

1.6 Soils

Soils develop from physical, chemical, and biological alteration of the underlying material. As might be expected from the geology, the principal soil types in WMA 3 have formed from the weathering of glacial till, glaciofluvial (outwash) sands and gravels, and glacial lake-related deposits. There are also numerous exposures of bedrock that are weathered to various degrees, but not to the extent where true soils have developed. Soils that are formed on weathered bedrock, common in other areas, are insignificant in WMA 3.

Because till is the unsorted material scoured by glacial ice from the pre-glacial terrain, its composition varies depending on the history of the glacier's movements. If the glacier's path took it through an area underlain by basalt, the till will be composed of basalt fragments. If the local ice mass had passed over a shale formation, the till will contain shale fragments. The movement of the ice was directed to a great extent by the pre-existing large-scale topography and the lobe that passed through WMA 3 moved parallel to the fault-bounded hills and valleys in the Highlands, which are oriented in the northeast-southwest direction. Where the ice scoured multiple terrains or along the contact between two lithologically different formations, the till will have a mixed composition of fragments.

Some soils have developed from stratified drift, including glacial lake-related and outwash deposits or from stratified materials deposited against or under glacial ice. The soils that have developed directly from lakebed deposits tend to be fine grained and poorly drained. Some soils formed from the sand and gravel of deltaic and shoreline deposits and are coarser and better drained. Whatever the parent material, some weathering and leaching of soluble and fine particulates takes place when it is exposed to the elements. Freeze/thaw cycles and the presence of plant roots and burrowing organisms rework the weathered material into distinct horizons and introduce organic material.

The principal soils, in terms of areal coverage are: (1) Soils that formed upon Wisconsinan age glacial till (including: Rockaway, Chatfield, Swartzwood, Hibernia, Ridgebury, Charlton, Norwich, Paxton, Netcong, Hollis, Alden, and Hasbrouck Series soils in the Highlands; and Boonton, Wethersfield, Cheshire, Holyoke, Haledon, and Hasbrouck Series soils in the Newark Basin); (2) Soils that formed upon Wisconsinan age outwash plains and terraces (including: Chenango, Pompton, and Hinckley Series soils in or deriving from Highlands material; and Riverhead, Dunellen, Preakness, and Otisville Series soils, as well as the Adrian Muck in the Newark Basin); and (3) Soils that formed upon glacial lakebed sediments (including Parsippany and Biddeford Series soils in the Newark Basin, as well as the Carlisle Muck, which occurs in both the Highlands and the Newark Basin).

The United States Department of Agriculture, Natural Resources Conservation Service (formerly called the Soil Conservation Service) has provided descriptions of these soils in their county soil surveys. Soil surveys for Morris, Sussex, Passaic, and Bergen Counties

were consulted to obtain the descriptions below. They can also be downloaded from the Natural Resources Conservation Service website:

<http://www.statlab.iastate.edu/soils/osd/dat/>

The availability of recharge to underlying aquifers is strongly dependent upon the recharge capacity of the soils overlying the aquifer. Some soils are readily amenable to almost continuous recharge, whereas others are more given to retaining water above the water table or to producing surface runoff. For the purpose of watershed management, USDA hydrologists and soils scientists have created a system of Hydrologic Soil Groups that rank the soils according to their recharge potential. There are four groups: A, B, C, and D, each with their respective characteristics and properties. There are also three dual group designations: A/D, B/D, and C/D, which indicate soils that in a natural condition would be assigned to Group D, but with some modification would behave as would a soil belonging to one of the other groups (see Plate 1.6.1). The following text is cited from a USDA web source and describes the hydrologic soil groups within WMA3: [<http://www.mo.nrcs.usda.gov/technical/section2/cropland.html#A2>]

Hydrologic Soil Group A

Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well-drained to excessively drained sands or gravels. These soils have a high rate of water transmission. (Low runoff potential)

Hydrologic Soil Group B

Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep or deep, moderately well or well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Hydrologic Soil Group C

Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine or fine textures and slow infiltration rate. These soils have a slow rate of water transmission.

Hydrologic Soil Group D

Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clayey soils with high swelling capacity or potential, (2) soils with a high permanent water table, (3) soils with a claypan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission (high runoff potential).

Dual Hydrologic Groups

Dual hydrologic groups, A/D and C/D, are given for criteria with soils that can be adequately drained. The first letter applies to the drained condition and the second to the undrained condition. Only soils that are rated D in their natural condition are assigned to dual groups.

