forage species that are tolerant of wetness should be selected for planting. Proper stocking rates and rotation grazing are needed.

The Allendale soil is poorly suited to building site development because of the wetness. The Croswell soil is fairly well suited to buildings without basements, but it is poorly suited to buildings with basements because of the wetness. In areas of the Croswell soil, buildings with basements can be constructed on well-compacted fill material, which raises the level of the site. A drainage system helps to lower the water table in these soils. The Allendale soil is generally unsuited to septic tank absorption fields because of the wetness, a poor filtering capacity in the sandy upper part of the profile, and the very slow permeability in the olayey lower part. The Croswell soil is poorly suited to septic tank absorption fields because of the high water table and a poor filtering capacity. If a septic tank disposal system is installed, filling or mounding with suitable material can raise the site above the seasonal high water table. The soils readily absorb but do not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soils are generally unsuited to sewage lagoons because of the wetness and seepage.

The woodland ordination symbols are 4W and 5S, the land capability classification is IIIw, and the Michigan soil management groups are 4/1 b and 5.3a. The primary habitat type is TMC-D, and the secondary habitat type is TM.

84B—Rousseau, dark subsoil-Alcona complex, 0 to 6 percent slopes.

These very deep, nearly level and undulating, well-drained soils are on broad plains and upland flats. Individual areas are irregular in shape and range from 10 to 600 acres in size. They are 50 to 70 percent Rousseau soil and 20 to 40 percent Alcona soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rousseau soil has a surface layer of black fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 3 inches thick. The subsoil is dark reddish brown and strong brown, very friable fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light brown and brown fine sand. In places, the soil is mottled in the lower part of the substratum.

Typically, the Alcona soil is covered by about 1 inch of undecomposed hardwood leaf litter. The surface layer is brown loamy very fine sand about 3 inches thick. The subsoil is about 52 inches thick. The upper part is dark reddish brown, yellowish brown, and brownish yellow, very friable very fine sandy loam and loamy very fine sand, and the lower part is light yellowish brown to strong brown, mottled, very friable loamy very fine sand and very fine sandy loam. The substratum to a depth of about 60 inches is yellowish brown and strong brown, mottled, stratified silt, silt loam, very fine sand, and loamy very fine sand. It has thin bands of silty clay loam.

Included with these soils in mapping are small areas of the moderately well drained Ocqueoc and somewhat poorly drained Wainola soils. Ocqueoc soils have a sandy surface layer and subsoil and a stratified, sandy and loamy substratum. They are in landscape positions similar to those of the Rousseau and Alcona soils. Wainola soils formed in deep deposits of sandy material. They are in the slightly lower landscape positions. Included soils make up about 5 to 20 percent of the map unit.

Permeability is rapid in the Rousseau soil and moderate in the Alcona soil. The available water capacity is low in the Rousseau soil and moderate in the Alcona soil. Surface runoff is slow on both soils. The Alcona soil has a perched seasonal high water table at a depth of 2.5 to 6.0 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, and plant competition. In the sandy areas, loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. In the loamy areas, traffic ability may be briefly limited in spring and in other excessively wet periods. When the soils are wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Year-round logging roads should be graveled. The mortality of planted or naturally, established seedlings can be a problem during dry periods because of the sandy surface layer and the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on these soils. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that conserve moisture, help to control soil blowing, and control water erosion. Examples are buffer strips, vegetative barriers, field windbreaks, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

These soils are well suited to pasture. Overgrazing during dry periods can destroy the plant cover and increase the susceptibility to erosion. Proper stocking rates, rotation grazing, strip grazing and restricted use during dry periods help to keep the pasture in good condition and prevent excessive erosion.

The Rousseau soil is well suited to building site development. The Alcona soil is well suited to buildings without basements and fairly well suited to buildings with basements. The wetness is a limitation. In areas of the Alcona soil, buildings with basements can be constructed on well-compacted fill material, which raises the level of the site above the water table. A drainage system helps to lower the water table. The soils are poorly suited to septic tank absorption fields because of a poor filtering capacity in the Rousseau soil and the wetness in the Alcona soil. The Rousseau soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. If a septic tank disposal system is installed in areas of the Alcona soil, filling or mounding with suitable material can raise the site above the seasonal high water table. The soils are generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbols are 3S and 3L, the land capability classification is IIIs, and the Michigan soil management groups are 5a and 3a-s. The primary habitat type is ATD.

84D—Rousseau, dark subsoil-Alcona complex, 6 to 15 percent slopes.

This map unit consists of deep, gently rolling to rolling, well drained Rousseau and moderately well drained Alcona soils on the sides of ridges and knolls. Individual areas are irregular in shape and range from 10 to more than 200 acres in size. They are about 50 to 70 percent Rousseau soil and 20 to 40 percent Alcona soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rousseau soil has a surface layer of black fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 3 inches thick. The subsoil is dark reddish brown and strong brown, very friable fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light brown and brown fine sand.

Typically, the Alcona soil is covered by about 1 inch of undecomposed hardwood leaf litter. The surface layer is brown loamy very fine sand about 3 inches thick. The subsoil is 52 inches thick. The upper part is dark reddish brown, yellowish brown, and brownish yellow, very friable very fine sandy loam and loamy very fine sand, and the lower part is light yellowish brown to strong brown, mottled, very friable loamy very fine sand and very fine sandy loam. The substratum to a depth of about 60 inches is yellowish brown and strong brown, mottled, stratified silt, silt loam, very fine sand, and loamy very fine sand. It has thin bands of silty clay loam.

Included with these soils in mapping are small areas of the moderately well drained Halfaday and Ontonagon soils. These included soils are in landscape positions similar to those of the Rousseau and Alcona soils. Halfaday soils are sand throughout. Ontonagon soils are clayey throughout. Included soils make up about 5 to 20 percent of the map unit.

Permeability is rapid in the Rousseau soil and moderate in the Alcona soil. The available water capacity is low in the Rousseau soil and moderate in the Alcona soil. Surface runoff is slow on both soils. The Alcona soil has a perched seasonal high water table at a depth of 2.5 to 6.0 feet from late fall to late spring.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, and plant competition. In the sandy areas, loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. In the loamy areas, traffic ability may be briefly limited in spring and in other excessively wet periods. When the soils are wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral

drainage, expose tree roots, and alter soil structure. Year-round logging roads should be graveled. The mortality of planted or naturally, established seedlings can be a problem during dry periods because of the sandy surface layer and the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on these soils. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are fairly well suited to building site development. The wetness in areas of the Alcona soil and the slope are the main limitations. The buildings should be designed so that they conform to the natural slope of the land. In areas of the Alcona soil, buildings with basements can be constructed on well-compacted fill material, which raises the level of the site above the water table. A drainage system helps to lower the water table in the Alcona soil. The soils are poorly suited to septic tank absorption fields because of a poor filtering capacity in the Rousseau soil and the high water table in the Alcona soil. The Rousseau soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. If a septic tank disposal system is installed in areas of the Alcona soil, filling or mounding with suitable material can raise the site above the seasonal high water table. The soils are generally unsuitable as sites for sewage lagoons because of seepage, the wetness, and the slope.

The woodland ordination symbols are 3S and 3L, the land capability classification is IDe, and the Michigan soil management groups are 5a and 3a-s. The primary habitat type is ATD.

84F—Rousseau, dark subsoil-Alcona complex, 25 to 50 percent slopes.

These very deep, well drained, steep and very steep soils are on the sides of ridges and knolls. Individual areas are irregular in shape and range from 10 to more than 150 acres in size. They are 50 to 70 percent Rousseau soil and 20 to 40 percent Alcona soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rousseau soil has a surface layer of black fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 3 inches thick. The subsoil is dark reddish brown and strong brown, very friable fine sand about 15 inches thick. The substratum to a depth of about 60 inches is light brown and brown fine sand. Typically, the Alcona soil is covered by about 1 inch of undecomposed hardwood leaf litter. The surface layer is brown loamy very fine sand about 3 inches thick. The subsoil is about 52 inches of dark reddish brown, yellowish brown and brownish yellow, very friable very fine sandy loam and loamy very fine sand. The substratum to a depth of about 60 inches is yellowish brown and strong brown, stratified sight, silt loam, very fine sand, and loamy very fine sand. It has thin bands of silty clay loam.

Included with these soils in mapping are small areas of the well-drained Ontonagon soils. These included soils are in landscape positions similar to those of the Rousseau and Alcona soils. They are clayey throughout. They make up about 5 to 20 percent of the map unit.

Permeability is rapid in the Rousseau soil and moderate in the Alcona soil. The available water capacity is low in the Rousseau soil and moderate in the Alcona soil. Surface runoff is medium on both soils.

These soils are used as woodland. The major management concerns are the equipment limitation, the erosion hazard, seedling mortality, and plant competition. Access is limited by the slope. Special care is needed in laying out logging roads and in operating equipment. The roads can be designed so that they conform to the natural slope of the land. Special logging methods, such as yarding with a cable, may be needed to minimize surface disturbance. In the sandy areas, loose sand and the slope can interfere with the traction of wheeled equipment. Removing water with water bars, out-sloping road surfaces,

culverts, and drop structures minimizes erosion. Landings should be located on the less sloping nearby soils. Seedling mortality can be a problem during dry periods because of the low available water capacity, especially on south aspects. Site preparation and planting are severely limited by the slope. The northern hardwoods cover type is dominant on these soils. Species preference can be managed by selective cutting.

These soils are generally unsuited to building site development and sanitary facilities because of the slope.

The woodland ordination symbol is 311, the land capability classification is VIe, and the Michigan soil management groups are 5a and 3a-s. The primary habitat type is ATD.

85B—Kalkaska-Ocqueoc complex, 0 to 6 percent slopes.

This map unit consists of very deep, nearly level and undulating, somewhat excessively drained Kalkaska and moderately well drained Ocqueoc soils on broad plains and upland flats. Individual areas are irregular in shape and range from 10 to 500 acres in size. They are 50 to 70 percent Kalkaska soil and 20 to 40 percent Ocqueoc soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Kalkaska soil is covered by about 1 inch of partially decomposed leaf litter. The surface layer is dark reddish brown sand about 2 inches thick. The subsurface layer is reddish brown sand about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loamy sand, and the lower part is dark brown and strong brown, very friable and loose sand. The substratum to a depth of about 60 inches is yellowish brown sand. In some places, it is mottled. In other places, the surface layer is loamy sand.

Typically, the Ocqueoc soil is covered by about 2 inches of well-decomposed leaf litter. The surface layer is pinkish gray fine sand about 8 inches thick. The subsoil is about 14 inches thick. The upper part is dark reddish brown, dark brown, and brown, very friable and loose fine sand, and the lower part is dark yellowish brown, very triable loamy fine sand. The substratum to a depth of about 60 inches is brown and yellowish brown, mottled, stratified fine sand to silt loam.

Included with these soils in mapping are small areas of the moderately well drained Alcona soils. These included soils are in landscape positions similar to those of the Kalkaska and Ocqueoc soils. They have a loamy surface layer. They make up about S to 10 percent of the map unit.

Permeability is rapid in the Kalkaska soil. IIIs rapid in the sandy upper part of the Ocqueoc soil and moderately slow in the lower part. The available water capacity is low in the Kalkaska soil and moderate in the Ocqueoc soil. Surface runoff is slow on both soils. The Ocqueoc soil has a seasonal high water table at a depth of 2.5 to 6.0 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on these soils. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are poorly suited to cropland, but such crops as oats, barley, wheat, and a mixture of grasses and legumes can be grown. The major management needs are measures that conserve moisture, maintain the organic matter content, and help to control soil blowing. Examples are buffer strips, vegetative barriers, field windbreaks, small grain crops, additions of organic material, and a system of

conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

These soils are fairly well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing and restricted use during dry periods help to keep the pasture in good condition.

The Kalkaska soil is well suited to building site development. The Ocqueoc soil is well suited to buildings without basements and fairly well suited to buildings with basements. The wetness and the shrink-swell potential are limitations. In areas of the Ocqueoc soil, buildings with basements can be constructed on well-compacted fill material, which raises the level of the site. A drainage system helps to lower the water table in the Ocqueoc soil. The soils are poorly suited to septic tank absorption fields because of a poor filtering capacity in the upper part of the Ocqueoc soil and in the Kalkaska soil. The Ocqueoc soil also is limited by wetness and by the moderately slow permeability in the lower part of the profile. The Kalkaska soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soils are generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 3S, the land capability classification is IVs, and the Michigan soil management groups are 5a and *412a.* The primary habitat type is ATD.

86A—Ingalls-Halfaday complex, 0 to 3 percent slopes.

This map unit consists of a very deep, nearly level, somewhat poorly drained Ingalls soil and a very deep, nearly level, moderately well drained Halfaday soil. The Ingalls soil is in depressions and drainage ways and on small flats. The Halfaday soil is on low ridges and knolls. Individual areas of this unit are irregular in shape and range from 5 to 100 acres in size. They are 40 to 55 percent Ingalls soil and 35 to 45 percent Halfaday soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Ingalls soil is covered by about 3 inches of leaf litter. The surface layer is brown loamy sand about 7 inches thick. The subsoil is about 33 inches thick. It is mottled. The upper part is dark brown, friable loamy sand and sand. The lower part is brown, very friable loamy tine sand. The substratum to a depth of about 60 inches is dark yellowish brown and brown, mottled, stratified loamy fine sand and silt loam.

Typically, the Halfaday soil is covered by about 1 inch of partially decomposed leaf litter. The surface layer is black sand about 1 inch thick. The subsurface layer is brown sand about 6 inches thick. The subsoil is sand about 30 inches thick. The upper part is dark reddish brown, dark brown, and strong brown and is very friable. The next pad is dark brown and brownish yellow, mottled, and very triable. The lower part is yellowish brown, mottled, and loose. The substratum to a depth of about 60 inches is brownish yellow, mottled sand.

Included with these soils in mapping are small areas of the somewhat poorly drained Au Gres and poorly drained Kinross soils. Au Gres and Kinross soils are sandy throughout. Au Gres soils are in landscape positions similar to those of the Ingalls soil. Kinross soils are in depressions and along drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the upper part of the Ingalls soil and moderately slow in the loamy lower part. It is rapid in the Halfaday soil. The available water capacity is moderate in the Ingalls soil and low in the Halfaday soil. Surface runoff is slow on both soils. From late fall to late spring, the Ingalls soil has a seasonal high water table at a depth of 0.5 foot to 1.5 feet and the Halfaday soil has one at a depth of 2 to 3 feet.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Landings can be located in the drier areas of the map unit. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. In some areas, seedling mortality can be a problem because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Because of the high water table, trees in some areas of this soil are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on these soils. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods, conserve moisture during dry periods, and help to control soil blowing. A subsurface drainage system can help to lower the water table. Conservation tillage, additions of organic material, buffer strips, vegetative barriers, field windbreaks, and small grain crops conserve moisture and help to control soil blowing.

These soils are fairly well suited to pasture. The forage species that are tolerant of wetness should be selected for planting. Proper stocking rates and rotation grazing are needed.

Because of the wetness, the Halfaday soil is only fairly well suited to buildings without basements and is poorly suited to buildings with basements. The Ingalls soil is poorly suited to building site development because of the wetness. It is generally unsuited to septic tank absorption fields because of the wetness, the moderately slow permeability in the lower part of the profile, and a poor filtering capacity in the upper part. Buildings with basements can be constructed on well-compacted fill material, which raises the level of the site. A drainage system helps to lower the water table. The Halfaday soil is poorly suited to septic tank absorption fields because of the wetness and a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. If a septic tank disposal system is installed, filling or mounding the absorption field with suitable material can raise the site above the seasonal high water table. The soils are generally unsuited to sewage lagoons because of the wetness and seepage.

The woodland ordination symbols are 4W and 3S, the land capability classification is IIIw, and the Michigan soil management groups are 4/2b and 5a. No habitat type is assigned.

87B—Rousseau fine sand, moderately wet, 0 to 6 percent slopes.

This very deep, moderately well drained, nearly level and undulating soil is on upland flats. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 2 inches thick. The subsoil is dark brown and dark yellowish brown, very triable fine sand about 22 inches thick. The substratum to a depth of about 60 inches is light brown, mottled fine sand. In places, the soil has loamy bands below a depth of 40 inches.

Included with this soil in mapping are small areas of the moderately well drained Alcona soils on the higher knobs. These soils are finer textured throughout than the Rousseau soil. Also included are areas of the somewhat poorly drained Wainola soils in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 6.5 feet from late tall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The modality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Northern hardwoods and red pine are the dominant cover types. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that conserve moisture, maintain the organic matter content, and help to control soil blowing. Examples are buffer strips, vegetative barriers, field windbreaks, small grain crops, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to dwellings without basements and is fairly well suited to buildings with basements. The wetness is the main limitation. Buildings with basements can be constructed on well-compacted fill material, which raises the level of the site above the water table. A drainage system helps to lower the water table. The soil is poorly suited to septic tank absorption fields because of the high water table and a poor filtering capacity. If a septic tank disposal system is installed, filling or mounding with suitable material can raise the site above the seasonal high water table. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soil is generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 5S, the land capability classification is IIIs, and the Michigan soil management group is 4a. No habitat type is assigned.

88A—Croswell-Au Gres sands, 0 to 3 percent slopes.

This map unit consists of very deep, nearly level, moderately well drained Croswell and somewhat poorly drained Au Gres soils on low ridges and small flats and in swales. Individual areas are irregular in shape and range from 10 to 300 acres in size. They are 40 to 60 percent Croswell soil and 25 to 45 percent Au Gres soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Croswell soil is covered by about 2 inches of black, partially decomposed leaf litter. The surface layer is brown sand about 2 inches thick. The subsoil is strong brown and yellowish brown, very friable and friable sand about 27 inches thick. The substratum to a depth of about 60 inches is light yellowish brown and brownish yellow, mottled sand.

Typically, the Au Gres soil is covered by about 1 inch of well-decomposed leaf litter. The surface layer is black sand about 1 inch thick. The subsurface layer is pinkish gray sand about 4 inches thick. The subsoil is mottled sand about 19 inches thick. The upper pad is yellowish red and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is brownish yellow and light yellowish brown, mottled sand.

Included with these soils in mapping are small areas of the excessively drained Rubicon and somewhat excessively drained Kalkaska soils on low ridges and knolls. Also included are small areas of the poorly drained Kinross soils in depressions. Included soils make up about 10 to 15 percent of the map unit.

