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BINGHAM WIND PROJECT

Located in Bingham, Maine
Portions of the project are also in the unorganized townships
of Mayfield and Kingsbury Plantation

SOIL NARRATIVE REPORT

February, 2013

PREPARED FOR:

Stantec Consulting Services, Inc.

by

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1.0 Introduction

Albert Frick Associates hereby provides the Soil Survey for the Bingham Wind Project in the organized town of *Bingham*, Maine. Portions of the project are also in Mayfield and Kingsbury Plantation. This Soil Survey includes:

- a Class L level of soil survey as required by *Maine Department of Environmental Protection* for *linear* projects (e.g. wind projects) in the area of the proposed turbine sites and proposed road alignment, and
- a High Intensity Class B Soil Survey at the proposed operations and maintenance building location, and project substation, both located in Mayfield.

1.1 Overview of Project and Location

Blue Sky West, LLC and Blue Sky West II, LLC (Applicants) subsidiaries of First Wind Energy, LLC, have proposed construction of the Bingham Wind Project (project), a utility-scale wind energy facility in Mayfield Township, Kingsbury Plantation, Moscow, Parkman, Abbot, and Bingham, in Somerset and Piscataquis Counties, Maine The project includes 62 turbines (63 potential turbine locations are being permitted) in Bingham, Kingsbury, and Mayfield capable of generating up to 191 megawatts (MW) of electricity. Other project features include: upgrades to existing roads, and new roads, to access the turbines and crane paths; up to 5 permanent and up to five temporary meteorological (met) towers; an Operations and Maintenance (O & M) building in Mayfield; above and below ground 34.5 kilovolt (kV) electrical collector lines among the turbines (the majority of which will be buried alongside project roads) and connecting to a new collector substation in Mayfield; and an approximately 17-mile 115 kV electrical generator lead transmission line connecting to an existing Central Maine Power (CMP) substation in Parkman, Maine.

2.0 Purpose

This investigation is a Class L (linear) soils survey for the proposed project, as required by the Maine Site Location of Development Act. A Class L Soil Survey for linear wind power projects is concentrated in the areas of proposed access roads, turbine pads, and laydown areas. The purpose of this Class L soils investigation is to provide soil information for the proposed wind power project along the proposed corridors of the access road alignment, and within the proposed turbine pad sites and laydown areas. More specifically, the purpose of this Class L soil survey is to identify and quantify soil limitations at the site for the proposed wind power development, particularly with respect to any design accommodations that may be necessary to address soil drainage, physical properties and/or depths to bedrock class.

The purpose of the High Intensity Class B Soil Survey at the O&M building site and project substation is to identify any soils limitations to more intensive use.

The *Maine Department of Environmental Protection* and the *Maine Land Use Planning Commission* are interested in project designs that retain hydraulic connections and maintain the natural perched ground water and surface run-off pattern as much as is feasible. This is relevant to this project, where there are traversing road alignments along the side slopes, which are subject to long drainage watersheds with perched ground water flows and surface water runoff. Currently, the *state of the art* of access road designs is to maintain a continued hydraulic connection between the upslope and downslope sides of new road beds, by allowing water to pass through as sheet flow and to minimize large channelized flow. A *rock sandwich* (aka *French mattress* per Penn State technical bulletin) is one such technique, which will be employed at the Bingham Wind Project, and/or other techniques as specified by the *DeLuca-Hoffman* engineers designing the access road.

Albert Frick Associates' soil scientists examined the proposed access road corridors, and turbine sites, identifying and survey-locating areas of soils which are:

1. poorly to somewhat poorly drained;
2. exhibit oxyaquic-like conditions (soils subjected to oxygen rich, seasonally perched ground water after rainfall events, e.g. early spring, late fall and during periods of heavy precipitation. These soils may exhibit more than one

color or streaking, caused by differential organic matter accumulation in soil profile horizons);

3. intermittent drainages not included in wetland delineation streams;
4. subterranean streams [or flow channels]; or
5. natural drainage swales that have potential to concentrate surface water runoff during periods of spring snowmelt, late fall rainfall, and/or during periods of extended heavy precipitation.

Where associates field-identified soil areas that should be subject to drainage considerations in the development plans, it was so noted on the soils plan.

In order to simplify the soils review, we overlaid a composite road alignment plan depicting cut and fill, grading, erosion and sediment control, cross-drainage techniques, and culverts onto the soils map.