In WMA 3, Hydrologic Soil Group A soils form on outwash sands and gravels. The most prominent Hydrologic Group A soils in the Highlands portion of the watershed management area belong to the Hinckley and Chenango Series. The Otisville Gravelly Loamy Sand is the predominant Group A soil in the Newark Basin portion of WMA 3. The Carlisle muck represents approximately 60 percent of the Group A/D soils shown in Plate 1.6.1. Most of the remaining area shown as Hydrologic Soil Group A/D is taken by the Adrian muck.

The most important Hydrologic Soil Group B soils in the Newark Basin, the Riverhead Gravelly sandy loam and the Dunellen sandy loam, are also formed on outwash. Another important Group B soil series in the Newark Basin portion of the WMA 3, the Cheshire Series, is formed on glacial till. Group B soils in the Highlands are primarily formed on till, the principal ones being the Chatfield and the Charlton Series. Most of the area indicating Hydrologic Soil Group B/D on Plate 1.6.1 belongs to the Preakness sandy loam, which forms on outwash.

The principal Hydrologic Soil Group C soils in WMA 3 all formed on glacial till. The Rockaway Series soils represent approximately 70 percent of the Group C soils in the Highlands. The Swartzwood Series soils, the Hibernia very stony loam, and the Ridgebury Series soils represent nearly all of the remainder of Group C soils in the Highlands. The Boonton gravelly loams and the Wethersfield Series soils represent most of the area covered by Hydrologic Soil Group C soils in the Newark Basin portion of the WMA 3. The area shown in Plate 1.6.1 indicating Hydrologic Soil Group C/D is divided between the Parsippany silt loam and Holyoke Rocky silt loam in the New Jersey portion of WMA 3, whereas the New York portion of Group C/D is mostly Hollis Series soils.

Rock outcrop areas are often assigned to Hydrologic Soil Group D. If that convention were used here, approximately 80 percent of the Group D soils in WMA 3 would be Rock outcrop. The principal soils of Hydrologic Soil Group D in WMA 3, in order of decreasing areal coverage are the Norwick Series silt loams, the Alden Series soils, and the Hasbrouck loam. These are all formed on glacial till. The first two occur in the Highlands. The Hasbrouck loam appears to form in both physiographic provinces.

Descriptions of the various major soils in WMA 3 are presented below.

Adrian Muck - Very deep, nearly level, very poorly drained soil formed in herbaceous organic material and in the underlying sandy deposits on outwash plains, lake plains and terraces, flood plains, moraines, and till plains. Permeability is moderately slow to moderately rapid in the organic material and rapid in the sandy material. The soil is

hydric and in its natural condition, would be assigned to Hydrologic Soil Group D. When drained, it can be assigned to Group A.

Alden Series Soils - Very deep, nearly level, very poorly drained soils formed on upland till plains in depressions and low areas in the landscape. They formed in a thin silty colluvial mantle overlying glacial till. The potential for surface runoff is negligible or very low. Permeability is moderate in the surface layer, moderately slow in the subsoil, and moderately slow or slow in the substratum. These soils are assigned to Hydrologic Soil Group D. They are associated with the Chenango soils, which occur on nearby outwash terraces.

Biddeford Silt Loam - Deep, nearly level, poorly drained soil in depressions along streams and old, naturally filled meander channels that traverse the bottom of former Glacial Lake Passaic. It has a very high water table and is considered hydric. Its permeability is slow and it is consequently assigned to Hydrologic Soil Group D.

Boonton Gravelly Loams - Gently sloping to very steep, well-drained and moderately well-drained, very deep and deep gravelly loams formed in acid, reddish sandstone, shale, basalt and conglomerate glacial till overlying shale and basalt bedrock and upland glacial till plains and ridges. These soils belong to Hydrologic Soil Group C. They are closely associated with the Haledon soils and together, they make up nearly all of the area of Hydrologic Soil Group C.

Carlisle Muck - Deep, very poorly drained to poorly drained peat and silt loam in former glacial lake bottom sediments. This soil belongs to Hydrologic Soil Group D in the natural undrained state and is hydric. If drained, it may be assigned to Hydrologic Soil Group A.

Charlton Series Soils - Very deep, nearly level to very steep, well drained loamy soils formed in till from schist, gneiss, or granite. These soils are found on plains and hills. Permeability is moderate or moderately rapid. Surface runoff is medium to rapid. These soils are assigned to Hydrologic Soil Group B. They are associated with Hollis soils.