Permeability is rapid in the Croswell and Au Gres soils, and the available water capacity is low. Surface runoff is slow. From late fall to late spring, the Croswell soil has a seasonal high water table at a depth of 2 to 4 feet and the Au Gres soil has one at a depth of 0.5 foot to 1.5 feet.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Landings can be located on the drier ridges. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Year-round logging roads should be built in the drier areas. They require a gravel base. Culverts are needed to maintain the natural drainage system. In some areas, seedling mortality can be a problem because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling modality rate. Replanting may be necessary in some areas. Because of the high water table, trees in the lower areas are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on these soils. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are poorly suited to cropland, but such crops as oats, barley, wheat, and a mixture of grasses and legumes can be grown. The major management needs are measures that conserve moisture, maintain the organic matter content, and help to control soil blowing. Examples are buffer strips, vegetative barriers, field windbreaks, small grain crops, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface. A subsurface drainage system in the lower areas is needed, especially during wet periods.

These soils are fairly well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing and restricted use during dry periods help to keep the pasture in good condition.

Because of the wetness, the Croswell soil is only fairly well suited to buildings without basements and is poorly suited to buildings with basements. The Au Gres soil is poorly suited to building site development because of the wetness. Buildings with basements can be constructed on well compacted till material, which raises the level of the site. A drainage system helps to lower the water table. The Croswell soil is poorly suited to septic tank absorption fields because of the wetness and a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding the absorption field with suitable material can raise the site above the seasonal high water table. The Au Gres soil is generally unsuited to septic tank absorption fields because of the wetness, seepage, and a poor filtering capacity. The soils are generally unsuitable as sites for sewage lagoons because of the wetness and seepage.

The woodland ordination symbols are 5S and 6W, the land capability classification is IVs, and the Michigan soil management groups are 5a and 5b. The primary habitat type is TM, and the secondary habitat type is TMC.

89A—Kinross-Au Gres complex, 0 to 3 percent slopes.

This map unit consists of very deep, nearly level, poorly drained Kinross and somewhat poorly drained Au Gres soils on low ridges and knolls. The Kinross soil is frequently ponded. Individual areas of this unit are irregular in shape and range from 10 to 350 acres in size. They are 40 to 60 percent Kinross soil and 30 to 50 percent Au Gres soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Kinross soil has a surface layer of black muck about 5 inches thick. The subsurface layer is brown sand about 5 inches thick. The subsoil is dark brown and brown, mottled, very friable and loose sand about 32 inches thick. The substratum to a depth of about 60 inches is grayish brown sand.

Typically, the Au Gres soil is covered by about 1 inch of well-decomposed leaf litter. The surface layer is black sand about 1 inch thick. The subsurface layer is pinkish gray sand about 4 inches thick. The subsoil is mottled sand about 19 inches thick. The upper part is yellowish red and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is brownish yellow and light yellowish brown, mottled sand.

Included with these soils in mapping are small areas of the very poorly drained Markey and Carbondale soils in depressions and drainage ways. These included soils have more than 1 6 inches of muck on the surface. Also included are small areas of the moderately well drained Halfaday soils on ridges. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kinross and Au Gres soils, and the available water capacity is low. Surface runoff is slow on the Au Ores soil and very slow or ponded on the Kinross soil. From fall to late spring, the Kinross soil has a seasonal high water table 1 foot above to 1 foot below the surface and the Au Gres soil has one at a depth of 0.5 foot to 1.5 feet.

These soils are used as woodland. The ‘major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. The number of suitable landing sites is severely limited because of the wetness. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. Because of the wetness, trees on these soils are shallow rooted. Many may be blown down during periods of high winds. Aspen and swamp conifers are the dominant cover types on these soils. Clear cutting is common. Trees generally are not planted on these soils. The opportunities for planting are limited because of the wetness, severe seedling mortality, and plant competition. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are poorly suited to building site development because of the wetness and the ponding. They are generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity and to sewage lagoons because of the wetness and seepage.

The woodland ordination symbols are 2W and 6W, the land capability classification is VIw, and the Michigan soil management groups are Sc and Sb. The primary habitat type is TTS, and the secondary habitat type is TMC.

91 B—Rousseau fine sand, 0 to 6 percent slopes.

This very deep, well-drained, nearly level and undulating soil is on ridge tops and upland flats. Individual areas are irregular in shape and range from S to 200 acres in size.

Typically, the surface is covered by about 1 inch of well-decomposed leaf litter. The surface layer is dark brown fine sand about 1 inch thick. The subsurface layer is brown fine sand about 3 inches thick. The subsoil is fine sand about 22 inches thick. The upper part is dark brown and strong brown and is very friable. The lower part is yellowish brown and is loose. The substratum to a depth of about 60 inches is brownish yellow fine sand. In places, the soil is mottled in the lower part of the substratum.

Included with this soil in mapping are small areas of the somewhat poorly drained Wainola soils in depressions. These soils make up about S to 10 percent of the map unit.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled

equipment, especially during dry periods. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Aspen and red pine are the dominant cover types. Species preference can be managed by selective cutting. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that conserve moisture, maintain the organic matter content, and help to control soil blowing. Examples are buffer strips, vegetative barriers, field windbreaks, small grain crops, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or pad of the crop residue on the surface.

This soil is well suited to pasture. Overgrazing during dry periods can destroy the plant cover. Proper stocking rates, rotation grazing, strip grazing and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soil is unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is SS, the land capability classification is IIIs, and the Michigan soil management group is 4a. The primary habitat type is TM, and the secondary habitat type is TMV.

91D—Rousseau fine sand, 6 to 15 percent slopes.

This very deep, gently rolling and rolling soil is on the sides of ridges and knolls. Individual areas are elongated or irregularly shaped and range from S to 100 acres in size.

Typically, the surface is covered by about 1 inch of well-decomposed leaf litter. The surface layer is dark brown fine sand about 1 inch thick. The subsurface layer is brown fine sand about 3 inches thick. The subsoil is fine sand about 22 inches thick. The upper part is dark brown and strong brown and is very friable. The lower part is yellowish brown and is loose. The substratum to a depth of about 60 inches is brownish yellow fine sand.

Permeability is rapid. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Landings can be located in the small nearly level areas that may be included in this unit. The modality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. Aspen and red pine are the dominant cover types. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means helps to control competing vegetation.

This soil is fairly well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity and the slope. It is generally unsuited to sewage lagoons because of seepage. It soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines across the slope generally helps to ensure that the absorption field functions properly.

The woodland ordination symbol is 5S, the land capability classification is IIe, and the Michigan soil management group is 4a. The primary habitat type is TM, and the secondary habitat type is TMV.

91E—Rousseau fine sand, 15 to 35 percent slopes.

This very deep, well drained, rolling to steep soil is on ridges and knolls. Individual areas are elongated or irregularly shaped and range from 10 to 200 acres in size.

Typically, the surface is covered by about 1 inch of well-decomposed leaf litter. The surface layer is dark brown fine sand about 1 inch thick. The subsurface layer is brown fine sand about 3 inches thick. The subsoil is fine sand about 22 inches thick. The upper part is dark brown and stron9 brown and is very friable. The lower part is yellowish brown and is loose. The substratum to a depth of about 60 inches is brownish yellow tine sand.

Permeability is rapid. The available water capacity is low. Surface runoff is slow or medium.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and seedling mortality. The use of equipment is limited because of the slope. Logging roads and skid trails should be constructed in the less sloping areas or on ridge tops. Constructing the roads and skid trails on the contour can minimize erosion. Loose sand can interfere with the traction of wheeled equipment. The number of suitable landing sites is severely limited by the slope. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The slope hinders site preparation and planting. Aspen and red pine are the dominant cover types. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. This soil is generally unsuited to building site development because of the slope. Ills generally unsuited to septic tank absorption fields and sewage lagoons because of seepage, a poor filtering capacity, and the slope.

The woodland ordination symbol is SR, the land capability classification is VIIe, and the Michigan soil management group is 4a. The primary habitat type is TM, and the secondary habitat type is TMV.

92A—Biscuit very fine sandy loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained, nearly level soil is on low plains and knolls. Individual areas are elongated or irregularly shaped and range from 5 to 325 acres in size.

Typically, the surface layer is dark gray very fine sandy loam about 10 inches thick. The subsurface layer is pinkish gray very fine sandy loam about 1 inch thick. The subsoil is about 20 inches thick. The upper part is dark reddish brown, yellowish red, and brown, mottled, friable loamy very fine sand and very fine sandy loam; the next part is reddish brown and brown, friable silt loam; and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of about 60 inches is reddish brown clay. It has thin bands of light gray silt. In places, the surface layer is loamy very fine sand or very fine sand.

Included with this soil in mapping are small areas of the poorly drained Gogomain and somewhat poorly drained Rudyard soils. Gogomain soils are in depressions and drainage ways. Rudyard soils are clayey throughout. They are in landscape positions similar to those of the Biscuit soil. Also included are small areas of the poorly drained, clayey Soo soils in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the loamy upper part of the Biscuit soil and very slow in the clayey lower part. The available water capacity is moderate. Surface runoff is slow. The soil has a perched seasonal high water table at a depth of 0.5 foot to 1.5 feet from late fall to late spring. The potential for frost action is high.

Most areas are used as woodland. Some small areas are used as cropland or pasture. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, the wind throw hazard, seedling mortality, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Landings can be used only when the soil is dry or frozen. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Because of the wetness, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. The aspen cover type is dominant on this soil. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods and help to control soil blowing. Shallow surface ditches and a subsurface drainage system can help to remove excess water. Tile lines should be protected with suitable material and installed on a self-cleaning grade so that they do not become clogged with very fine sand and silt. Adding organic material, planting small grain crops or hay, and applying a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface can improve soil structure and permeability and help to control soil blowing. Working the soil when it is wet can result in surface compaction and the formation of ruts.

This soil is well suited to pasture. Overgrazing or grazing when the soil is wet causes surface compaction and destroys forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the wetness and a high shrink-swell potential. It is generally unsuited to septic tank absorption fields because of the wetness and the very slow permeability and to sewage lagoons because of the wetness and seepage.

The woodland ordination symbol is 2W, the land capability classification is IIIw, and the Michigan soil management group is 3/1 b. The primary habitat type is TMC, and the secondary habitat type is TMC-D.

93F - Ontonagon-Pickford complex, 0 to 50 percent slopes.

This map unit consists of a very deep, steep and very steep, well drained Ontonagon soil on side slopes in ravines and in drainage ways and a very deep, nearly level, poorly drained Pickford soil on the bottom of the ravines. The Pickford soil is frequently ponded and is occasionally flooded. Perennial and intermittent streams are on the bottom of the ravines. Individual areas of this unit are elongated or irregularly shaped and range from 10 to 500 acres in size. They are 60 to 80 percent Ontonagon soil and 15 to 30 percent Pickford soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Ontonagon soil has a surface layer of dark brown silt loam about 7 inches thick. The subsoil is about 25 inches thick. The upper part is reddish brown and brown, friable silty clay and silt loam, and the lower part is reddish brown and grayish brown, firm clay. The substratum to a depth of about 60 inches is reddish brown and grayish brown, varved clay. In some places, it is stratified with thin bands of silt loam and silty clay loam. In other places the surface layer is loam or silty clay loam.

Typically, the Pickford soil has a surface layer of very dark gray silty clay loam about 8 inches thick. The subsurface layer is dark gray, mottled silty clay loam about 2 inches thick. The subsoil is about 14 inches of weak red, mottled, firm and very firm silty clay and clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In places, the surface layer is fine sand or fine sandy loam.

Included with these soils in mapping are small areas of the well-drained Sugar and somewhat poorly drained Rudyard soils. Sugar soils have a loamy surface layer and subsoil. They are on the slope breaks and side slopes of ravines and in drainage ways. Rudyard soils are along the foot slopes of ravines and on slope breaks at the top of ravines. Included soils make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Ontonagon and Pickford soils, and the available water capacity is moderate. Surface runoff is rapid on the Ontonagon soil and very slow or ponded on the Pickford soil. The Pickford soil has a perched seasonal high water table 1 foot above to 1 foot below the surface from tall to early summer.

These soils are used as woodland. The major management concerns are the equipment limitation, the erosion hazard, the wind throw hazard, seedling mortality, and plant competition. Access is limited by the slope and the wet ravine bottoms. The ravine bottoms are generally too wet and narrow for logging roads. Equipment cannot be operated safely on the steep and very steep side slopes. Disturbed areas are subject to erosion. Special logging methods, such as yarding with a cable, *may* be needed to minimize erosion. Logging roads and skid trails can be located in nearby areas that are better suited. Because of the wetness, trees on the Pickford soil in ravine bottoms are shallow rooted. Some may be blown down during periods of high winds. If trees are planted in the sloping areas, selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. After the over story has been removed, plant competition can be controlled by mechanical or chemical means. Aspen and northern hardwoods are the dominant cover types.

These soils are generally unsuited to building site development and septic tank absorption fields because of the slope and the restricted permeability in areas of the Ontonagon soil and the flooding, the ponding, and the restricted permeability in areas of the Pickford soil. The Ontonagon soil is generally unsuited to sewage lagoons because of the slope, and the Pickford soil is generally unsuited because of the flooding and the ponding.

The woodland ordination symbols are 2R and 6W, the land capability classification is VIIe, and the Michigan soil management groups are Qa and ic. The primary habitat type is TAM, and the secondary habitat type is TTP.

94A—Markey-Kinross-Au Gres complex, 0 to 3 percent slopes.

This map unit consists of very deep, nearly level, very poorly drained Markey, poorly drained Kinross, and somewhat poorly drained Au Gres soils. The Markey and Kinross soils are in depressions and drainage ways. They are frequently ponded. The Au Gres soil is on low knolls and ridges. Individual areas of this unit are irregular in shape and range from 5 to several thousand acres in size. They are 40 to 60 percent Markey soil, 25 to 45 percent Kinross soil, and 10 to 25 percent Au Gres soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Markey soil has a surface layer of dark reddish brown mucky peat about 3 inches thick. Below this is black, dark brown and dark reddish brown muck about 30 inches thick. The substratum to a depth of about 60 inches is brown sand. In places, the surface layer is mucky peat.

Typically, the Kinross soil has a surface layer of black muck about 5 inches thick. The subsurface layer is brown sand about 5 inches thick. The subsoil is dark brown and brown, mottled, very friable and loose sand about 32 inches thick. The substratum to a depth of about 60 inches is grayish brown sand.

Typically, the Au Gres soil is covered by about 1 inch of well-decomposed leaf litter and live roots. The surface layer is black sand about 1 inch thick. The subsurface layer is pinkish gray sand about 4 inches thick. The subsoil is mottled sand about 19 inches thick. The upper part is yellowish red and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is brownish yellow and light yellowish brown, mottled sand.

Included with these soils in mappin9 are small areas of the very poorly drained Carbondale and moderately well drained Croswell and Halfaday soils. Carbondale soils have more than 51 inches of muck. They are in landscape positions similar to those of the Markey soil. Croswell and Halfaday soils are on ridges and knolls. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic layers of the Markey soil and rapid in the sandy substratum. It is rapid in the Au Gres and Kinross soils. The available water capacity is high in the Markey soil and low in the Au Gres and Kinross soils. Surface runoff is very slow or ponded on the Kinross and Markey soils and slow on the Au Gres soil. The Markey and Kinross soils have a seasonal high water table 1 foot above to 1 foot below the surface from fall to summer, and the Au Ores soil has one at a depth of 0.5 foot to 1.5 feet from late fall to late spring.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness and the instability of the muck, trees can be logged only during periods in winter when logging roads are frozen. Year-round logging roads should be built in the drier areas. They require fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited. The landings can be used only during periods when the ground is frozen. Because of the wetness, trees on these soils are shallow rooted. Many may be blown down during periods of high winds and excessive wetness. Aspen and swamp conifers are the dominant cover types on these soils. Clear cutting and strip cutting are common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on these soils because of the wetness, seedling mortality, and plant competition.

The Markey soil is generally unsuited to building site development and septic tank absorption fields because of the ponding, low strength, and subsidence. The Au Gres and Kinross soils are poorly suited to building site development because of the wetness and the ponding and are generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity. The soils are generally unsuited to sewage lagoons because of the ponding and seepage.

The woodland ordination symbols are 7W, 2W, and 6W; the land capability classification is VIw; and the Michigan soil management groups are M/4c, 5c, and Sb. The primary habitat type is TTS, and the secondary habitat type is TMC.

95A—Bowers silt loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained, nearly level soil is on broad plains. Individual areas are irregular in shape and range from 5 to 800 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is about 18 inches thick. It is mottled and firm. The upper part is reddish brown silty clay loam, and the lower part is brown and pinkish gray, stratified silty clay loam and silt loam. The substratum to a depth of about 60 inches is brown and reddish brown, mottled, stratified silty clay loam and silt loam.

Included with this soil in mapping are small areas of the poorly drained Soo soils in depressions and drainage ways. Also included are the somewhat poorly drained Rudyard and Allendale soils. These soils are in landscape positions similar to those of the Bowers soil. Rudyard soils contain more clay

than the Bowers soil. Allendale soils have a sandy surface layer and subsoil. Included soils make up about 5 to 15 percent of the map unit.

Permeability is slow in the Bowers soil. The available water capacity is high. Surface runoff is slow. A perched seasonal high water table is at a depth of 1 to 2 feet from late fall to late spring. The potential for frost action is high.

Most areas are used as cropland or pasture. Some are wooded. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to expose tree roots, alter soil structure, and restrict lateral drainage. Year-round logging roads should be graveled. Culverts are needed. The use of landing sites is restricted to periods when the soil is dry or frozen. Landings may need to be stabilized so that they can withstand the repeated use of heavy equipment. Because of the wetness, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness. The aspen cover type is dominant on this soil. Clear cutting is common. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods and that maintain tilth. Shallow surface ditches can help to remove excess water if adequate outlets are available. A subsurface drainage system can help to lower the water table. Erosion-control structures may be needed where surface ditches enter outlet drainage ways. When the soil is wet, ruts form easily and the load-bearing capacity is low. Tilling when the soil is at the proper moisture content helps to minimize surface compaction and maintain good soil structure. Returning crop residue to the soil, adding organic material, and applying a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface can improve tilth and increase the content of organic matter.

This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet causes surface compaction and destroys forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the wetness. It is generally unsuited to septic tank absorption fields because of the wetness and the slow permeability. It is poorly suited to sewage lagoons because of the wetness. Buildings without basements can be constructed on well-compacted, coarse textured fill, which can raise the level of the site above the seasonal high water table. If outlets are available, subsurface drains can be installed around the foundation to remove excess water. Suitable filtering material is needed to keep fine sand and silt from plugging the tile lines.

The woodland ordination symbol is 7W, the land capability classification is IIw, and the Michigan soil management group is 1 .5b. The primary habitat type is
TTP.

96B—Velvet-Westbury complex, 0 to 6 percent slopes.