3.0 Methodology

Albert Frick Associates performed soils identification, mapping and soil surveys in accordance with the standards adopted by the *Maine Association of Professional Soil Scientists (February 2004 as revised)* for *Class L* soil surveys for the proposed access road and proposed turbine sites and *Class B* for the proposed O&M building site.

The proposed road alignment, turbine sites, project substation, laydown areas, and O & M building site were examined in the field on November 9, 10, 16, 17 and 18, 2010, December 9, 10 and 15, 2010, November 1, 2, 3, 4, 8, and 9, 2011, September 20, 21, 25, 26, and November 6, 7, 12 and 28, 2012. *Albert Frick or James Logan,* Maine Certified Soil Scientists, accompanied by a Field Technician with Global Positioning Systems (GPS) unit [Trimble GeoXT submeter accuracy] performed the field work. The latitude and longitude coordinates were recorded in UTMNAD 83 Zone 19 U.S. foot. The civil design team provided amendments to the road alignment, turbine site, project substation, laydown areas and O & M building sites, and subsequent field work was done to address these design changes.

Soils are described using standard soil terminology developed by the *USDA Natural Resources Conservation Service*, which is also where soil interpretation records originate for each soil series described in Maine. Where important distinctions between hydric and non-hydric soils are made in the mapping, the *Maine Association of Professional Soil Scientists Key to Soil Drainage Classes* was also utilized, as well as a separate list of regional indicators for identification of hydric soils (*Field Indicators for Identifying Hydric Soils in New England, version 3 2004*).

The Bingham Wind Project is sited in a somewhat remote forested area. Consequently, it was not feasible to utilize mechanized equipment (i.e., backhoe excavation, drilling rig) due to inaccessibility in this remote location. In such situations, the soil mapping standards allow for use of a tile spade shovel, hand soil auger, and tile probe to excavate test pits to a depth of 40 inches or until refusal due to encountering bedrock, large boulders, or basal lodgment till.

Field work consisted of documenting soil morphology and characteristics with hand dug test pits, borings and probes to bedrock and/or refusal. We identified test pits on-site with numbered flagging tape. Field staff located each test pit by submeter GPS. Soil types were identified and depicted on the proposed project Site Plan 1” = 100’.

Additional confirmatory soil borings/observations by soil auger were done to assist in the placement of soil map unit boundaries onto the soil survey base map. Field staff located observed bedrock outcroppings by GPS survey to further identify shallow to bedrock soil map units, and project the relative depth to bedrock in the soil map units.

Soil map units were designed and structured to report the pertinent soil characteristics along with possible soil limitations for the proposed use and management of a wind power project site, so that the design team could take such limitations into account. Here, soil drainage is the primary concern in identifying soil limiting factors. Therefore, we used *ad hoc* symbols in places on the map to provide more detailed information about bedrock outcropping locations, groundwater seeps, surface water runoff, soil areas comprised of *oxyaquic*-like soils, intermittent and perennial streams or watercourses, and other natural features encountered within the project area. We provided this additional detailed information where we anticipated that civil engineers should further evaluate the need for special cross drainage culverting, and/or erosion and sediment control measures.

A preliminary soils map was developed by obtaining the electronic layer of the *U.S. Natural Resource Conservation Service* medium intensity map, and importing the soil boundary information into the project CAD file. This was utilized for a preliminary soil map and the entire project area was reviewed in the field along the proposed access road corridor, turbine sites, and laydown areas. Soil test pit excavations and descriptions were performed to upgrade, refine, and modify the map within the project borders.

The soils data provide information useful for engineering by anticipating existing and proposed conditions with regards to *depth to bedrock*, that will affect blasting, benching techniques, and source of road building materials and/or cost; *soil drainage characteristics* that will affect road hydraulic cross-drainage, culverting frequency and sizing, storm water design, erosion and sediment control, and *soil textures/slopes* that will affect erosion potential.

4.0 Site Location/Setting

The proposed Bingham Wind Project area consists of moderately sloping to steeply sloping topography, and is currently comprised mainly of undeveloped land managed for commercial timber.

5.0 General Site and Subsurface Conditions

The site primarily includes forested side slopes and ridgelines. Soil landforms generally consist of *loam* and *sandy loam* soils derived from glacial till. The tops of the ridgelines are generally bedrock controlled, and consequently exhibit shallow to bedrock soil conditions. The sideslopes tend to be comprised of deeper soils (ie. +40” in depth), which are *loam* to *sandy loam* textured soils generally derived from glacial till. These soils commonly exhibit a firm substratum that produces a perched ground water table.