Chatfield Series Soils - Moderately deep, well drained, and somewhat excessively drained soils formed in a moderately thick mantle of glacial till overlying granite, gneiss, or schist bedrock. Slopes range from 0 to 70 percent. Rock outcrops are rare to common and are limited to the more resistant bedrock. They are well to somewhat excessively drained. Runoff is medium to very rapid, and permeability is moderate or moderately rapid. They are assigned to Hydrologic Soil Group B. This series is associated with soils of the Paxton series. The shallower Hollis soils are often on nearby ridge crests and areas adjacent to rock outcrops.

Chenango Series Soils - Very deep, nearly level to very steep, well and somewhat excessively drained soils formed in water-sorted gravelly and loamy drift on outwash plains, kames, eskers, terraces, and alluvial fans. The parent material is derived from gray sandstone, shale, and siltstone and lesser amounts of material from limestone and

igneous rocks. The potential for surface runoff ranges from low to high. Permeability is moderate to moderately rapid in the solum and rapid in the substratum. These soils are assigned to Hydrologic Soil Group A.

Cheshire Series Soils - Very deep, nearly level to very steep, well drained loamy soils formed on till plains and hills in acid glacial till derived mostly from reddish sandstone, shale, and conglomerate with some basalt. Permeability is moderate or moderately rapid. Surface runoff is medium to rapid. These soils are assigned to Hydrologic Soil Group B. They are associated with the Holyoke and Wethersfield soils.

Dunellen Sandy Loam - Nearly level to strongly sloping, deep and very deep, well-drained gravelly, sandy loams formed in sandy, stratified glacial outwash plains and terraces and on river and stream terraces. These belong to Soil Hydrologic Group B.

Haledon Series Soils - Nearly level to strongly sloping, poorly drained and somewhat poorly drained, very deep silt loam, formed in sandstone, shale, and basalt composition glacial till over shale and basalt bedrock along drainage ways, on broad till plains and ridges, and at the bases of till plains and ridges. This soil belongs to Hydrologic Soil Group C and is locally hydric.

Hasbrouck Loam - Level and poorly drained or very poorly drained loam that formed in broad drainageways or depressions in till plains. Permeability is moderate in the surface layer and subsoil, but there is a fragipan layer where the permeability is slow or very slow. This soil belongs to Hydrologic Soil Group D.

Hibernia Very Stony Loam - Deep, gently sloping to steep, somewhat poorly drained gravelly loam with a fragipan and surface stones formed in glacial till in the Highlands and colluvium derived from such deposits. These soils are found in depressions, in watercourses, and at the base of steep slopes. They are assigned to Hydrologic Soil Group C.

Hinckley Series Soils - Very deep, excessively drained soils formed in water-sorted material. They are nearly level to very steep soils on terraces, outwash plains, deltas, kames, and eskers. The soils formed in water-sorted sand and gravel derived principally from granite, gneiss, and schist. Permeability is moderately rapid or rapid in the solum and rapid or very rapid in the substratum. Surface runoff is negligible to low. These soils are assigned to Hydrologic Soil Group A. They are associated with Charlton and Paxton soils.

Hollis Series Soils - Shallow, nearly level to very steep, well drained and somewhat excessively drained soils formed in a thin mantle of till derived mainly from gneiss, schist, and granite. They are upland soils on bedrock-controlled hills and ridges. Permeability is moderate or moderately rapid. Surface runoff is negligible to very high. These soils are assigned to Hydrologic Soil Group C/D. They are associated with Charlton, Chatfield, Hibernia, Paxton, Ridgebury, and Rockaway soils.

Holyoke Rocky Silt Loam – Shallow, gently sloping to steep, well-drained soils that formed on glacially scoured basalt ridges in thin discontinuous deposits of glacial till derived mainly from basalt, siltstone, and sandstone. The areas mapped as this soil type typically contain bedrock exposures. The permeability is moderate and the soil is assigned to Hydrologic Soil Group C/D.

Netcong Gravelly Sandy Loam - Deep, gently sloping to strongly sloping, well drained gravelly sandy loam formed in moderately weathered, somewhat gravelly and cobbly sandy loam glacial till, some stones and boulders are scattered on the surface and within the soil. This soil is found in large patches on rolling uplands. Its permeability is moderately rapid and it is assigned to Hydrologic Soil Group B.

Norwich Series Silt Loam - Deep, nearly level to sloping, poorly and very poorly drained soils formed in glacial till. They are also in depressions and in wetlands in areas covered by glacial till rich in reddish sandstone, siltstone, and shale. Runoff is slow to temporarily ponded. Internal drainage is slow. Permeability is slow to very slow. These soils are assigned to Hydrologic Soil Group D.

Otisville Gravelly Loamy Sand - Deep, gently sloping to steep, excessively drained gravelly loamy sand formed in assorted gravelly and sandy glacial outwash deposits. These soils are on gently rolling high terraces or steep-sided kames within valleys. This soil is assigned to Hydrologic Soil Group A.