This map unit consists of a very deep, level and undulating, moderately well drained Velvet soil on low knolls and uplands and a very deep, nearly level, somewhat poorly drained Westbury soil in depressions. Stones and boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 120 to less than 3 feet apart. Individual areas of this unit are irregular in shape and range from 5 to 170 acres in size. They are 40 to 60 percent Velvet soil and 30 to 50 percent Westbury

soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Velvet soil is covered by about 2 inches of well-decomposed leaf litter. The surface layer is grayish brown very stony loamy sand about 3 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown and strong brown, very friable and loose very stony and very cobbly loamy sand. The lower part is grayish brown and reddish brown, mottled, very firm gravelly loamy sand and gravelly fine sandy loam. The substratum to a depth of about 60 inches is brown gravelly fine sandy loam. In places, the surface layer is the cobbly, gravelly, very cobbly, or very gravelly analogs of sand and loamy fine sand or cobbly, gravelly, or very gravelly loamy sand.

Typically, the Westbury soil is covered by about 3 inches of leaf litter. The surface layer is reddish gray, very stony fine sandy loam about 1 inch thick. The subsoil is about 44 inches thick. It is mottled. The upper part is dark brown and dark yellowish brown, friable cobbly silt loam and gravelly fine sandy loam. The lower part is light brown and brown, very firm very gravelly sandy loam. The substratum to a depth of about 60 inches is light brown, mottled very gravelly sandy loam.

Included with these soils in mapping are small areas of the somewhat poorly drained Rudyard and poorly drained Ermatinger soils. Rudyard soils are clayey throughout. They are in landscape positions similar to those of the Velvet and Westbury soils. Ermatinger soils are in depressions. Also included are areas of extremely stony or bouldery soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the upper part of the Velvet soil, very slow in the dense, very firm middle part, and moderate in the substratum. Ills very slow in the very firm subsoil of the Westbury soil and moderate in the rest of the profile. From fall to late spring, a perched seasonal high water table is at a depth of 1 to 2 feet in the Velvet soil and at a depth of 0.5 foot to 1.5 feet in the Westbury soil. The available water capacity is low in both soils. Surface runoff is slow. The potential for frost action is high in the Westbury soil.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. The use of equipment is limited by the wetness and the stony surface. The upper part of the subsoil is saturated during wet periods. Equipment should be used only when the soils are dry or have an adequate snow cover. Landings should be located in the higher, drier areas. Large stones on the surface can reduce the operating speed of skidders or tractors, result in equipment damage, and hinder the construction of logging roads or skid trails. Because of the dense, firm layer and the wetness, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. Aspen and northern hardwoods are the dominant cover types. Clear cutting is common. Tree planting is limited because of the large number of stones on the surface. If trees are planted, selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. After the over story has been removed, plant competition can be controlled by mechanical or chemical means.

These soils are poorly suited to pasture. In most areas, the stones on the surface make seedbed preparation and pasture improvement difficult. If feasible, removing the stones can improve the pasture. Proper stocking rates, rotation grazing, and restricted grazing during dry periods or wet periods can help to keep the pasture in good condition.

Because of the wetness and the large stones, these soils are poorly suited to buildings without basements and are generally unsuited to buildings with basements. They are poorly suited to septic tank absorption fields because of the restricted permeability in the dense, firm layers and because of the wetness and the large stones. They are generally unsuited to sewage lagoons because of seepage, the

wetness, and the large stones. Buildings without basements can be constructed on well-compacted fill material, which can raise the site above the high water table. The large stones can cause construction problems. The restricted permeability and the wetness can be overcome on sites for septic tank absorption fields by breaking up the dense, firm layer and by mounding with suitable fill material.

The woodland ordination symbols are 3X and 3W, the land capability classification is VIs, and the Michigan soil management groups are Ga and Gbc. The primary habitat type is TM.

97A—Wega very fine sandy loam, 0 to 3 percent slopes.

This very deep, nearly level, somewhat poorly drained soil is on broad flats on former glacial flood plains. Individual areas are irregularly shaped or elongated and range from 5 to 900 acres in size.

Typically, the surface layer is very dark grayish brown very fine sandy loam about 9 inches thick. The substratum extends to a depth of about 60 inches. It is mottled. The upper part is light yellowish brown, pale brown and brown fine sandy loam; the next part is strong brown and pale brown loamy very fine sand; and the lower part is pale brown and dark gray very fine sandy loam.

Included with this soil in mapping are small areas of the poorly drained Ermatinger soils in the slightly lower landscape positions. These soils make up about 5 to 10 percent of the map unit.

Permeability is moderately slow in the Wega soil. The available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall to late spring.

Most areas are woodland or are abandoned farmland that is reverting to woodland. Some are used as cropland.

The major concerns in managing woodland are the equipment limitation, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to periods when the soil is dry or has an adequate snow cover. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed to maintain the natural drainage system. Landings can be used only when the soil is dry or frozen. Because of the wetness, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on this soil, but an area of northern hardwoods is included in the Dunbar Experimental Forest. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management concern is removing excess water during wet periods. A surface drainage system can reduce the wetness if adequate outlets are available. A subsurface drainage system can help to lower the water table. Tile lines should be protected with suitable material and installed on a self-cleaning grade so that they do not become clogged with fine sand and silt.

This soil is well suited to pasture and hay. The forage species that are tolerant of wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development and septic tank absorption fields because of the wetness. A surface or subsurface drainage system helps to lower the water table on sites for buildings. The buildings can be constructed on well-compacted fill material, which can raise the level of the site. If a septic tank disposal system is installed, filling or mounding the absorption field with suitable material can raise the site above the seasonal high water table.

The woodland ordination symbol is 3W, the land capability classification is IIw, and the Michigan soil management group is 2.5b. No habitat type is assigned.

98—Ermatinger silt loam.

This very deep, nearly level, poorly drained soil is on broad flats on former glacial flood plains. It is frequently ponded. Individual areas are irregular in shape and range from 5to 1,100 acres in size.

Typically, the surface layer is black silt loam about 8 inches thick. The substratum extends to a depth of about 60 inches. It is mottled. The upper part is grayish brown silt loam, and the lower part is gray and brown very fine sandy loam and loamy very fine sand. In some places, mucky layers or decaying vegetation is in the lower part of the substratum. In other places, the surface layer is very fine sandy loam, loamy very fine sand, or the mucky analogs of those textures.

Included with this soil in mapping are small areas of the somewhat poorly drained Wega soils on the slightly higher flats. These soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in the Ermatinger soil. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.

Most areas are used as cropland or pasture. Some are wooded. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed. The number of suitable landing sites is severely limited because of the wetness. Because of the wetness, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, and plant competition.

This soil is generally unsuited to cropland, but such crops as oats, barley, wheat, and a mixture of grasses and legumes can be grown. The major management need is removing excess water during wet periods. Surface drains can remove the water if adequate outlets are available. Equipment can be used only during dry periods. A subsurface drainage system can help to lower the water table. Tile lines should be protected with suitable material and installed on a self-cleaning grade so that they do not become clogged with fine sand and silt. When the soil is wet, ruts form easily and the load-bearing capacity is low. This soil is poorly suited to pasture. The forage species that are tolerant of wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to building site development and to septic tank absorption fields and sewage lagoons because of the ponding.

The woodland ordination symbol is 2W, the land capability classification is Vw, and the Michigan soil management group is 2.5c. The primary habitat type is TAM-Eq.

99A—Westbury stony fine sandy loam, 0 to 3 percent slopes.

This very deep, nearly level, somewhat poorly drained soil is on low knolls and upland flats. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are irregularly shaped or elongated and range from 5 to 150 acres in size.

Typically, the surface is covered by about 3 inches of leaf litter. The surface layer is reddish gray stony fine sandy loam about 1 inch thick. The subsoil is about 44 inches thick. It is mottled. The upper part is dark brown and dark yellowish brown, friable cobbly silt loam and gravelly fine sandy loam. The lower

part is light brown and brown, very firm very gravelly sandy loam. The substratum to a depth of about 60 inches is light brown, mottled very gravelly sandy loam. In places, the surface layer is loamy sand, sandy loam, the gravelly or cobbly analogs of those textures, or gravelly or cobbly fine sandy loam.

Included with this soil in mapping are small areas of the poorly drained Pickford soils in depressions and along the edges of the unit and small areas of the moderately well drained Velvet soils in the slightly higher landscape positions. Also included are small areas of the very stony Westbury soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is very slow in the dense, firm middle part of the Westbury soil and moderate in the rest of the profile. The available water capacity is low. Surface runoff is slow. A perched seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall to late spring. The potential for frost action is high.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. The use of equipment is limited by the wetness and the stony surface. The upper part of the subsoil is saturated during wet periods. Equipment should be used only during dry summer months or during winter months when the snow cover is adequate. Landings can be used only when the soil is dry or frozen. Large stones on the surface can reduce the operating speed of skidders or tractors and can result in equipment damage. Because of the dense, firm layer and the wetness, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. The opportunities for planting are limited on this soil because of the wetness, the stones on the surface, severe seedling mortality, and plant competition. If seedlings are planted, selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Furrowing before planting also can increase the seedling survival rate. After the over story has been removed, plant competition can be controlled by mechanical or chemical means.

This soil is poorly suited to building site development because of the wetness and the stoniness. It is generally unsuited to septic tank absorption fields because of the wetness, the stoniness, and the restricted permeability in the dense, firm layer.

The woodland ordination symbol is 3W, the land capability classification is VIIs, and the Michigan soil management group is Gbc. No habitat type is assigned.

10l—Chippeny muck.

This moderately deep and deep, very poorly drained, nearly level soil is in depressions and on low, broad plains. It is frequently ponded. Individual areas are irregular in shape and range from 3 to 90 acres in size.

Typically, the surface layer is black muck about 20 inches thick. The next layer is dark brown muck about 5 inches thick. The substratum to a depth of about 35 inches is gray very gravelly sandy loam. Limestone bedrock is at a depth of about 35 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Ensign soils on low knolls. Also included are small areas of the poorly drained Ruse soils in landscape positions similar to those of the Chippeny soil. Ruse soils have a mucky surface layer that is thinner than that of the Chippeny soil. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderately slow in the upper organic layers of the Chippeny soil and slow to moderate in the lower loamy layers. The available water capacity is high. Surface runoff is very slow or ponded. The water table is 1 foot above to 1 foot below the surface from fall to summer and seldom drops below a depth of 1 foot. The potential for frost action is high.

This soil is used as woodland. The major management concerns are the equipment limitation,

seedling modality, the wind throw hazard, and plant competition. Because of the wetness and the instability of the muck, trees can be logged only during periods in winter when logging roads are frozen. The swamp conifer cover type is dominant on this soil. Clear cutting is common. Because of the wetness and the depth to bedrock, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. After the trees are cut, competition from wetland brush can prevent or delay natural regeneration. Trees generally are not planted on this soil because of severe seedling mortality, the wetness, and severe plant competition.

This soil is generally unsuited to building site development because of the ponding and low strength. It is generally unsuited to septic tank absorption fields because of seepage, the ponding, and the depth to bedrock and to sewage lagoons because of seepage, excess humus, and the ponding.

The woodland ordination symbol is 4W, the land capability classification is VIIw, and the Michigan soil management group is M/Rc. No habitat type is assigned.

102—Kinross-Dawson complex.

This map unit consists of very deep, nearly level, poorly drained Kinross and very poorly drained Dawson soils in depressions and on low plains that have very low ridges. These soils are frequently ponded. Individual areas are irregular in shape and range from 10 to 600 acres in size. They are 35 to 55 percent Kinross soil and 25 to 45 percent Dawson soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Kinross soil has a surface layer of black muck about 5 inches thick. The subsurface layer is brown sand about 5 inches thick. The subsoil is dark brown and brown, mottled, very friable and loose sand about 32 inches thick. The substratum to a depth of about 60 inches is grayish brown sand.

Typically, the Dawson soil has a surface layer of yellowish brown sphagnum moss about 6 inches thick. Below this is dark reddish brown muck about 12 inches thick. The upper part of the substratum is dark brown and pinkish gray fine sand about 1 inch thick. The lower part to a depth of about 60 inches is dark reddish brown and dark brown loamy fine sand and fine sand. In places, the organic layers are more than 51 inches thick.

Included with these soils in mapping are small areas of the somewhat poorly drained Wainola and moderately well drained Croswell soils on low knolls and ridges. These included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the Kinross soil. It is moderately slow to moderately rapid in the organic layers of the Dawson soil and rapid in the sandy substratum. The available water capacity is low in the Kinross soil and high in the Dawson soil. Surface runoff is very slow or ponded on both soils. The water table is 1 foot above to 1 foot below the surface of both soils from fall to early summer. It seldom drops below a depth of 1 foot. The potential for frost action is high in the Dawson soil.

These soils are used as woodland. Some areas support native bog vegetation and a few trees. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Logging is extremely limited because of the wetness and the instability of the organic material. In areas where the muck is less than 16 inches deep, access is limited to dry summer months or to winter months when the snow cover is adequate. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on these soils are shallow rooted. Many may be blown down during periods of high winds. The swamp conifer cover type is dominant on the Kinross soil. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on these soils because of the wetness, severe seedling mortality, plant competition, and low productivity.

These soils are generally unsuited to building site development because of the ponding and low strength. They are generally unsuited to septic tank absorption fields because of the ponding, a poor filtering capacity, the restricted permeability, and excess humus and to sewage lagoons because of seepage, excess humus, and the ponding.
The woodland ordination symbol is 2W, the land capability classification is VIw, and the Michigan soil management groups are 5c and Mo-a. The primary habitat type is TTS, and the secondary habitat type is Pos.

103D—Velvet-Rockbottom complex, 6 to 15 percent slopes.
These very deep, gently rolling and rolling, moderately well drained soils are on side slopes along the shoreline of Sugar Island. Stones and boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 120 to less than 3 feet apart. Individual areas of this unit are elongated and range from 20 to 250 acres in size. They are 40 to 60 percent Velvet soil and 30 to 50 percent Rockbottom soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical. Typically, the Velvet soil is covered by about 2 inches of well-decomposed leaf litter. The surface layer is grayish brown very stony loamy sand about 3 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown and strong brown, very friable and loose very stony and very cobbly loamy sand. The lower part is grayish brown and reddish brown, mottled, very firm gravelly loamy sand and gravelly fine sandy loam. The substratum to a depth of about 60 inches is brown gravelly fine sandy loam. In places, the surface layer is the gravelly, cobbly, very gravelly, or very cobbly analogs of sand or loamy fine sand or cobbly, gravelly, or very gravelly loamy sand.
Typically, the Rockbottom soil has a surface layer of very dark grayish brown stony silt loam about 6 inches thick. The next layer is mixed, very dark gray and dark grayish brown stony silt loam about 4 inches thick. The subsoil is about 19 inches thick. The upper part is brown, firm silty clay loam, and the lower part is brown, mottled, friable extremely cobbly sandy clay loam. The substratum to a depth of about 60 inches is pale brown, very cobbly fine sandy loam and very gravelly fine sandy loam. In places, the surface layer and subsoil are clay. In some areas, the substratum is sand.
Included with these soils in mapping are small areas of the moderately well drained Ontonagon and somewhat poorly drained Rudyard soils. These included soils are clayey throughout. Ontonagon soils are in landscape positions similar to those of the Velvet and Rockbottom soils, and Rudyard soils are in shallow depressions and drainage ways. Also included are small areas of the extremely stony or bouldery Velvet and Rockbottom soils. Included soils make up about 5 to 20 percent of the map unit.
Permeability is rapid in the upper part of the Velvet soil, very slow in the dense, very firm middle part, and moderate in the substratum. It is moderately slow in the upper part of the Rockbottom soil and moderate in the lower part. The available water capacity is low in the Velvet soil and moderate in the Rockbottom soil. Surface runoff is slow on the Velvet soil and medium on the Rockbottom soil. A perched seasonal high water table is at a depth of 1 to 2 feet in both soils from late fall to late spring.
These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Large stones on the surface can reduce the operating speed of skidders or tractors, result in equipment damage, and hinder the construction of logging roads. Traffic ability may be briefly limited in spring, in fall, and in other excessively wet periods. When the soils are wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Year-round logging roads should be graveled. Landings can be located in the small nearly level areas of this unit, if available, or in the nearly level adjacent areas. Because of the dense, firm layer, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. Aspen and northern

hardwoods are the dominant cover types. Species preference can be managed by selective cutting. Trees generally are not planted on these soils because of the large number of stones on the surface.

These soils are poorly suited to building site development because of the wetness and the large stones. The slope also is a limitation in areas where it exceeds 8 percent. The building site should be raised, and a drainage system should be installed to remove excess water. The foundation trench should be widened and backfilled with suitable material. The large stones can cause construction problems. The soils are generally unsuited to septic tank absorption fields because of the wetness, the restricted permeability, and the large stones and to sewage lagoons because of the slope, the large stones, and the wetness.

The woodland ordination symbol is 3X, the land capability classification is VIs, and the Michigan soil management groups are Ga and 2.5a. The primary habitat type is TM.

103E—Velvet-Rockbottom complex, 15 to 35 percent slopes.

This map unit consists of very deep, rolling to steep, well-drained Velvet and Rockbottom soils on side slopes along the shoreline of Sugar Island. Stones and boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 120 to less than 3 feet apart. Individual areas of this unit are elongated and range from 20 to 80 acres in size. They are 40 to 60 percent Velvet soil and 30 to 50 percent Rockbottom soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Velvet soil is covered by about 2 inches of well-decomposed leaf litter. The surface layer is grayish brown very stony loamy sand about 3 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown and strong brown, very friable and loose very cobbly loamy sand. The lower part is grayish brown and reddish brown, very firm gravelly loamy sand and gravelly fine sandy loam. The substratum to a depth of about 60 inches is brown gravelly fine sandy loam. In places, the surface layer is the cobbly, gravelly, very cobbly, or very gravelly analogs of sand and loamy fine sand or cobbly, gravelly, or very gravelly loamy sand.

Typically, the Rockbottom soil has a surface layer of very dark grayish brown stony silt loam about 6 inches thick. The next layer is mixed, very dark gray and dark grayish brown stony silt loam about 4 inches thick. The subsoil is about 19 inches thick. The upper part is brown, firm silty clay loam, and the lower part is brown, friable extremely cobbly sandy clay loam. The substratum to a depth of about 60 inches is pale brown, very cobbly fine sandy loam and very gravelly fine sandy loam. In places, the surface layer and subsoil are clay. In some areas, the substratum is sand.

Included with these soils in mapping are small areas of the well-drained Ontonagon soils. These included soils are clayey throughout. They are in landscape positions similar to those of the Velvet and Rockbottom soils. Also included are small areas of the extremely stony or bouldery Velvet and Rockbottom soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the upper part of the Velvet soil, very slow in the dense, very firm middle part, and moderate in the substratum. It is moderately slow in the upper part of the Rockbottom soil and moderate in the lower part. The available water capacity is low in the Velvet soil and moderate in the Rockbottom soil. Surface runoff is slow on the Velvet soil and rapid on the Rockbottom soil.

These soils are used as woodland. The major management concerns are the equipment limitation, the erosion hazard, seedling modality, the wind throw hazard, and plant competition. The use of equipment is limited because of the slope. Logging roads and skid trails should be constructed in the less sloping areas or on ridge tops. Constructing the roads and skid trails on the contour can minimize erosion. Large stones on the surface can reduce the operating speed of skidders or tractors, result in equipment damage, and hinder the construction of logging roads. Traffic ability may be briefly limited in spring,

in fall, and in other excessively wet periods. When the soils are wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Year-round logging roads should be graveled. Because of the dense, firm layer, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. Aspen and northern hardwoods are the dominant cover types. Species preference can be managed by selective cutting. Trees generally are not planted on these soils because of the large number of stones on the surface.

These soils are generally unsuited to building site development because of the slope and the large stones. They are generally unsuited to septic tank absorption fields because of the slope, the large stones, and the restricted permeability and to sewage lagoons because of the slope, the large stones, and seepage. The woodland ordination symbol is 3R, the land capability classification is VIs, and the Michigan soil management groups are Ga and 2.5a. The primary habitat type is TM.

104B—Amasa very fine sandy loam, 0 to 6 percent slopes.

This very deep, well-drained, nearly level and undulating soil is on upland flats and ridge tops. Individual areas are irregular in shape and range from 5 to 800 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is black very fine sandy loam about 1 inch thick. The subsurface layer is dark reddish gray very fine sandy loam about 4 inches thick. The subsoil is about 17 inches thick. It is friable. The upper part is dark reddish brown and dark brown very fine sandy loam, and the lower part is strong brown fine sandy loam. The substratum to a depth of about 60 inches is strong brown sand. In some places, the substratum is mottled. In other places, the surface layer is fine sandy loam or silt loam.

Included with this soil in mapping are small areas of the well-drained Rousseau and moderately well drained Sugar soils. These soils are in landscape positions similar to those of the Amasa soil. Rousseau soils are fine sand throughout. Sugar soils have a clayey substratum. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the loamy upper part of the Amasa soil and very rapid in the sandy substratum. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. A few small areas are used as pasture or cropland.

The major concerns in managing woodland are the equipment limitation and plant competition. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management concern is controlling water erosion. Grassed waterways, small grain crops, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface help to control erosion. This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet can cause surface compaction, destroy forage plants, and increase the susceptibility to erosion. Proper stocking rates, rotation grazing, strip grazing, and restricted use during wet periods can help to keep the pasture in good condition and prevent excessive erosion.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soil is generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 3L, the land capability classification is IIe, and the Michigan soil management group is 3/5a. The primary habitat type is ATD, and the secondary habitat type is AVO.

104D—Amasa very fine sandy loam, 6 to 15 percent slopes.

This very deep, well-drained, gently rolling and rolling soil is on the sides of ridges and knolls. Individual areas are irregularly shaped or elongated and range from 5 to 80 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is black very fine sandy loam about 1 inch thick. The subsurface layer is dark reddish gray very fine sandy loam about 4 inches thick. The subsoil is about 17 inches thick. It is friable. The upper part is dark reddish brown and dark brown very fine sandy loam, and the lower part is strong brown fine sandy loam. The substratum to a depth of about 60 inches is strong brown sand. In places, the surface layer is fine sandy loam or silt loam.

Included with this soil in mapping are small areas of the well-drained Rousseau and Sugar soils. These soils are in landscape positions similar to those of the Amasa soil. Rousseau soils are tine sand throughout. Sugar soils have a clayey substratum. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the loamy upper part of the Amasa soil and very rapid in the sandy substratum. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation and plant competition. Traffic ability is briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soil is generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 3L, the land capability classification is IIe, and the Michigan soil management group is *315a.* The primary habitat type is ATD, and the secondary habitat type is AVG.

104F—Amasa very fine sandy loam, 25 to 50 percent slopes.

This very deep, well drained, steep and very steep soil is on ridges, knolls, and side slopes. Individual areas are irregularly shaped or elongated and range from 10 to 80 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is black very fine sandy loam about 1 inch thick. The subsurface layer is dark reddish gray very fine sandy loam about 4 inches thick. The subsoil is about 17 inches thick. It is friable. The upper part is dark reddish brown and dark brown very fine sandy loam, and the lower part is strong brown fine sandy loam. The substratum to a depth of about 60 inches is strong brown sand. In places, the surface layer is fine sandy loam or silt loam.

Included with this soil in mapping are small areas of the well-drained Rousseau and Sugar soils. These soils are in landscape positions similar to those of the Amasa soil. Rousseau soils are fine sand throughout. Sugar soils have a clayey substratum. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the loamy upper part of the Amasa soil and very rapid in the sandy substratum. The available water capacity is low. Surface runoff is rapid.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and plant competition. Access is limited by the slope. Special care is needed in laying out logging roads and in operating equipment. Constructing the roads and skid trails on the contour can minimize erosion. Special logging methods, such as yarding with a cable, may be needed to minimize surface disturbance. Erosion can result from the concentration of runoff on roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping road surfaces, culverts, and drop structures minimizes erosion. Landings should be located in the less sloping nearby areas. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Site preparation and planting are severely limited by the slope. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting.

This soil is generally unsuited to building site development because of the slope. It is generally unsuited to septic tank absorption fields because of the slope and a poor filtering capacity and to sewage lagoons because of seepage and the slope.

The woodland ordination symbol is 3R, the land capability classification is VIIe, and the Michigan soil management group is 3/5a. The primary habitat type is ATD, and the secondary habitat type is AVO.

106A—Potagannissing-Rock outcrop complex, 0 to 3 percent slopes.

This map unit consists of a shallow, nearly level, somewhat poorly drained Potagannissing soil and exposed limestone bedrock on large flats, benches, and ridge tops. The Rook outcrop generally occurs as flat areas of exposed bedrock, but vertical drops of 5 to 10 feet are common. Most areas of this unit are on the Maxton Plains on Drummond Island. The Maxton Plains is a unique grassland area where some rare plants are associated with soils that are shallow over limestone bedrock. Individual areas of this unit are irregular in shape and range from 5 to 1,000 acres in size. They are 30 to 60 percent Potagannissing soil and 20 to 70 percent Rock outcrop. The Potagannissing soil and Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Potagannissing soil has a surface layer of very dark gray gravelly silt loam about 4 inches thick. The substratum to a depth of about 7 inches is yellowish brown, mottled gravelly fine sandy loam. Limestone bedrock is at a depth of about 7 inches. In some places, the depth to bedrock is more than 10 inches. In other places, the soil is not mottled in the solum. In some areas, a thin layer of organic material overlies the surface layer.

Included with this unit in mapping are small areas of the well-drained Summerville soils in the slightly higher landscape positions. Also included are areas of the stony or flaggy Potagannissing soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in the Potagannissing soil. The available water capacity is very low. Surface runoff is slow. A perched seasonal high water table is at or within a depth of 0.5 foot from late fall to late spring. The potential for frost action is high.

This map unit is used as woodland. The major management concerns are the equipment limitation, seedling mortality, and the wind throw hazard. The exposed bedrock benches can interfere with the use of equipment and road construction and can hinder harvesting. When the soil is wet, ruts form easily. The ruts can alter natural soil drainage and cause ponding along roads. Because of the bedrock, trees on the Potagannissing soil are shallow rooted. Many may be blown down during periods of high winds. Aspen and swamp conifers are the dominant cover types. Trees generally are not planted because of severe seedling mortality, the wetness, the shallowness to bedrock, and the exposed bedrock.

The Potagannissing soil is generally unsuited to building site development, septic tank absorption fields, and sewage lagoons because of the shallowness to bedrock and the wetness.
The woodland ordination symbol assigned to the Potagannissing soil is 3W, the land capability classification is VIIs, and the Michigan soil management group is Rbc. No habitat type is assigned.

107B—Oldman stony fine sandy loam, 2 to 6 percent slopes.
This very deep, moderately well drained, nearly level and undulating soil is on side slopes and broad plains. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are irregular in shape and range from 10 to 700 acres in size.
Typically, the surface is covered by about 1 inch of well-decomposed leaf litter. The surface layer is black stony fine sandy loam about 4 inches thick. The subsurface layer is reddish gray stony fine sandy loam about 1 inch thick. The subsoil is about 55 inches thick. The upper part is dark reddish brown and strong brown, friable very cobbly fine sandy loam and very gravelly fine sandy loam; the next part is reddish brown, light reddish brown, and pinkish gray, mottled, firm very gravelly sandy loam and very gravelly fine sandy loam; and the lower part is pinkish gray and reddish brown, mottled, friable very gravelly fine sandy loam. In places the surface layer is sandy loam, loam, the cobbly or very cobbly analogs of those textures, fine sandy loam, or very cobbly fine sandy loam.
Included with this soil in mapping are small areas of the moderately well drained Ontonagon and somewhat poorly drained Westbury soils. Ontonagon soils are clayey throughout. They are in landscape positions similar to those of the Qidman soil. Wesibury soils are on the lower flats and in drainage ways. Included soils make up about 5 to 15 percent of the map unit.
Permeability is moderate in the upper part of the Oldman soil, very slow in the dense, very firm middle part, and moderately slow in the lower part. The available water capacity is low. Surface runoff is slow. A perched seasonal high water table is at a depth of 1 to 2 feet from late fall to late spring.
This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Large stones on the surface can reduce the operating speed of skidders or tractors, result in equipment damage, and hinder the construction of logging roads and skid trails. Equipment should be used only when the soil is dry or has adequate snow cover. During wet periods when the upper part of the subsoil is saturated, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Year-round logging roads require a gravel base. Because of the dense, firm layer, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. Trees generally are not planted on this soil because of the large number of stones on the surface.
Because of the wetness and the large stones, this soil is poorly suited to buildings without basements and is generally unsuited to buildings with basements. It is poorly suited to septic tank absorption fields because of the restricted permeability in the dense, firm layer and the wetness. It is generally unsuited to sewage lagoons because of the large stones and seepage. Buildings without basements can be constructed on well-compacted fill material, which can raise the site above the seasonal high water table. The large stones can cause construction problems. On sites for septic tank absorption fields, the restricted permeability and the wetness can be overcome by breaking up the dense, firm layer and by mounding the site with suitable fill material.
The woodland ordination symbol is 3X, the land capability classification is VIs, and the Michigan soil management group is Ga. The primary habitat type is AVO, and the secondary habitat type is ATD.

108D—Shelter-Alpena complex, 0 to 15 percent slopes.

This map unit consists of a very deep, nearly level, somewhat poorly drained Shelter soil and a very deep, gently rolling and rolling, excessively drained Alpena soil. These soils are on upland flats, ridges, and side slopes. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this unit are irregular in shape and range from 10 to 200 acres in size. They are 40 to 60 percent Shelter soil and 30 to 50 percent Alpena soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Shelter soil has a surface layer of black very stony loam about 4 inches thick. The next layer is very dark gray and dark brown very stony loam about 2 inches thick. The subsoil is light yellowish brown, mottled, friable very cobbly fine sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray, mottled very cobbly fine sandy loam. In some places, limestone bedrock is at a depth of about 40 to 60 inches. In other places, the surface layer is the cobbly, gravelly, very cobbly, or very gravelly analogs of loam or silt loam or cobbly, gravelly, or very gravelly loam.

Typically, the Alpena soil is covered by about 3 inches of partially decomposed leaf litter. The surface layer is very dark grayish brown very cobbly sandy loam about 4 inches thick. The subsoil is brown, very friable very cobbly fine sandy loam about 12 inches thick. The substratum to a depth of about 60 inches is pale brown extremely gravelly sand. In some places, loamy textures are in the lower part of the substratum. In other places, limestone bedrock is at a depth of about 40 to 60 inches. In some areas the surface layer is fine sandy loam, loam, or the gravelly, very gravelly, cobbly, or very cobbly analogs of those textures.

Included with these soils in mapping are small areas of the well-drained Posen soils on low knolls. Also included, along lakeshores, are small areas of the extremely stony or bouldery Shelter and Alpena soils. Included soils make up about 5 percent of the map unit.

Permeability is very slow in the Shelter soil and very rapid in the Alpena soil. The available water capacity is low in the Shelter soil and very low in the Alpena soil. Surface runoff is slow on both soils. The Shelter soil has a perched seasonal high water table at a depth of 0.5 to 1.0 foot from late fall to late spring. The potential for frost action is high in the Shelter soil.

These soils are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, seedling mortality, and plant competition. In the wetter areas, equipment should be used only during dry summer months or during winter months when the snow cover is adequate. In the wetter areas, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads require a gravel base. Large stones on the surface can hinder harvesting and planting and can result in equipment damage. Landings can be located in the nearly level, drier areas that may be included in this unit. Because of the firm substratum and the wetness, trees in the wetter areas are shallow rooted. They may be blown down during periods of high winds. Swamp conifers and aspen are the dominant cover types. Clear cutting is common. Trees generally are not planted on these soils because of the large number of stones on the surface.

The Shelter soil is generally unsuited to building site development because of the wetness and the large stones. It is generally unsuited to septic tank absorption fields because of the wetness, the slope, and the restricted permeability. The Alpena soil is fairly well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. The Alpena soil is generally unsuited to sewage lagoons because of seepage. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The woodland ordination symbols are 4X and 3F, the land capability classification is VIw, and the Michigan soil management groups are Gbc and Ga. No habitat type is assigned.

111—Gutport muck.

This moderately deep, very poorly drained, nearly lever soil is in depressions on low plains. It is frequently ponded. It occurs mainly on Drummond Island. Individual areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface is covered by dark reddish brown, live roots and sphagnum moss about 1 inch thick. The surface layer is black muck about 1 2 inches thick. The substratum is about 14 inches thick. The upper part is dark gray and gray silt loam and silty clay loam. The lower part is reddish brown and pinkish gray, mottled, varved silty clay. Limestone bedrock is at a depth of about 27 inches. In places, the muck surface layer is more than 16 inches thick.

Included with this soil in mapping are small areas of the shallow, somewhat poorly drained Potagannissing soils on low knolls and ridges. These soils make up about 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic material of the Gutport soil and slow in the clayey part of the substratum. The available water capacity is moderate. Surface runoff is very slow or ponded. The water table is 1 foot above to 1 foot below the surface from fall to summer and seldom drops below a depth of 1 foot. The potential for frost action is high.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness and the instability of the organic surface layer, trees can be logged only during periods in winter when logging roads are frozen. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. The swamp conifer cover type, with a large component of ash, is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Because of the high water table, the trees are shallow rooted. Many may be blown down during periods of high winds. Trees generally are not planted on this soil because of severe seedling mortality, the wetness, and severe plant competition.

This soil is generally unsuited to building site development because of the ponding and the depth to bedrock. It is generally unsuited to septic tank absorption fields because of the ponding, the depth to bedrock, and the restricted permeability and to sewage lagoons because of seepage, the depth to bedrock, and excess humus.

The woodland ordination symbol is 3W, the land capability classification is VIIw, and the Michigan soil management group is MIRe. No habitat type is assigned.

112—Soo silty clay loam.

This very deep, poorly drained, nearly level soil is on broad plains and in drainage ways and depressions. It is frequently ponded. Individual areas are irregular in shape and range from 5 to 1,000 acres in size.

Typically, the surface layer is very dark gray, mottled silty clay loam about 7 inches thick. The subsoil is dark brown, mottled, very firm silty clay loam about 10 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled silty clay loam. It has thin bands of pinkish gray silt loam. In places, the surface layer is loamy fine sand, fine sandy loam, silt loam, or the mucky analogs of those textures.

Included with this soil in mapping are small areas of the somewhat poorly drained Bowers and poorly drained Fibre soils. Bowers soils are on low knolls and ridges and on the slope breaks along streams and drainage ways. Fibre soils are in landscape positions similar to those of the Soo soil or are along the edges of drainage ways. They have a sandy surface layer and subsoil. Included soils make up about 5 to 1 5 percent of the map unit.

Permeability is slow in the Soo soil. The available water capacity is moderate. Surface runoff is very slow or ponded. A perched seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer. The potential for frost action is high.

Most areas are used as cropland or pasture. Some are used as woodland. Some areas of abandoned farmland are reverting to speckled alder and willow. The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled and culverts installed. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of severe seedling mortality, the wetness, and plant competition.

If drained, this soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. It is poorly suited to crops in undrained areas. The major management concerns are removing excess water during wet periods and maintaining tilth. Shallow surface ditches and subsurface drains can help to remove excess water if adequate outlets are available. Erosion-control structures may be needed where surface ditches enter drainage ways. Working the soil when it is wet results in surface compaction and the formation of clods. Tilling when the soil is at the proper moisture content can minimize surface compaction and maintain good soil structure. Additions of organic material and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface can minimize crusting and increase the rate of water infiltration.

This soil is well suited to pasture. Overgrazing or grazing when the soil is too wet can cause surface compaction and destroy forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the ponding. The shrink-swell potential also is a limitation. The soil is generally unsuited to septic tank absorption fields because of the ponding and the restricted permeability. Buildings should be constructed on well-compacted, coarse textured fill, which can raise the level of the site. Widening and backfilling foundation trenches with suitable coarse textured material helps to prevent the damage caused by shrinking and swelling. Excess water should be removed from the site. The soil is generally unsuited to sewage lagoons because of the ponding.

The woodland ordination symbol is 6W, the land capability classification is IIw, and the Michigan soil management group is 1 .5c. The primary habitat type is TTP.

113—Ruse mucky fine sandy loam.

This shallow, poorly drained, nearly level soil is in depressions. It is frequently ponded. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is black mucky fine sandy loam about 5 inches thick. The subsoil is brown and light brownish gray, mottled, friable fine sandy loam about 9 inches thick. Limestone bedrock is at a depth of about 14 inches. In places, the bedrock is at a depth of less than 10 inches.

Included with this soil in mapping are small areas of the very poorly drained Chippeny and Carbondale soils. These soils are in landscape positions similar to those of the Ruse soil. Chippeny soils formed in 20 to 40 inches of organic material over bedrock. Carbondale soils formed in more than 51 inches of organic material. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate or moderately rapid in the Ruse soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer. The potential for frost action is high.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. Because of the high water table and the bedrock, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The swamp conifer cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, and the shallowness to bedrock.

This soil is generally unsuited to building site development and septic tank absorption fields because of the ponding and the depth to bedrock. It is generally unsuited to sewage lagoons because of seepage, the depth to bedrock, and the ponding. The woodland ordination symbol is 5W, the land capability classification is VIIw, and the Michigan soil management group is Rbc. No habitat type is assigned.