Parsippany Silt Loam - Deep, nearly level, poorly drained silt loam with a moderately fine textured subsoil formed in stratified sediment of glaciolacustrine origin. These soils are found on the nearly level bottom of the basin formerly occupied by former Glacial Lake Passaic. These soils belong to Hydrologic Soil Group D in the natural, undrained state. If drained they can be assigned to Hydrologic Soil Group C.

Paxton Series Soils – Well-drained loamy soils formed in glacial till derived mostly from schist, gneiss, and granite. They are very deep, nearly level to steep soils on till plains, hills, and drumlins. Slope ranges from 0 to 35 percent. Surface runoff is medium to rapid. Permeability is moderate in the solum and slow or very slow in the substratum. These soils are assigned to Hydrologic Soil Group C. They are associated with the Charlton, Chatfield, and Ridgebury soils.

Pompton Sandy Loam - Deep, nearly level to gently sloping, somewhat poorly drained soil formed on terraces and outwash plains in major valleys. The parent material and substratum is sandy and gravelly outwash derived mainly from granitic rock eroded by the ice sheet. In places, other source materials include red and brown shale and traprock. The permeability is moderately rapid and it is assigned to Hydrologic Soil Group B.

Preakness Sandy Loam - Deep, nearly level, poorly drained sandy loam that formed in glacial outwash material composed primarily of granitic material. It is found in low area that frequently receive runoff from adjacent areas. The water table is seasonally at the

ground surface. The permeability is moderate in the surface and increases with depth to rapid in the substratum. In its natural state it is assigned to Hydrologic Soil Group D. When drained, it can be reassigned to Hydrologic Soil Group B.

Ridgebury Series Soils - Very deep, somewhat poorly and poorly drained soils formed in glacial till derived mainly from granite, gneiss and schist. They are nearly level to gently sloping soils in slightly concave areas and shallow drainageways in uplands. Permeability is moderate to moderately rapid in the solum and slow or very slow in the substratum. Runoff is slow to medium. These soils are assigned to Hydrologic Soil Group C. They are associated with the Charlton, Chatfield, Hollis, and Paxton soils.

Riverhead Gravelly Sandy Loam - This is a well drained, nearly level to strongly sloping gravelly soil that forms on glacial outwash plains and terraces near the granitic source material in the Highlands. It has moderately rapid permeability and is assigned to Hydrologic Soil Group B.

Rockaway Series Soils - Gravelly sandy loam and very stony and extremely stony sandy loam. Deep, gently sloping to very steep, well drained and moderately well drained sandy loam with a moderately developed fragipan and subsurface mottles formed in sandy loam glacial till. These soils are found on uplands and make up the majority of the Hydrologic Soil Group C.

Rock Outcrop - Areas of exposed crystalline bedrock. They are assigned to Hydrologic Soil Group D.

Swartswood Series Soils - Deep and very deep, nearly level to very steep, well drained and moderately well drained soils formed in till derived primarily from gray and brown quartzite, conglomerate, and sandstone. Stones and boulders are common surface features in wooded areas of these soils. Permeability is moderately rapid to moderately slow above the fragipan and moderately slow or slow in the fragipan. Surface runoff is slow to rapid. These soils are assigned to Hydrologic Soil Group C. They are associated with the Wurtsboro soils.

Udorthents - Areas where the ground surface has been altered by cutting or filling. The slope ranges from steep (cuts) to nearly level (fill). These areas include regrading for construction of buildings and roads, residential and recreational areas, and refuse disposal. Where fill was used to level freshwater wetlands, floodplains, or salt marshes, there is an organic substratum. No Hydrologic Soil Group is assigned to these areas.

Urban Land - Gently sloping to nearly level areas where more than 80 percent of the land surface has been covered by impervious surfaces such as concrete, asphalt, and buildings. Urban Land is generally not assigned to any Hydrologic Soil Group except in Bergen County where it is assigned to Group D. The mapped units for the various soils may include some Urban Land in a “soil – Urban Land Complex,” typically containing 25 to 40 percent Urban Land.

Wethersfield Series Soils - Very deep, nearly level to steep, well drained loamy soils formed in dense glacial till derived mostly from reddish sandstone, shale, and conglomerate with some basalt on till plains, low ridges, and drumlins. Permeability is moderately rapid or moderate in the solum and slow or very slow in the dense substratum. Surface runoff is negligible to high. These soils are assigned to Hydrologic Soil Group C. They are associated with Cheshire and Holyoke soils.

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