114B—Velvet very stony loamy sand, 0 to 6 percent slopes.

This very deep, moderately well drained, nearly level and undulating soil is on low knolls, ridges, and side slopes. Stones and boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 120 to less than 3 feet apart. Individual areas of this soil are irregularly shaped or elongated and range from 5 to 35 acres in size.

Typically, the surface is covered by about 2 inches of well-decomposed leaf litter. The surface layer is grayish brown very stony loamy sand about 3 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown and strong brown, very friable and loose very cobbly and very stony loamy sand. The lower part is grayish brown and reddish brown, mottled, very firm gravelly loamy sand and gravelly fine sandy loam. The substratum to a depth of about 60 inches is brown gravelly fine sandy loam. In places, the surface layer is the gravelly, cobbly, very gravelly, or very cobbly analogs of sand or loamy fine sand or cobbly, gravelly, or very gravelly loamy sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Westbury and poorly drained Pickford soils. Westbury soils are in the slightly lower landscape positions. Pickford soils are clayey throughout. They are in depressions. Also included are small areas of the extremely stony Velvet soils. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the upper part of the Velvet soil, very slow in the dense, very firm middle part, and moderate in the substratum. The available water capacity is low. Surface runoff is slow. A perched seasonal high water table is at a depth of 1 to 2 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. The use of equipment is restricted by

wetness in fall, in spring, and in other excessively wet periods when the upper part of the subsoil is saturated. During these periods, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads require a gravel base. Large stones on the surface can reduce the operating speed of skidders or tractors, result in equipment damage, and hinder the construction of logging roads and skid trails. Because of the dense, firm layer, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on this sod, but small areas of northern hardwoods are common. Clear cutting is common. Trees generally are not planted on this soil because of the large number of stones on the surface.

Because of the wetness and the large stones, this soil is poorly suited to buildings without basements and is generally unsuited to buildings with basements. It is poorly suited to septic tank absorption fields because of the restricted permeability in the dense, firm layer, the wetness, and the large stones. It is generally unsuited to sewage lagoons because of the large stones and seepage. Buildings without basements can be constructed on well-compacted fill material, which can raise the site above the water table. The large stones can cause construction problems. If septic tank absorption fields are used, the restricted permeability and the wetness can be overcome by breaking up the dense, firm layer and using fill to mound the site.

The woodland ordination symbol is 3X, the land capability classification is VIs, and the Michigan soil management group is Ga. The primary habitat type is TM, and the secondary habitat type is ATD.

114D—Velvet very stony loamy sand, 6 to 15 percent slopes.

This very deep, moderately well drained, gently rolling and rolling soil is on knolls and ridges. Stones and boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 120 to less than 3 feet apart. Individual areas of this soil are irregularly shaped or elongated and range from 10 to 80 acres in size.

Typically, the surface is covered by about 2 inches of well-decomposed leaf litter. The surface layer is grayish brown very stony loamy sand about 3 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown and strong brown, very friable and loose very cobbly and very stony loamy sand. The lower part is grayish brown and reddish brown, mottled, very firm gravelly loamy sand and gravelly fine sandy loam. The substratum to a depth of about 60 inches is brown gravelly fine sandy loam. In places, the surface layer is gravelly, cobbly, very gravelly, or very cobbly analogs of sand or loamy fine sand or cobbly, gravelly, or very gravelly loamy sand.

Included with this soil in mapping are small areas of the moderately well drained Ontonagon soils. These soils are in landscape positions similar to those of the Velvet soil. They are clayey throughout. Also included are small areas of the extremely stony or bouldery Velvet soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the upper part of the Velvet soil, very slow in the dense, very firm middle part, and moderate in the substratum. The available water capacity is low. Surface runoff is slow. A perched seasonal high water table is at a depth of 1 to 2 feet from late fall to late spring.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Large stones on the surface can reduce the operating speed of skidders or tractors, result in equipment damage, and hinder the construction of logging roads and skid trails. Landings can be located in the small nearly level areas that may be included in this unit. Traffic ability is briefly limited in spring, in fall, and in other excessively wet periods when the upper part of the subsoil is saturated. When the soil is wet, year-round logging roads are slippery and ruts form easily. Because of the dense, firm layer, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. Aspen and northern hardwoods are the

dominant cover types. Species preference can be managed by selective cutting. Trees generally are not planted on this soil because of the large number of stones on the surface.

Because of the wetness and the large stones, this soil is poorly suited to buildings without basements and is generally unsuited to buildings with basements. In areas where it exceeds 8 percent, the slope is a limitation. The soil is poorly suited to septic tank absorption fields because of the restricted permeability in the dense, firm layer and the large stones. It is generally unsuited to sewage lagoons because of seepage and the large stones. The large stones and the dense, firm layer can cause construction problems. Buildings without basements can be constructed on well-compacted fill material, which can raise the site above the water table. The buildings should be designed so that they conform to the natural slope of the land. On sites for septic tank absorption fields, the restricted permeability can be overcome by breaking up the dense, firm layer. Land shaping and installing the distribution lines across the slope generally helps to ensure that the absorption field functions properly.

The woodland ordination symbol is 3X, the land capability classification is VIs, and the Michigan soil management group is Ga. The primary habitat type is TM, and the secondary habitat type is ATD.

116 - Udorthents, nearly level.

This map unit consists of soils that are the result of cutting and tilling. The original soil material has been altered to such an extent that a recognizable soil profile is no longer evident. The original ridges have been leveled. The lower, wetter, and poorly drained depressions and potholes have been filled. Some areas of this unit consist of soil covering municipal or industrial waste. The soils range in texture from loam to clay. The soil material is moderately well drained to poorly drained. In some areas, there is a slight darkening of the surface caused by grass roots and other decaying vegetation. Individual areas of this unit are irregular in shape and range from 10 to 150 acres in size.

Included with these soils in mapping are small areas of undisturbed Pickford and Rudyard soils. Also included are small areas of soils that are sandier than the Udorthents. Included soils make up about 5 to 10 percent of the map unit.

Areas of these soils are used mainly as urban land or are idle. The soils have limited suitability for most uses. Onsite investigation is needed to determine specific soil properties.

No interpretive groups are assigned.

117B—Manistee sand, 0 to 6 percent slopes.

This very deep, moderately well drained, nearly level and undulating soil is on broad plains, ridge tops, and side slopes. Individual areas are irregular in shape and range from 5 to 125 acres in size.

Typically, the surface is covered by about 3 inches of well-decomposed leaf litter. The surface layer is pinkish gray sand about 9 inches thick. The subsoil is about 26 inches thick. It is firm. The upper part is dark reddish brown sand; the next part is dark brown, mottled sand; and the lower part is reddish brown and pinkish gray, mottled silty clay barn and loamy sand. The substratum to a depth of about 60 inches is reddish brown clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Allendale, moderately well drained Ocqueoc, and well-drained Rousseau and Superior soils. Allendale soils are in depressions. Ocqueoc, Rousseau, and Superior soils are in landscape positions similar to those of the Manistee soil. Ocqueoo soils have a stratified, sandy and loamy substratum. Rousseau soils are sandy throughout. Superior soils are loamy in the surface layer and in the upper part of the subsoil. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the sandy upper part of the Manistee soil, slow, and very slow in the clayey lower part. The available water capacity is low. Surface runoff is slow. A perched seasonal high water table is at a depth of 2.5 to 4.0 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The use of equipment is limited in spring, in fall, and in other excessively wet periods. Logging equipment can cause deep ruts. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity in the upper 20 inches. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that conserve moisture, maintain the organic matter content, and help to control soil blowing. Examples are buffer strips, vegetative barriers, field windbreaks, small grain crops, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves aU or part of the crop residue on the surface.

This soil is well suited to pasture. Overgrazing during dry periods can destroy the paint cover. The major management concern is droughtiness. Proper stocking rates, rotation grazing, strip grazing and restricted use during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to building site development. The wetness and a high *shrink-swell* potential are limitations on sites for buildings with basements. These buildings can be constructed on well-compacted fill material, which raises the level of the site. A drainage system helps to lower the seasonal high water table. The soil is poorly suited to septic tank absorption fields because of the wetness, a poor filtering capacity in the upper part of the profile, and the very slow permeability in the lower part. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Riling or mounding the absorption field with suitable material can raise the site above the seasonal high water table. The soil is *generally* unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 3S, the land capability classification is IIIs, and the Michigan soil management group is 4/la. No habitat type is assigned.

117D - Manistee sand, 6 to 15 percent slopes.

This very deep, well-drained, gently rolling and rolling soil is on the sides of ridges and knolls. Individual areas are elongated or irregularly shaped and range from 5 to more than 40 acres in size.

Typically, the surface is covered by about 3 inches of well-decomposed leaf litter. The surface layer is pinkish gray sand about 9 *inches thick.* The subsoil is about 26 inches thick. It is firm. The upper part is dark reddish brown and dark brown sand. The lower part is reddish brown and pinkish gray silty clay loam and loamy sand. The substratum to a depth of about 60 inches is reddish brown clay.

Included with this soil in mapping are small areas of the well-drained Ocqueoc, Rousseau, and Superior soils. These soils are in landscape positions similar to those of the Manistee soil. Ocqueoc soils have a stratified, sandy and loamy substratum. Rousseau soils are sandy throughout. Superior soils are loamy in the surface layer and in the upper part of the subsoil. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the sandy upper part of the Manistee soil and slow and very slow in the clayey lower part. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be located in the small nearly level areas that may be included in this unit. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity in the upper part of the profile. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to building site development. The slope is the main limitation. A high shrink-swell potential is an additional limitation on sites for buildings with basements. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity in the upper part of the profile, the restricted permeability in the lower part, and the slope. It is generally unsuited to sewage lagoons because of seepage and the slope. Buildings should be designed so that they conform to the natural slope of the land. The soil readily absorbs but does not adequately filler the effluent in septic tank absorption fields. Filling or mounding the field with suitable material can raise the site above the water table. Land shaping and installing the distribution lines across the slope generally help to ensure that the absorption field functions properly.

The woodland ordination symbol is 3S, the land capability classification is IIe, and the Michigan soil management group is 4/la. No habitat type is assigned.

117F—Manistee sand, 25 to 50 percent slopes.

This very deep, well drained, steep and very steep soil is on the sides of ridges and in ravines. Some areas are dissected by shallow drainage ways. Individual areas are elongated and range from 5 to 60 acres in size.

Typically, the surface is covered by about 3 inches of well-decomposed leaf litter. The surface layer is pinkish gray sand about 9 inches thick. The subsoil is about 26 inches thick. It is firm. The upper part is dark reddish brown and dark brown sand, and the lower part is reddish brown and pinkish gray silty clay loam and loamy sand. The substratum to a depth of about 60 inches is reddish brown clay.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska and well-drained Ontonagon soils. These soils are in landscape positions similar to those of the Manistee soil. Kalkaska soils are sandy throughout. Ontonagon soils are clayey throughout. Included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the sandy upper part of the Manistee soil and slow and very slow in the clayey lower part. The available water capacity is low. Surface runoff is medium.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, seedling mortality, and plant competition. Access is limited by the slope. Special care is needed in laying out logging roads and in operating equipment. The roads can be designed so that they conform to the natural slope of the land. Special logging methods, such as yarding with a cable, may be needed to minimize surface disturbance. Loose sand and the slope can interfere with the traction of wheeled equipment. Erosion can result from the concentration of runoff on roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out sloping road surfaces, culverts, and drop structures minimizes erosion. Seedling mortality can be a problem during dry periods

because of the low available water capacity, especially on south aspects. Site preparation and planting are severely limited by the slope. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting.

This soil is generally unsuited to building site development and septic tank absorption fields because of the slope.

The woodland ordination symbol is 3R, the land capability classification is VIIe, and the Michigan soil management group is 4/la. No habitat type is assigned.

119—Gogomain very fine sandy loam.

This very deep, poorly drained, nearly level soil is on low, broad plains. It is frequently ponded. Individual areas are irregular in shape and range from 5 to 2,000 acres in size.

Typically, the surface layer is black very fine sandy loam about 6 inches thick. The subsoil is about 31 inches thick. It is mottled and very friable. The upper part is grayish brown and pale brown very fine sandy loam and loamy very fine sand, and the lower part is brown very fine sand. The substratum to a depth of about 60 inches is light reddish brown and pinkish gray, mottled clay. In some places, the surface layer is loamy very fine sand or silt loam. In other places, a thin organic layer overlies the surface layer.

Included with this soil in mapping are small areas of the somewhat poorly drained Biscuit and poorly drained Fibre and Pickford soils. Biscuit soils are on low knolls and ridges. Fibre soils have a sandy surface layer and subsoil. Pickford soils are clayey throughout. Fibre and Pickford soils are in landscape positions similar to those of the Gogomain soil. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderately rapid in the loamy upper part of the Gogomain soil and very slow in the clayey substratum. The available water capacity is moderate. Surface runoff is very slow or ponded. A perched seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.

Most areas are used as woodland. Some are idle grassland or abandoned farmland reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed. The number of suitable landing sites is severely limited because of the wetness. Because of the wetness, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, and plant competition.

This soil is generally unsuited to cropland, but such crops as oats, barley, wheat, and a mixture of grasses and legumes can be grown. The major management concern is removing excess water during wet periods. Surface drains can help to remove water if adequate outlets are available. Ruts form easily, and the load-bearing capacity is low. As a result, fieldwork should be done during dry periods. If subsurface tile is used, the tile lines should be protected with suitable material and installed on a self-cleaning grade so that they do not become clogged with fine sand and silt.

This soil is poorly suited to pasture. The forage species that are tolerant of wetness, such as trefoil-grass mixtures, should be used. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is generally unsuited to building site development *because* of *the* ponclirig. it *is* generally unsuited to septic tank absorption fields because of the ponding and the restricted permeability. It is generally unsuited to sewage lagoons because of seepage and the ponding.
The woodland ordination symbol is 4W, the land capability classification is Vw, and the Michigan soil management group is 3/ic. No habitat type is assigned.

121 B—Rockbottom stony silt loam, 2 to 6 percent slopes.
This very deep, moderately well drained, nearly level and undulating soil is on ridges, side slopes, and knolls. Stones and small bouiders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas *of* this soil *are* irregularly shaped or elongated and range from 5 to 80 acres in size.
Typically, the surface layer is very dark grayish brown stony silt loam about 6 inches thick. The next *layer* is mixed very dark *gray and* dark grayish brown stony silt loam about 4 inches thick. The subsoil is about 19 inches thick. The upper part is brown, mottled, firm silty clay loam, and the lower part is brown, friable extremely cobbly sandy clay loam. The substratum to a depth of about 60 inches is pale brown very gravelly fine sandy loam. In some places, the subsoil is clay. In other places the surface layer is silt loam, loam, fine sandy loam, or clay. In some areas, the surface layer and the upper part of the subsoil are extremely stony.
Included with this soil in mapping are small areas of the moderately *well* drained Oldman and somewhat poorly drained Shelter soils. Oldman soils contain Jess clay than the Rockbottom soil. They are in landscape positions similar to those of the Rockbottom soil. Shelter soils are in the slightly lower landscape positions. Included soils make up about 5 to 15 percent of the map unit.
Permeability is moderately slow in the clayey upper part of the Rockbottom soil *and* moderate in the loamy lower part. The available water capacity is moderate. Surface runoff is slow. A perched seasonal high water table is at a depth of 1 .5 to 2.5 feet from late fall to late spring.
This soil is used as woodland. The major management concerns are the equipment limitation and plant competition. Traffic ability is briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Large stones on the surface can hinder harvesting and planting and can result in equipment damage. Northern hardwoods and aspen are the dominant cover types. Species preference can be managed by selective cutting. Trees generally are not planted on this soil because of the large number of stones on the surface.
This soil is poorly suited to building site development because of the wetness. It is generally unsuited to septic tank absorption fields because of the wetness and the restricted permeability. It is poorly suited to sewage lagoons because of seepage. On sites for buildings, the foundation trench should be widened and backfilled with suitable coarse textured material. The building site should be raised, and a drainage system should be installed to remove excess water.
The woodland ordination symbol is 3X, the land capability classification is VIs, and the Michigan soil management group is 2.5a. No habitat type is assigned.

122—Pits, quarry.
This map unit consists of open excavations from which dolomite limestone has been removed. Most areas are actively mined. The outer edges of these excavations have steep vertical side slopes. Some areas have been excavated into underground springs or below the water table and have formed small lakes. The unused rubble material on the sides of the excavations supports some vegetation, mainly

northern white cedar and paper birch. Some of the rubble is used for roads. Individual areas of this unit range from 5 to 400 acres in size.
No interpretive groups are assigned.

123B - Ocqueoc fine sand, 0 to 6 percent slopes.
This very deep, moderately well drained, nearly level and undulating soil is on upland flats and ridge tops. Individual areas are irregular in shape and range from 5 to 400 acres in size.
Typically, the surface is covered by about 2 inches of well-decomposed leaf litter. The surface layer is pinkish gray fine sand about 8 inches thick. The subsoil is about 14 inches thick. The upper part is dark reddish brown, dark brown, and brown, very friable and loose fine sand, and the lower part is dark yellowish brown, very friable loamy fine sand. The substratum to a depth of about 60 inches is brown and yellowish brown, mottled, stratified tine sand to very tine sandy loam. Included with this soil in mapping are small areas of the moderately well drained Alcona, well-drained Rousseau, and somewhat poorly drained Ingalls soils. Alcona soils are finer textured throughout than the Ocqueoc soil. Rousseau soils are fine sand throughout. Alcona and Rousseau soils are in landscape positions similar to those of the Ocqueoc soil. Ingalls soils are in depressions. Included soils make up about 5 to 15 percent of the map unit.
Permeability is rapid in the sandy upper part of the Ocqueoc soil and moderately slow in the substratum. The available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 6.0 feet from late fall to late spring.
Most areas are used as woodland. The major management concerns are the equipment limitation and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The use of equipment is limited in spring, in fall, and in other excessively wet periods. The mortality of planted or naturally established seedlings can be a problem because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation -
This soil is fairly well suited to building site development. The wetness and the shrink-swell potential are limitations on sites for buildings with basements. Buildings with basements can be constructed on well-compacted fill material, which raises the level of the site above the water table. A drainage system helps to lower the seasonal high water table. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity in the upper part of the profile and the wetness and the restricted permeability in the lower part. The upper part of the soil readily absorbs but does not adequately filter the effluent. Filling or mounding the absorption field with suitable material can raise the site above the seasonal high water table. The soil is generally unsuited to sewage lagoons because of seepage and the wetness.
The woodland ordination symbol is 3S, the land capability classification is IIIs, and the Michigan soil management group is 4/2a. No habitat type is assigned.

124D—Alpena very cobbly sandy loam, 0 to 15 percent slopes.
This very deep, excessively drained, nearly level to rolling soil is on upland flats and ridges. Individual areas are irregularly shaped or elongated and range from 5 to 150 acres in size.
Typically, the surface is covered by about 3 inches of partially decomposed leaf litter. The surface layer is very dark grayish brown very cobbly sandy loam about 4 inches thick. The subsoil is brown, very friable very cobbly fine sandy loam about 12 inches thick. The substratum to a depth of about 60 inches

is pale brown extremely gravelly sand. In some places, loamy textures are in the lower part of the substratum. In other places the surface layer is fine sandy loam, loam, or the gravelly, very gravelly, cobbly, or very cobbly analogs of those textures.

Included with this soil in mapping are small areas of the well-drained Posen and somewhat poorly drained Shelter soils. Posen soils are finer textured throughout than the Alpena soil. They are in landscape positions similar to those of the Alpena soil. Shelter soils are in the slightly lower landscape positions. Also included are small areas of the stony Alpena soils. Included soils make up about 5 to 10 percent of the map unit.

Permeability is very rapid in the Alpena soil. The available water capacity is very low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Traffic ability may be briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery. Where possible, logging roads and skid trails can be designed so that they conform to the natural slope of the land. Landings can be located in the small nearly level areas within the unit. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. Replanting may be necessary in some areas. The swamp conifer cover type is dominant on this soil. Some areas are clear-cut. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to building site development. The slope is a management concern in areas where it exceeds 8 percent. The buildings should be designed so that they conform to the natural slope of the land. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soil is generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 3F, the land capability classification is VIs, and the Michigan soil management group is Ga. No habitat type is assigned.

125B—Croswell-Markey complex, 0 to 6 percent slopes.

This map unit consists of a very deep, nearly level and undulating, moderately well drained Croswell soil on low ridges and knolls and a very deep, nearly level, very poorly drained Markey soil in depressions and drainage ways. The Markey soil is frequently ponded. Individual areas of this unit are irregular in shape and range from 5 to 700 acres in size. They are 45 to 60 percent Croswell soil and 25 to 45 percent Markey soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Croswell soil is covered by about 2 inches of black, partially decomposed leaf litter. The surface layer is brown sand about 2 inches thick. The subsoil is strong brown and yellowish brown, very friable and friable sand about 15 inches thick. The substratum to a depth of about 60 inches is light yellowish brown and brownish yellow, mottled sand.

Typically, the Markey soil has a surface layer of dark reddish brown mucky peat about 3 inches thick. Below this is black, dark brown and dark reddish brown muck about 30 inches thick. The substratum to a depth of about 60 inches is brown sand. In places, the soil has less than 16 inches of organic material.

Included with these soils in mapping are small areas of the somewhat poorly drained Au Gres and excessively drained Rubicon soils. Au Gres soils are in the lower landscape positions. Rubicon soils are in the higher landscape positions. Included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the Croswell soil. It is moderately slow to moderately rapid in the organic part of the Markey soil and rapid in the sandy substratum. The available water capacity is low in the Croswell soil and high in the Markey soil. Surface runoff is slow on the Croswell soil and very slow or ponded on the Markey soil. The water table is at a depth of 2 to 4 feet from late fall to late spring in the Croswell soil. It is 1 foot above to 1 foot below the surface from fall to early summer in the Markey soil and seldom drops below a depth of 1 foot. The potential for frost action is high in the Markey soil.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness and the instability of the muck, trees can be logged only during periods in winter when logging roads are frozen. Roads and landings should be located on the ridges. Seedling mortality is a problem on the ridges because of ciroughtiness and in the depressions because of the wetness. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate on the sandy ridges. Trees in the wetter areas are shallow rooted. Some may be blown down during periods of high winds. Aspen and swamp conifers are the dominant cover types. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Plant competition is severe in the mucky areas because of the wetness. If trees are planted on the ridges, site preparation by mechanical or chemical means is needed to control competing vegetation.

The Croswell soil is fairly well suited to building site development. The wetness is a limitation on sites for buildings with basements. These buildings can be constructed on well-compacted fill material, which raises the level of the site above the water table. A drainage system helps to lower the water table. The Croswell soil is poorly suited to septic tank absorption fields because of the wetness and a poor filtering capacity. If a septic tank disposal system is installed, filling or mounding the absorption field with suitable material can raise the site above the seasonal high water table. The Croswell soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The Markey soil is generally unsuited to building site development because of the ponding and low strength. It is generally unsuited to septic tank absorption fields because of excess humus, the ponding, and a poor filtering capacity and to sewage lagoons because of seepage, excess humus, and the ponding.

The woodland ordination symbols are 5S and 2W, the land capability classification is IVs, and the Michigan soil management groups are 5a and M/4c. The primary habitat type is TM, and the secondary habitat type is TTS.

126—Pickford silt loam.

This very deep, poorly drained, nearly level soil is on broad plains. It is frequently poncled. Individual areas are irregular in shape and range from 5 to 3,000 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is light brownish gray, mottled silty clay loam about 2 inches thick. The subsoil is about 14 inches of weak red, mottled, firm and very firm silty clay and clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In places, it is varved or stratified with thin bands of silt loam and silty clay loam. In some areas, the surface layer is sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Bowers and Rudyard soils. Bowers soils have a stratified, silty substratum. Rudyard and Bowers soils are on low knolls, on ridges, and on the side slopes along streams and drainage ways. They make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Pickford soil. The available water capacity is moderate. Surface runoff is very slow or ponded. A perched seasonal high water table is 1 foot above to 1 foot below the surface from late fall to early summer (fig. B).

Most areas are used as cropland or pasture. Some are used as woodland. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of severe seedling mortality, the wetness, and severe plant competition.

If drained, this soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. It is poorly suited to these crops in undrained areas. The major management needs are measures that remove excess water during wet periods, maintain tilth, and minimize surface compaction. Shallow surface ditches can help to remove excess water if adequate outlets are available. A subsurface drainage system can lower the water table. Erosion-control structures may be needed where surface ditches enter drainage ways. When the soil is wet, ruts form easily and the load-bearing capacity is low. Working the soil when it is wet results in surface compaction and the formation of clods. Returning crop residue to the soil, applying a system of conservation tillage, and adding organic material improve tilth and minimize surface compaction.

This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet causes surface compaction and destroys forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the ponding. A moderate shrink-swell potential also is a limitation on building sites. The soil is generally unsuited to septic tank absorption fields and buildings with basements because of the wetness and the very slow permeability. It is poorly suited to sewage lagoons. It is well suited, however, if the excavation site is properly banked and the lagoon is sealed. Building sites should be raised, and a drainage system should be installed to remove excess water. The foundation trench should be widened and backfilled with suitable coarse textured material, which reduces the shrink-swell potential.

The woodland ordination symbol is 6W, the land capability classification is IIIw, and the Michigan soil management group is IC. The primary habitat type is TTP, and the secondary habitat type is FE.

127—Gay stony muck.

This very deep, poorly drained, nearly level soil is along drainage ways and in swales and depressions. It is frequently ponded. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are irregularly shaped or elongated and range from 5 to 50 acres in size.

Typically, the surface layer is dark brown stony muck about 5 inches thick. The subsurface layer is light brownish gray, mottled sandy loam about 5 inches thick. The subsoil is brown and pale brown,

mottled, friable sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is light brown, mottled sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Westbury soils on low knolls and along the edges of the unit. These soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in the Gay soil. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is 1 toot above to 1 foot below the surface from fall to early summer.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. Swamp conifers and aspen are the dominant cover types. Clear cutting is common. After the trees are out, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of the wetness, seedling mortality, and plant competition.

This soil is generally unsuited to building site development and onsite waste disposal systems because of the ponding.

The woodland ordination symbol is SW, the land capability classification is Vow, and the Michigan soil management group is 3c. No habitat type is assigned.

128F—Alcona-Markey complex, 0 to 50 percent slopes.

This map unit consists of a very deep, very steep, well-drained Alcona soil on ridges, on the side slopes of ravines, and in drainage ways and a very deep, nearly level, very poorly drained Markey soil on the bottom of the ravines. The Markey soil is frequently ponded. Perennial and intermittent streams are on the bottom of the ravines. Individual areas of this unit are elongated or irregularly shaped and range from 10 to 600 acres in size. They are 60 to 80 percent Alcona soil and 15 to 30 percent Markey sail. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Aicona soil is covered by about 1 inch of undecomposed hardwood leaf litter. The surface layer is brown loamy very fine sand about 3 inches thick. The subsoil is about 52 inches of dark reddish brown, yellowish brown, and brownish yellow, very friable very fine sandy loam and loamy very fine sand. The substratum to a depth of about 60 inches is yellowish brown and strong brown, stratified silt, silt loam, very fine sand, and loamy very fine sand. It has thin bands of silty clay loam.

Typically, the Markey soil has a surface layer of dark reddish brown mucky peat about 3 inches thick. Below this is black, dark brown, and dark reddish brown muck about 30 inches thick. The substratum to a depth of about 60 inches is brown sand.

Included with these soils in mapping are small areas of the somewhat poorly drained Gaastra, well-drained Sugar, and poorly drained Ermatinger soils. Gaastra soils are on the foot slopes of ravines and in depressions on ridge tops. Sugar soils are underlain by clay. They are in landscape positions similar to those of the Alcona soil. Ermatinger soils formed in stratified mineral material. They are in landscape positions similar to those of the Markey soil. Included soils make up about 5 to 25 percent of the map unit.

Permeability is moderate in the Alcona soil. It is moderately slow to moderately rapid in the organic part of the Markey soil and rapid in the sandy substratum. The available water capacity is moderate in the Alcona soil and high in the Markey soil. Surface runoff is medium on the Alcona soil and very slow or ponded on the Markey soil. The Markey soil has a seasonal high water table 1 foot above to 1 foot below the surface from fall to summer.

These soils are used as woodland. The major management concerns are the equipment limitation, the erosion hazard, the wind throw hazard, seedling mortality, and plant competition. Access is limited by the slope and the wet ravine bottoms. The ravine bottoms are generally too wet and narrow for logging roads.

Special care is needed in laying out logging roads and in operating equipment. Logging roads and skid trails can be located on ridge tops, if any are available, or on nearby soils that are better suited. Disturbed areas are subject to erosion. Special logging methods, such as yarding with a cable, may be needed to minimize erosion. Because of the wetness, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. Northern hardwoods, aspen, and swamp conifers are the dominant cover types. The opportunities for planting are limited because of the slope. If trees are planted in the sloping areas, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are generally unsuited to building site development and sanitary facilities because of the slope in areas of the Alcona soil and the ponding, low strength, and excess humus in areas of the Markey soil.

The woodland ordination symbols are 3R and 2W, the land capability classification is VIIe, and the Michigan soil management groups are 3a-s and M/4c. The primary habitat type is AVO, and the secondary habitat type is TTS.

129A—Rudyard silt loam, 0 to 3 percent slopes.

This very deep, somewhat poorly drained, nearly level soil is on broad plains. Individual areas are irregular in shape and range from 5 to 600 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 12 inches of reddish brown, mottled, firm silty clay and clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In places it is varved or stratified with thin bands of silt loam and silty clay loam. In some areas the surface layer is fine sand.

Included with this soil in mapping are small areas of the moderately well drained Ontonagon and poorly drained Pickford soils. Ontonagon soils are on low knolls, on ridges, and on side slopes along streams and drainage ways. Pickford soils are in depressions and drainage ways. Included soils make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Rudyard soil. The available water capacity is moderate. Surface runoff is slow. A perched seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall to late spring. The shrink-swell potential is high.

Most areas are used as cropland or pasture. Some are used as woodland. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness and the sticky and plastic qualities of the subsoil, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Oulverts are needed. The use of landing sites is restricted to periods when the soil is dry or frozen. The landings should be located in

the better-drained areas that may be available in this map unit. They should be stabilized so that they can withstand the repeated use of heavy equipment. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, plant competition can delay natural regeneration. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods, maintain tilth, maintain the organic matter content, and minimize surface compaction. Shallow surface ditches can help to remove excess water if adequate outlets are available. Erosion-control structures may be needed where surface ditches enter outlet drainage ways. When the soil is wet, ruts form easily and the load-bearing capacity is low. Tilling when the soil is at the proper moisture content helps to minimize surface compaction and maintain good soil structure. Returning crop residue to the soil, adding organic material, and applying a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface can improve tilth and increase the organic matter content.

This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet causes surface compaction and destroys forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the wetness and the high shrink-swell potential. It is generally unsuited to septic tank absorption fields because of the wetness and the restricted permeability. It is well suited to sewage lagoons. On sites for buildings, the foundation trench should be widened and backfilled with suitable coarse textured material, which reduces the shrink-swell potential. The building site should be raised, and a drainage system should be installed to remove excess water.

The woodland ordination symbol is 6W, the land capability classification is IIIw, and the Michigan soil management group is Ob. The primary habitat type is
TIP.

130A—Rudyard-Pickford silty clay barns, 0 to 3 percent slopes.

This map unit consists of very deep, nearly level, somewhat poorly drained Rudyard and poorly drained Pickford soils on broad plains. The Pickford soil is in slight depressions and is subject to ponding. Individual areas of this unit are irregular in shape and range from 5 to 700 acres in size. They are 40 to 60 percent Rudyard soil and 30 to 50 percent Pickford soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rudyard soil has a surface layer of brown silty clay loam about 6 inches thick. The subsoil is about 11 inches thick. It is mottled and firm. The upper part is brown and gray silty clay loam and silt loam, and the lower part is reddish brown clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In places it is varved or stratified with thin bands of silt loam and silty clay loam.

Typically, the Pickford soil has a surface layer of very dark gray silty clay loam about 8 inches thick. The subsurface layer is dark gray, mottled silty clay loam about 2 inches thick. The subsoil is about 14 inches of weak red, mottled, firm and very firm silty clay and clay. The substratum to a depth of

about 60 inches is reddish brown, mottled clay. In places it is varved or stratified with thin bands of silt loam and silty clay loam.

Included with these soils in mapping are small areas of the moderately well drained Ontonagon soils on low knolls, on ridges, and on side slopes along streams and drainage ways. These included soils make up about 5 to 10 percent of the map unit.

Permeability is very slow in the Rudyard and Pickford soils, and the available water capacity is moderate. Surface runoff is slow on the Rudyard soil and very slow or ponded on the Pickford soil. From fall to late spring, the Rudyard soil has a perched seasonal high water table at a depth of 0.5 foot to 1.5 feet and the Pickford soil has one 1 foot above to 1 foot below the surface. The shrink-swell potential is high in the Rudyard soil and moderate in the Pickford soil.

Most areas are used as cropland or pasture. Some are used as woodland. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table and the sticky and plastic qualities of the subsoil, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soils are wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed. The use of landings is limited to periods when the soils are dry or frozen. The landings should be located in the better-drained areas that may be available in this unit. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Because of the high water table, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on these soils. Clear Cutting is common. After the trees are cut, plant competition can delay or prevent natural regeneration. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are fairly well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that remove excess water during wet periods, maintain tilth, and minimize surface compaction. In low areas these soils pond after heavy rains or spring snowmelt. Shallow surface ditches can help to remove excess water if outlets are available. Erosion-control structures may be needed where surface ditches enter drainage ways. Working the soils when they are wet results in surface compaction and the formation of clods. Returning crop residue to the soil, planting small grain crops, adding organic material, and applying a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface can improve tilth and minimize surface compaction.

These soils are well suited to pasture and hay. Overgrazing or grazing when the soils are wet can cause surface compaction and destroy forage plants. The forage species that can tolerate wetness, such as trefoil-grass mixtures, should be selected for planting. Proper stocking rates, rotation grazing, and restricted grazing during wet periods help to keep the pasture in good condition.

These soils are poorly suited to building site development because of the wetness, the ponding, and the shrink-swell potential. They are generally unsuited to septic tank absorption fields because of the wetness and the restricted permeability. The Rudyard soil is well suited to sewage lagoons, but the Pickford soil is poorly suited. It is well suited, however, if the excavation site is properly banked and the lagoon is sealed. Building sites should be raised, and a drainage system should be installed to remove excess water. Widening the foundation trench and backlilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling.

The woodland ordination symbol is 6W, the land capability classification is IIIw, and the Michigan soil management groups are Ob and IC. The primary habitat type is TTP.

132B—Sugar very fine sandy loam, 0 to 6 percent slopes.

This very deep, moderately well drained, nearly level and undulating soil is on broad plains. Individual areas are irregularly shaped or elongated and range from 5 to 100 acres in size.

Typically, the surface is covered by about 1 inch of black, well-decomposed forest litter. The surface layer is black very fine sandy loam about 3 inches thick. The subsurface layer is pinkish gray loamy very tine sand about 7 inches thick. The subsoil is about 35 inches thick. The upper part is dark brown and strong brown, firm very tine sandy loam; the next part is yellowish brown and light brown, mottled, firm loamy very fine sand; and the lower part is reddish brown and white, mottled, firm, stratified silt loam, loamy very fine sand, and silty clay loam. The substratum to a depth of about 60 inches is reddish brown and light reddish brown, stratified silt loam and clay.

Included with this soil in mapping are small areas of the moderately well drained Ontonagon and somewhat poorly drained Biscuit soils. Ontonagon soils are clayey throughout. They are in landscape positions similar to those of the Sugar soil. Biscuit soils are in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate in the loamy upper part of the Sugar soil and very slow in the clayey lower part. The available water capacity is moderate. Surface runoff is slow. A perched seasonal high water table is at a depth of 1 to 4 feet from late fall to late spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. Traffic ability is briefly limited in spring and fall and in other excessively wet periods. When the soil is wet, unsurfaced Fogging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Year-round logging roads should be graveled. Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to such crops as oats, barley, wheat, and a mixture of grasses and legumes. The major management needs are measures that control water erosion and help to control soil blowing. Examples are small grain crops, grassed waterways, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface.

This soil is well suited to pasture. Overgrazing or grazing when the soil is wet causes surface compaction, destroys forage plants, and increases the susceptibility to erosion. Proper stocking rates, pasture rotation, and restricted use during wet period's help to keep the pasture in good condition.

This soil is poorly suited to building site development because of the wetness. A high shrink-swell potential also is a limitation on sites for buildings with basements. The soil is poorly suited to septic tank absorption fields because of the wetness and the very slow permeability in the lower part of the profile. It is only fairly well suited to sewage lagoons because of the slope and seepage. On sites for buildings, the foundation trench should be widened and backfilled with suitable coarse textured material, which reduces the shrink-swell potential. The building site should be raised, and a drainage system should be installed to remove excess water. Lagoons should be sealed and banked, installed on fill material, and artificially drained.

The woodland ordination symbol is 3L, the land capability classification is IIe, and the Michigan soil management group is 3/la. The primary habitat type is ATD, and the secondary habitat type is AVO.

132F—Sugar very fine sandy loam, 25 to 50 percent slopes.

This very deep, well drained, steep and very steep soil is on the sides of ridges, on uplands, and in ravines. Many areas are dissected with shallow intermittent drainage ways. Individual areas are elongated and range from 5 to 250 acres in size.

Typically, the surface is covered by about 1 inch of black, well-decomposed forest litter. The surface layer is black very tine sandy loam about 3 inches thick. The subsurface layer is pinkish gray loamy very fine sand about 7 inches thick. The subsoil is about 35 inches thick. The upper part is dark brown and strong brown, firm very fine sandy loam; the next part is yellowish brown and light brown, firm loamy very fine sand; and the lower part is reddish brown and white, firm, stratified silt loam, loamy very fine sand, and silty clay loam. The substratum to a depth of about 60 inches is reddish brown and light reddish brown, stratified silt loam and clay.

Included with this soil in mapping are small areas of the well-drained Ontonagon soils. These soils are in landscape positions similar to those of the Sugar soil. They are clayey throughout. They make up about 5 to 10 percent of the map unit.

Permeability is moderate in the loamy upper part of the Sugar soil and very slow in the clayey lower part. The available water capacity is moderate. Surface runoff is rapid.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and plant competition. Access is limited by the slope. Special care is needed in laying out logging roads and in operating equipment. The roads can be designed so that they conform to the natural slope of the land. Special logging methods, such as yarding with a cable, may be needed to minimize surface disturbance. Erosion can result from the concentration of runoff on roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping road surfaces, culverts, and drop structures minimizes erosion. Landings should be located in the less sloping nearby areas. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. After the over story is removed, plant competition is moderate.

This soil is generally unsuited to building site development, septic tank absorption fields, and sewage lagoons because of the slope.

The woodland ordination symbol is 3R, the land capability classification is VIIe, and the Michigan soil management group is 3/1 a. The primary habitat type is ATD, and the secondary habitat type is AVO.

133—Dora muck.

This very deep, very poorly drained, nearly level soil is in depressions and drainage ways. It is frequently ponded. Individual areas are elongated or irregularly shaped and range from 5 to 400 acres in size.

Typically, the surface layer is black muck about 12 inches thick. Below this is about 1 3 inches of very dark gray muck and dark reddish brown mucky peat. The substratum to a depth of about 60 inches is gray and reddish brown, mottled silty clay loam and silty clay. In places the soil has less than 16 inches of muck.

Included with this soil in mapping are small areas of Carbondale soils. These soils are in landscape positions similar to those of the Dora soil. They formed in more than 51 inches of organic material. They make up about 5 to 15 percent of the map unit.

Permeability is moderate or moderately rapid in the organic layers of the Dora soil and very slow in the clayey substratum. The available water capacity is high. Surface runoff is very slow or ponded.

The water table is 1 foot above to 1 foot below the surface from fall to summer and seldom drops below a depth of 1 foot.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness and the instability of the muck, trees can be logged only during periods in winter when logging roads are frozen. The swamp conifer cover type is dominant on this soil. Clear cutting and strip cutting are common. After the trees are cut, competition from wetland brush can be expected to delay or prevent natural regeneration. Because of the wetness, the trees are shallow rooted. Many may be blown down during periods of high winds. Trees generally are not planted on this soil because of severe seedling mortality, the wetness, and severe plant competition.

This soil is generally unsuited to building site development because of the ponding, low strength, and a high shrink-swell potential. It is generally unsuited to septic tank absorption fields because of the ponding, excess humus, and the restricted permeability and to sewage lagoons because of seepage, the ponding, and excess humus.

The woodland ordination symbol is 3W, the land capability classification is VIw, and the Michigan soil management group is M/lc. No habitat type is assigned.

135B—Longrie-Posen complex, 0 to 6 percent slopes.

This map unit consists of nearly level and undulating, well drained, moderately deep Longrie and deep Posen soils on broad plains and ridge tops. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this unit are irregular in shape and range from 20 to 500 acres in size. They are 40 to 55 percent Longrie soil and 40 to 50 percent Posen soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Longrie soil has a surface layer of black sandy loam about 4 inches thick. The subsurface layer is reddish gray sandy loam about 5 inches thick. The subsoil is dark reddish brown and reddish brown, friable fine sandy loam about 18 inches thick. The substratum is light brown gravelly loam about 4 inches thick. Limestone bedrock is at a depth of about 31 inches. In places the surface layer is tine sandy loam, loam, or silt loam.

Typically, the Posen soil is covered by about 1 inch of partially decomposed leaf litter. The surface layer is very dark gray cobbly fine sandy loam about 3 inches thick. The subsoil is dark brown and brown, friable very cobbly silt loam about 13 inches thick. The substratum to a depth of about 60 inches is brown very gravelly fine sandy loam. In places the surface layer is the gravelly or cobbly analogs of loam or silt loam or gravelly fine sandy loam.

Included with these soils in mapping are small areas of the somewhat poorly drained Ensign and Shelter soils in the slightly lower landscape positions. Also included are scattered small areas of rock outcrop. Included areas make up about 5 to 10 percent of the map unit.

Permeability is moderate in the Longrie and Posen soils. The available water capacity is low in the Longrie soil and moderate in the Posen soil. Surface runoff is slow.

Most areas are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. The bedrock may interfere with road construction. Traffic ability is briefly limited in spring and in other excessively wet periods. When the soils are wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Large stones on the surface can hinder harvesting and can result in equipment damage. Year-round logging roads should be graveled. Culverts are needed to maintain the natural drainage system. Because of the moderate depth to bedrock, trees on the

Longrie soil are shallow rooted. Some may be blown down during periods of high winds. The northern hardwoods cover type is dominant on these soils. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

The Longrie soil is fairly well suited to building site development, but the depth to bedrock is a limitation on sites for buildings with basements. The Posen soil is poorly suited to building site development because of the content of coarse fragments. The soils are poorly suited to septic tank absorption fields because of the depth to bedrock in the Longrie soil and the coarse fragments in the Posen soil. If a septic tank disposal system is installed, mounding the absorption field with suitable material can raise the site above the bedrock. Also, the coarse fragments in the Posen soil should be removed. The soils are generally unsuited to sewage lagoons because of seepage and the depth to bedrock.

The woodland ordination symbols are 2D and 2X, the land capability classification is IIe, and the Michigan soil management groups are 3/Ra and 3a. The primary habitat type is AVO.

136A—Westbury-Gay complex, 0 to 3 percent slopes.

This map unit consists of a very deep, nearly level, somewhat poorly drained Westbury soil on low knolls and low, broad plains and a very deep, nearly level, poorly drained Gay soil in depressions, swales, and drainage ways. The Gay soil is frequently ponded. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this unit are irregular in shape and range from 5 to 500 acres in size. They are 40 to 55 percent Westbury soil and 40 to 50 percent Gay soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Wesibury soil is covered by about 3 inches of very dark gray and black leaf litter. The surface is reddish gray, stony fine sandy loam about 1 inch thick. The subsoil is about 44 inches thick. It is mottled. The upper part is dark brown and dark yellowish brown, friable cobbly silt loam and gravelly fine sandy loam. The lower part is light brown and brown, very firm very gravelly sandy loam. The substratum to a depth of about 60 inches is light brown, mottled very gravelly sandy loam.

Typically, the Gay soil has a surface layer of dark brown stony muck about 5 inches thick. The subsurface layer is light brownish gray, mottled sandy loam about 5 inches thick. The subsoil is brown and pale brown, mottled, friable sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is light brown, mottled sandy loam.

Included with these soils in mapping are small areas of the poorly drained Pickford and moderately well drained Qidman and Velvet soils. Pickford soils are clayey throughout. They are in landscape positions similar to those of the Wesibury and Gay soils. Qidman and Velvet soils are in the higher landscape positions. Included soils make up about 10 to 15 percent of the map unit.

Permeability is very slow in the dense, firm, middle part of the Westbury soil and moderate in the rest of the profile. It is moderate in the Gay soil. The available water capacity is low in the Westbury soil and moderate in the Gay soil. Surface runoff is slow on the Westbury soil and very slow or ponded on the Gay soil. From late fall to late spring, the Westbury soil has a perched seasonal high water table at a depth of 0.5 foot to 1.5 feet and the Gay soil has one 1.0 foot above to 0.5 foot below the surface. The potential for frost action is high in the Gay soil.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. The use of equipment is limited by the wetness and the stoniness. Equipment should be used only during dry summer months or during

winter months when the snow cover is adequate. Year-round logging roads require fill and a gravel base. Culverts are needed to maintain the natural drainage system. Landings can be used only when the soils are dry or frozen. Because of the dense, firm layer in the Westbury soil and the wetness, trees are shallow rooted. Some may be blown down during periods of high winds. Swamp conifers and aspen are the dominant cover types. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. The opportunities for planting are limited because of the wetness, the stones on the surface, severe seedling mortality, and plant competition. If seedlings are planted, selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling modality rate. Furrowing before planting also can increase the seedling survival rate. After the over story has been removed, plant competition can be controlled by mechanical or chemical means.

These soils are generally unsuited to building site development and onsite waste disposal systems because of the ponding and the stoniness.

The woodland ordination symbols are 3W and 6W, the land capability classification is VHs, and the Michigan soil management groups are Gbc and 3c. No habitat type is assigned.

137A—Kinross-Wainola complex, 0 to 3 percent slopes.

This map unit consists of very deep, nearly level, poorly drained Kinross and somewhat poorly drained Wainola soils on low ridges and in swales. The Kinross soil is frequently ponded. Individual areas of this unit are irregular in shape and range from 10 to 1,000 acres in size. They are 50 to 70 percent Kinross soil and 25 to 50 percent Wainola soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Kinross soil has a surface layer of black muck about 3 inches thick. The subsurface layer is dark gray fine sand about 7 inches thick. The subsoil is dark brown and brown, mottled, very friable and loose fine sand about 15 inches thick. The substratum to a depth of about 60 inches is brown fine sand.

Typically, the Wainola soil is covered by about 3 inches of partially decomposed leaf litter. The subsurface layer is grayish brown fine sand about 5 inches thick. The subsoil is dark reddish brown, strong brown, and yellowish brown, mottled, friable fine sand about 19 inches thick. The substratum to a depth of about 60 inches is brown fine sand.

Included with these soils in mapping are small areas of the very poorly drained Dawson and moderately well drained Rousseau soils. Dawson soils have 16 to 50 inches of organic material. They are in the lowest positions on the landscape. Rousseau soils are on the higher knobs and ridges. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kinross and Wainola soils, and the available water capacity is low. Surface runoff is slow on the Wainola soil and very slow or ponded on the Kinross soil. The Kinross soil has a seasonal high water table 1 foot above to 1 foot below the surface from fall to early summer. The Wainola soil has one at a depth of 0.5 foot to 1.5 feet from late fall to late spring.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Access is limited to dry summer months or to winter months when the snow cover is adequate. Year-round logging roads require fill and a gravel base. Oulverts are needed to maintain natural drainage systems. The number of suitable landing sites is severely limited. The landings can be used only during periods when the ground is frozen. Because of the wetness, trees on these soils are shallow rooted. Many may be blown down during periods of high winds. Aspen and swamp conifers are the dominant cover types. Clear cutting

and strip cutting are common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. The opportunities for planting are limited because of the wetness, seedling mortality, and plant competition. If seedlings are planted, selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. Furrowing before planting also can increase the seedling survival rate. After the over story has been removed, plant competition can be controlled by mechanical or chemical means.

These soils are poorly suited to building site development because of the poriding in areas of the Kinross soil and the wetness in areas of the Au Gres soil. They are generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity. They are generally unsuited to sewage lagoons because of seepage and the wetness.

The woodland ordination symbols are 2W and 6W, the land capability classification is VIw, and the Michigan soil management groups are 5c and 5b. The primary habitat type is TTS, and the secondary habitat type is TMC.

138B—Rousseau, dark subsoil-Urban land complex, 0 to 4 percent slopes.

This map unit consists of urban land and a very deep, nearly level and undulating, well-drained Rousseau soil on broad flats. Individual areas are irregular in shape and are about 1,800 acres in size. They are 45 to 65 percent Rousseau soil and 20 to 40 percent urban land. The Rousseau soil and urban land occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rousseau soil has a surface layer of black fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 3 inches thick. The subsoil is dark reddish brown and strong brown, very friable fine sand about 15 inches thick. The substratum to a depth of about 60 inches is brown and light brown fine sand. In places part or all of the soil is sand.

The Urban land is covered by streets, parking lots, runways, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible. Some areas have been filled, leveled, built up, or cut during construction.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is slow.

The Rousseau soil is in areas where lawns or gardens are established and in other parts of the unit. It is fairly well suited to lawns, gardens, most recreational uses, and most kinds of building site development. Droughtiness is a limitation affecting lawns, gardens, and trees. Regular additions of water during dry periods can overcome this limitation. Adding peat or topsoil can increase the available water capacity.

The Rousseau soil is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Sanitary facilities should be connected to commercial sewers and treatment plants.

No interpretive groups are assigned.

139A—Rudyard-Urban land complex, 0 to 3 percent slopes.

This map unit consists of urban land and a very deep, nearly level, somewhat poorly drained Rudyard soil on broad flats. Individual areas are irregular in shape and range from 100 to 1,000 acres in size. They are 40 to 65 percent Rudyard soil and 30 to 50 percent urban land. The Rudyard soil

and urban land occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rudyard soil has a surface layer of brown, silty clay loam about 6 inches thick. The subsoil is about 11 inches thick. It is mottled and firm. The upper part is brown and gray silty clay loam and silt loam, and the lower part is reddish brown clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay. In places it is varved or stratified with thin bands of silt loam or silty clay loam.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not feasible. Some areas have been filled, leveled, built up, or cut during construction.

Included with this unit in mapping are small areas of the somewhat poorly drained Allendale soils. These soils are in landscape positions similar to those of the Rudyard soil. They have a sandy surface layer and subsoil. Also included are small areas of the poorly drained Pickford soils in depressions and drainage ways. Included soils make up about 5 to 20 percent of the map unit.

Permeability is very slow in the Rudyard soil. The available water capacity is moderate. Surface runoff is slow. A perched seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall to late spring. The shrink-swell potential is high.

The Rudyard soil is in areas where lawns or gardens are established and in other parts of the unit. Because of the wetness and the very slow permeability, it is generally unsuited to septic tank absorption fields. It is poorly suited to building site development because of the wetness and the shrink-swell potential. A surface or subsurface drainage system is needed. Buildings without basements can be constructed on well-compacted fill material, which can raise the level of the site above the perched seasonal high water table. Widening the foundation trench and backfilling with suitable coarse textured material reduce the shrink-swell potential. Subsurface drains can be installed around the foundation if outlets are available. Low strength and frost action are limitations on sites for local roads and streets. These limitations can be overcome by replacing or covering the upper layer of the soil with suitable base material. Sanitary facilities should be connected to commercial sewers and treatment plants.

No interpretive groups are assigned.

143—Burleigh loamy fine sand.

This very deep, poorly drained, nearly level soil is on low, broad plains. It is frequently ponded. Individual areas range from 15 to 1,500 acres in size.

Typically, the surface layer is very dark gray loamy fine sand about 7 inches thick. The substratum is mottled. The upper part is dark gray loamy tine sand about 6 inches thick; the next part is yellowish brown fine sand about 8 inches thick; and the lower part to a depth of about 60 inches is light brownish gray and light brown, stratified fine sand, very fine sand, and silt loam. In some places mucky layers are in the lower part of the substratum. In other places the surface layer is fine sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Ingalls and poorly drained Ermatinger soils. Ingalls soils are on low ridges. Ermatinger soils are finer textured throughout than the Burleigh soil. They are in landscape positions similar to those of the Burleigh soil. Included soils make up about 5 to 10 percent of the map unit.

Permeability is rapid in the upper part of the Burleigh soil and moderately slow in the stratified lower part. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Year-round logging roads should be graveled. Culverts are needed. The number of suitable landing sites is severely limited because of the wetness. Because of the wetness, trees on this soil are shallow rooted. Many may be blown down during periods of high winds and excessive wetness. The aspen cover type is dominant on this soil. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, and plant competition.

This soil is generally unsuited to building site development because of the ponding. It is generally unsuited to septic tank absorption fields because of the ponding, the restricted permeability, and a poor filtering capacity and to sewage lagoons because of seepage and the ponding.

The woodland ordination symbol is 2W, the land capability classification is Vw, and the Michigan soil management group is 4/2c. No habitat type is assigned.

144—Urban Land-Udorthents complex, nearly level.

This map unit consists of urban land and nearly level, moderately well drained to poorly drained soils in areas where the landscape has been disturbed. It is within the city limits of Sault Ste. Marie. Individual areas are irregular in shape and range from 350 to 1,500 acres in size. They are 60 to 75 percent urban land and 20 to 40 percent Udorthents. The Urban land and Udorthents occur as areas so intricately mixed or so small that mapping them separately is not practical.

The Urban land is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification of the soil series is not practical. Some areas are shallow over sandstone bedrock or consist of dredged bedrock at the surface.

The Udorthents vary greatly in texture and drainage. The original soil material has been removed, mixed, or covered with fill.

Included with this unit in mapping are small areas of the poorly drained Ermatinger and somewhat poorly drained Wega and Rudyard soils. Ermatinger and Wega soils are stratified, loamy soils. Rudyard soils are clayey throughout. Included soils make up about 5 to 15 percent of the map unit.

The areas of Udorthents are used for building site development or are idle land. Onsite investigation is necessary to determine the suitability of these soils for specific uses.

No interpretive groups are assigned.

145A—Gaastra Gogomain-Ingalls complex, 0 to 3 percent slopes.

This map unit consists of very deep, nearly level, somewhat poorly drained Gaastra and Ingalls and poorly drained Gogomain soils. The Gaastra and Ingalls soils are on broad plains, low ridges, and low knolls. The Gogomain soil is in depressions and drainage ways. It is frequently ponded. Individual areas of this unit are irregular in shape and range from 15 to 1,200 acres in size. They are 35 to 50 percent Gaastra soil, 25 to 40 percent Gogomain soil, and 15 to 30 percent Ingalls soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Gaastra soil is covered by about 2 inches of well-decomposed leaf litter and live roots. The surface layer is brown and pinkish gray, mottled silt loam about 8 inches thick. The subsoil is about 33 inches thick. It is mottled and friable. The upper part is reddish brown and strong brown very fine sandy loam, the next part is light reddish brown loamy very fine sand, and the lower part is

reddish brown and light reddish brown very fine sandy loam. The substratum to a depth of about 60 inches is light reddish brown and reddish brown, mottled, stratified very fine sandy loam, loamy very fine sand, and fine sand.

Typically, the Gogomain soil has a surface layer of black very fine sandy loam about 6 inches thick. The subsoil is about 31 inches thick. It is mottled and very triable. The upper part is grayish brown and pale brown very fine sandy loam and loamy very fine sand, and the lower part is brown very fine sand. The substratum to a depth of about 60 inches is light reddish brown and pinkish gray, mottled clay. In some places the upper part of the soil is loamy sand. In other places the surface layer is loamy very fine sand or silt loam. Typically, the Ingalls soil is covered by about 3 inches of leaf litter. The surface layer is brown loamy sand about 7 inches thick. The subsoil is about 33 inches thick. It is mottled. The upper part is dark brown, friable loamy sand and sand, and the lower part is brown, very friable loamy fine sand. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, stratified loamy fine sand and silt loam.

Included with these soils in mapping are small areas of the very poorly drained Markey and poorly drained Pickford soils. These included soils are in landscape positions similar to those of the Gogomain soil. Markey soils formed in organic material 16 to 50 inches deep over sand and fine sand. Pickford soils are clayey throughout. Also included are small areas of the moderately well drained Alcona soils on knolls and ridges. Included soils make up about 5 to 25 percent of the map unit.

Permeability is moderately slow in the Gaastra soil. It is moderately rapid in the loamy upper part of the Gogomain soil and very slow in the clayey substratum. It is rapid in the upper part of the Ingalls soil and moderately slow in the stratified lower part. The available water capacity is high in the Gaastra soil and moderate in the Gogomain and Ingalls soils. Surface runoff is slow on the Gaastra and Ingalls soils and very slow or ponded on the Gogomain soil. From late fall to late spring, the Gaastra soil has a seasonal high water table at a depth of 1 to 2 feet, the Gogomain soil has one 1 foot above to 1 foot below the surface, and the Ingalls soil has one at a depth of 0.5 to 1 .0 foot.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. When the soils are wet, unsurfaced logging roads are slippery and ruts form easily. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Year-round logging roads should be graveled. Gulverts are needed. The number of suitable landing sites is severely limited because of the wetness. Because of the wetness, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on these soils. Some small areas support swamp conifers. Clear cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate in the better-drained areas. After the over story has been removed, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of the wetness, these soils are poorly suited or unsuited to building site development. They are generally unsuited to septic tank absorption fields because of the wetness, the ponding, the restricted permeability, and seepage and to sewage lagoons because of the wetness, the ponding, and seepage.

The woodland ordination symbol is 3W for the Gaastra soil and 4W for the Gogomain and Ingalls soils; the land capability classification is IIw; and the Michigan soil management groups are 2.5b, 3/ic, and 4/2b. The primary habitat type is TMC-D.

146A—Allendale-Fibre complex, 0 to 3 percent slopes.

This map unit consists of very deep, nearly level, somewhat poorly drained Allendale and poorly drained Fibre soils. The Allendale soil is on low knolls and ridges. The Fibre soil is in slight depressions and on low flats. It is frequently ponded. Individual areas of this unit are irregular in shape and range from 20 to 200 acres in size. They are 30 to 60 percent Allendale soil and 30 to 50 percent Fibre soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Allendale soil has a surface layer of black loamy fine sand about 5 inches thick. The subsurface layer is pinkish gray fine sand about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark reddish brown, very friable loamy fine sand; the next part is strong brown and yellowish brown, mottled, very friable fine sand; and the lower part is reddish brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is light reddish brown, mottled silty clay that has thin strata of yellowish brown silty clay loam and silt loam. In places the surface layer is fine sand or loamy sand.

Typically, the Fibre soil has a surface layer of black muck about 5 inches thick. The subsurface layer is brown sand about 8 inches thick. The subsoil is about 14 inches thick. It is mottled. The upper part is dark brown and reddish brown, very friable loamy sand and sandy loam, and the lower part is reddish brown, firm clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay that has thin bands of pinkish gray silt.

Included with these soils in mapping are small areas of the somewhat poorly drained Rudyard, poorly drained Pickford, and very poorly drained Markey soils. Rudyard and Pickford soils have a clayey surface layer. Rudyard soils are in landscape positions similar to those of the Allendale soil. Pickford soils are in landscape positions similar to those of the Fibre soil. Markey soils have 16 to 51 inches of organic material over sand. They are in depressions or drainage ways. Included soils make up about S to 15 percent of the map unit.

Permeability is moderately rapid and rapid in the sandy upper pad of the Allendale and Fibre soils and very slow in the clayey lower part. The available water capacity is moderate in both soils. Surface runoff is slow on the Allendale soil and very slow or ponded on the Fibre soil. The Allendale soil has a perched seasonal high water table at a depth of 0.5 foot to 1.5 feet from late fall to late spring, and the Fibre soil has one 1 foot above to 1 foot below the surface from tall to late spring.

These soils are used as woodland. The major management concerns are the equipment limitation seedling mortality, the wind throw hazard, and plant competition. Because of the high water table, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Year-round logging roads should be graveled. Culverts are needed. Landings can be used only when the soils are dry or frozen. Because of the high water table, trees on these soils are shallow rooted. Some may be blown down during periods of high winds. The aspen cover type is dominant on these soils. The mortality of planted seedlings can be expected because of the wetness. Selection of special planting stock, such as containerized seedlings, and special site preparation that protects the surface with thin layers of loose slash can reduce the seedling mortality rate. If trees are planted in the better-drained areas, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of the ponding and a high shrink-swell potential, the Allendale soil is poorly suited to building site development and the Fibre soil is generally unsuited. Both soils are generally unsuited to septic tank absorption fields because of the wetness, the ponding, a poor filtering capacity in the sandy upper part of the profile, and the very slow permeability in the clayey lower part. They are generally unsuited to sewage lagoons because of seepage, excess humus, and the ponding.
The woodland ordination symbols are 4W and 3W, the land capability classification is IIIw, and the Michigan soil management groups are 4/1 b and 4/1 c. The primary habitat type is TMC-D.

147B—Shelter very stony loam, 0 to 6 percent slopes.
This very deep, somewhat poorly drained, nearly level and undulating soil is on low ridges and broad plains. Stones and small boulders are on the surface. They range from 10 to 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are irregular in shape and range from 5 to more than 2,000 acres in size.
Typically, the surface layer is black, very stony loam about 4 inches thick. The next layer is very dark gray and dark brown very stony loam about 2 inches thick. The subsoil is light yellowish brown, mottled, friable very cobbly fine sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray, mottled, very cobbly fine sandy loam. In some places limestone bedrock is at a depth of about 40 to 60 inches. In other places the surface layer is the cobbly, gravelly, very cobbly, or very gravelly analogs of fine sandy loam or silt loam or cobbly, gravelly, or very gravelly loam.
Included with this soil in mapping are small areas of the excessively drained Alpena, somewhat poorly drained Ensign, and poorly drained Beavertail soils. Alpena soils are sandier throughout than the Shelter soil. They are in landscape positions similar to those of the Shelter soil or are on ridges. Ensign soils are underlain by limestone bedrock within a depth of 40 inches. They are in landscape positions similar to those of the Shelter soil or are slightly lower on the landscape. Beavertail soils are in depressions. Also included, along lakeshores, are small areas of extremely stony or bouldery Shelter soils. Included soils make up about 5 to 15 percent of the map unit.
Permeability is very slow in the Shelter soil. The available water capacity is low. Surface runoff is slow. A perched seasonal high water table is at a depth of 0.5 to 1 .0 foot from fall to late spring.
Most areas are used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. Equipment should be used only during dry summer months or during winter months when the snow cover is adequate. During wet periods, the surface layer and subsoil become saturated and unsurfaced logging roads are slippery. Year-round logging roads require a gravel base. Oulverts are needed to maintain the natural drainage system. Landings generally can be used only during the driest part of the year. Large stones on the surface can hinder harvesting and can result in equipment damage. Because of the firm substratum and the wetness, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. Swamp conifers and aspen are the dominant cover types. Trees generally are not planted on this soil because of the large number of stones on the surface and the wetness.
This soil is generally unsuited to building site development because of the wetness and the stoniness. It is generally unsuited to septic tank absorption fields because of the wetness, the stoniness, and the restricted permeability and to sewage lagoons because of the stoniness.
The woodland ordination symbol is 4X, the land capability classification is VIw, and the Michigan soil management group is Obo. No habitat type is assigned.

147D—Shelter very stony loam, 6 to 15 percent slopes.

This very deep, somewhat poorly drained, gently rolling and rolling soil is on side slopes, ridges, and knolls. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are elongated or irregularly shaped and range from 5 to 80 acres in size.

Typically, the surface layer is black very stony loam about 4 inches thick. The next layer is very dark gray and dark brown very stony loam about 2 inches thick. The subsoil is light yellowish brown, mottled, friable very cobbly fine sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray, mottled very cobbly fine sandy loam. In some places limestone bedrock is at a depth of about 40 to 60 inches. In other places the surface layer is the cobbly, gravely, very cobbly, or very gravelly analogs of fine sandy loam or silt loam or cobbly, gravelly, or very gravelly loam.

Included with this soil in mapping are small areas of the excessively drained Alpena and well drained Posen soils in landscape positions similar to or slightly higher than those of the Shelter soil. Also included are small areas of very stony or bouldery Shelter soils. Included soils make up about 5 to 15 percent of the map unit.

Permeability is very slow in the Shelter soil. The available water capacity is low. Surface runoff is slow. A perched seasonal high water table is at a depth of 0.5 to 1 .0 foot from fall to late spring.

This soil is used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. Equipment should be used only during dry summer months or during winter months when the snow cover is adequate. During wet periods, the surface layer and subsoil become saturated and unsurfaced logging roads are slippery. Year-round logging roads require a gravel base. Culverts are needed to maintain the natural drainage system. Landings generally can be used only during the driest part of the year and can be established only in nearly level areas. Large stones on the surface can reduce equipment speed and can result in equipment damage. Because of the firm substratum and the wetness, trees on this soil are shallow rooted. Some may be blown down during periods of high winds. Swamp conifers and aspen are the dominant cover types. Trees generally are not planted on this soil because of the large number of stones on the surface and the wetness.

This soil is generally unsuited to building site development because of the wetness, the stoniness, and the slope. It is generally unsuited to septic tank absorption fields because of the wetness, the stoniness, the slope, and the very slow permeability and to sewage lagoons because of the slope and the stoniness.

The woodland ordination symbol is 4X, the land capability classification is VIw, and the Michigan soil management group is Gbc. No habitat type is assigned.

148B—Longrie-Rock outcrop complex, 1 to 6 percent slopes.

This map unit consists of a moderately deep, well drained, nearly level and undulating Longrie soil and exposed limestone bedrock on benches, ridge tops, and broad plains. The Rock outcrop occurs as flat areas or vertical drops of 5 to 15 feet. Individual areas of this unit are irregular in shape and range from 10 to 1,000 acres in size. They are 30 to 70 percent Longrie soil and 20 to 70 percent Rock outcrop. The Longrie soil and Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Longrie soil has a surface layer of black sandy loam about 4 inches thick. The subsurface layer is reddish gray sandy loam about 5 inches thick. The subsoil is dark reddish brown and reddish brown, friable fine sandy loam about 18 inches thick. The substratum is light brown

gravelly loam about 4 inches thick. Limestone bedrock is at a depth of about 31 inches. In some places the depth to bedrock is more than 40 inches or less than 20 inches. In other places the surface layer is fine sandy loam, loam, or silt loam.

Included with this unit in mapping are small areas of the moderately deep, somewhat excessively drained Duel soils and the deep, somewhat poorly drained Shelter soils. Duel soils are sandy and are underlain by limestone bedrock. They are in landscape positions similar to those of the Longrie soil. Shelter soils are loamy-skeletal. They are in landscape positions similar to those of the Longrie soil or are in slight depressions. Included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in the Longrie soil. The available water capacity is low. Surface runoff is slow.

This map unit is used as woodland. The major management concerns are the equipment limitation, the wind throw hazard, and plant competition. The use of equipment is limited by the exposed bedrock. The bedrock may interfere with road construction. Traffic ability is briefly limited in spring and in other excessively wet periods. When the soil is wet, unsurfaced logging roads are slippery and ruts form easily. Because of the depth to bedrock, trees on the Longrie soil are shallow rooted. Some may be blown down during periods of high winds. Year-round logging roads should be graveled. The northern hardwoods cover type is dominant on the Longrie soil. Species preference can be managed by selective cutting. If seedlings are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of the depth to bedrock, the Longrie soil is only fairly well suited to buildings without basements. It can be used as a site for buildings with basements if fill material is used to raise the site above the bedrock. The soil is generally unsuited to septic tank absorption fields and sewage lagoons because of the shallowness to bedrock and seepage.

The woodland ordination symbol assigned to the Longrie soil is 3D, the land capability classification is IIe, and the Michigan soil management group is 3/Ra. The primary habitat type is AVO.

149B—Kalkaska sand, 0 to 6 percent slopes, stony.

This very deep, somewhat excessively drained, nearly level and undulating soil is on broad plains and upland flats. Stones and small boulders are on the surface. They range from 10 to more than 50 inches in diameter and are 350 to less than 25 feet apart. Individual areas of this soil are irregularly shaped or elongated and range from 10 to 200 acres in size.

Typically, the surface is covered by about 1 inch of partially decomposed leaf litter. The surface layer is dark reddish brown sand about 2 inches thick. The subsurface layer is reddish brown sand about 5 inches thick. The subsoil is about 24 inches thick. The upper part is dark reddish brown, friable loamy sand, and the lower part is dark brown and strong brown, very friable and loose sand. The substratum to a depth of about 60 inches is light yellowish brown sand. In places the surface layer is loamy sand.

Included with this soil in mapping are small areas of the moderately well drained Alcona and somewhat poorly drained Au Gres soils. Alcona soils formed in stratified, sandy and loamy deposits. They are in landscape positions similar to those of the Kalkaska soil. Au Gres soils are somewhat poorly drained and are in depressions. Included soils make up about 5 to 15 percent of the map unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is slow.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Large stones on the surface can hinder

harvesting and can result in equipment damage. The mortality of planted or naturally established seedlings can be a problem during dry periods because of the low available water capacity. Planting containerized seedlings or special nursery stock can reduce the seedling mortality rate. He planting may be necessary in some areas. The northern hardwoods cover type is dominant on this soil. Species preference can be managed by selective cutting. Some areas are clear-cut. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cropland, but such crops as oats, barley, wheat, and a mixture of grasses and legumes can be grown. The major management needs are measures that conserve moisture, maintain the organic matter content, and help to control soil blowing. Examples are buffer strips, vegetative barriers, field windbreaks, small grain crops, additions of organic material, and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface. The stones on the surface make seedbed preparation difficult.

This soil is fairly well suited to pasture. Proper stocking rates, rotation grazing, strip grazing, and restricted use during dry periods help to keep the pasture in good condition. The stones on the surface can hinder the use of equipment for pasture improvement or seedbed preparation.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The soil is generally unsuited to sewage lagoons because of seepage.

The woodland ordination symbol is 3S, the land capability classification is VIs, and the Michigan soil management group is 5a. The primary habitat type is ATD, and the secondary habitat type is TM.

150—Fibre muck.

This very deep, poorly drained, nearly level soil is on low plains in depressions and drainage ways. It is frequently ponded. Individual areas are irregular in shape and range from 5 to 500 acres in size.

Typically, the surface layer is black muck about 5 inches thick. The subsurface layer is brown sand about 8 inches thick. The subsoil is about 14 inches thick. It is mottled. The upper part is dark brown and reddish brown, very friable loamy sand and sandy loam. The lower part is reddish brown, firm clay. The substratum to a depth of about 60 inches is reddish brown, mottled clay that has thin bands of pinkish gray silt.

Included with this soil in mapping are small areas of the somewhat poorly drained Allendale and poorly drained Soo and Pickford soils. Allendale soils are on low knolls and ridges. Soo and Pickford soils have subsoil that is finer textured than that of the Fibre soil. They are in landscape positions similar to those of the Fibre soil. Included soils make up about 5 to 15 percent of the map unit.

Permeability is moderately rapid and rapid in the upper part of the Fibre soil and very slow in the clayey lower part. The available water capacity is moderate. Surface runoff is very slow or ponded. A perched seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.

Most areas are used as woodland. Some areas of abandoned farmland are reverting to speckled alder and willow.

The major concerns in managing woodland are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Equipment should be used only during dry summer months or during winter months when the snow cover is adequate. Year-round logging roads require

fill and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The swamp conifer cover type is dominant on this soil. After the trees are cut, plant competition can be expected to delay or prevent natural regeneration unless precautionary measures are taken. Trees generally are not planted on this soil because of the wetness, severe seedling mortality, plant competition, and low productivity.

This soil is generally unsuited to building site development because of the ponding. It is generally unsuited to septic tank absorption fields because of the ponding, seepage, and the restricted permeability and to sewage lagoons because of seepage, the ponding, and excess humus.

The woodland ordination symbol is 3W, the land capability classification is Vw, and the Michigan soil management group is 4/ic. The primary habitat type is TMC-D.

151—Beavertail muck.

This very deep, poorly drained, nearly level soil is in depressions and on low plains. It is frequently ponded. Individual areas are oval or irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is black muck about 8 inches thick. The subsoil is light yellowish brown, mottled, friable very gravelly fine sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is light brownish gray and pale brown, mottled very gravelly fine sandy loam.

Included with this soil in mapping are small areas of the shallow, somewhat poorly drained Potagannissing soils and the deep, somewhat poorly drained Shelter soils. Shelter soils are on knolls and ridges. Also included are small areas of the very poorly drained Markey soils in landscape positions similar to those of the Beavertail soil. Markey soils formed in organic material 16 to 50 inches deep over sand. Included soils make up about 5 to 10 percent of the map unit.

Permeability is slow in the Beavertail soil. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface from fall to early summer.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the wind throw hazard, and plant competition. Because of the wetness, the use of equipment is restricted to dry summer months or to winter months when the snow cover is adequate. Year-round logging roads require till and a gravel base. Culverts are needed to maintain the natural drainage system. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, trees on this soil are shallow rooted. Many may be blown down during periods of high winds. The swamp conifer cover type is dominant on this soil. Clear cutting or strip cutting is common. After the trees are cut, competition from wetland brush can delay or prevent natural regeneration. Trees generally are not planted on this soil because of the wetness, severe seedling modality, and plant competition.

This soil is generally unsuited to building site development because of the ponding. It is generally unsuited to septic tank absorption fields because of the ponding and the restricted permeability and to sewage lagoons because of the ponding and excess humus.

The woodland ordination symbol is 3W, the land capability classification is Vw, and the Michigan soil management group is Gbc. No habitat type is assigned.