6.0 Soil Map Unit Descriptions

The kinds of map units used in a survey depend primarily on the purposes of the survey and the pattern of the soils and miscellaneous areas in the landscape. The pattern in nature is fixed, and it is not exactly the same in each delineation of a given map unit. In soil surveys, these patterns must be recognized, and map units designed to meet the major objectives of the survey. It must be remembered that soil interpretations are made for areas of land, and the most useful map units are those that group similarities.

The soil map unit descriptions included in Appendix C provide details regarding the soil series encountered and the composition of soils within the given map unit (both for the range of soil characteristics and the potential similar and dissimilar soil within the soil map unit). Soil map units with multiple names are generally listed in order of their prevalence within the map unit. Slope gradient ranges are also provided, and refer to slope phases indicated in the soil survey map and in the soil legend. The soil narrative report is provided to describe the soil composition and physical characteristics, the general soil limitations, and related recommendations for the proposed use and management. The soils map depicts the spatial location of the soil or soils within the project site.

7.0 Conclusions and Recommendations

Based on our observations of the project site, and our knowledge of the proposed use of the property, the soils within the development area are suitable for the proposed use, with the following notable exceptions:

> *Recommend providing road cross drainage of the natural perched and surface water flow in the specified areas of the soil map located within the cross-hatched blue area as shown on the plans. (Civil engineers should consider rock sandwich*

[aka French mattress], frequent cross culverts, drainage turn-outs to maintain and maximize sheet flow, and standard road construction techniques where appropriate, per their opinion).

Albert Frick, Soil Scientist, of Albert Frick Associates, Dale Knapp of Stantec, and Stephen Blake, P.E. of DeLuca-Hoffman met on January 3, 2013 to review the proposed road alignment, road grading and soil properties and conditions, and discuss applicable erosion sediment control and drainage techniques.

The nearly level, moderately sloping glacial till soils that are moderately well drained or well drained are generally suitable for the proposed use, although some modifications to drainage or slope may be needed to improve conditions.

The somewhat poorly drained soils, where seasonal high groundwater tables are within 12 inches of the mineral soil surface for a significant portion of the year, may require additional measures such as the addition of coarse granular fill, rock sandwich, or the installation of upslope curtain drain to intercept sheet flow drainage, to overcome limitations.

The poorly or very poorly drained hydric soils have further limitations due to prolonged wetland and frost susceptibility, and may have additional permitting implications, if identified as wetland areas.

The proposed area currently is a “working” forest subject to forestry management and timber harvesting. Consequently, there is an array of existing graveled roads that currently access the project area. These existing roads are accessible by 2-wheel and 4-wheel drive vehicles. However, proposed new roads and proposed road upgrades have been subjected to substantially more review of soils, wetlands, topographic mapping, and extensive civil engineering proven practices of soil and erosion control standards for year-round access road construction.

APPENDIX A

Limitations

This soil narrative report and accompanying soil survey map have been prepared for the exclusive use of *Stantec Consulting* for its specific application to the proposed Bingham Wind Project in and around *Bingham*, *Maine*. Albert Frick Associates, Inc. conducted the work in accordance with generally accepted soil science practices outlined in the *Maine Association of Professional Soil Scientists Guidelines*, and the *Maine Board of Certification of Geologists and Soil Scientists Guidelines*. Further, presentation of mapping information meets the requirements of Guidelines for Maine Certified Soil Scientists for Soil Identification and Mapping (2004 as revised), and in accordance with standards adopted by the Maine Department of Environmental Protection (MDEP) for project review. No other warranty, expressed or implied, is made.

It should be recognized that map unit design is influenced by the intended use of the soil survey information, and may not be adequate or sufficient to evaluate for uses other than that for which the specific soil survey was developed. Soils which are non-limiting for one use may be considered a limitation for different use than that identified.

The analysis contained herein is based on data obtained during subsurface exploration of the site, and the interpretation of published information by the *USDA Natural Resources Conservation Services*. Due to the glaciation of Maine, and the complexity of the landscape, variations in subsurface conditions may exist between exploration sites which may not become evident until significant project excavation begins. Should significant variations in subsurface conditions become evident after the submission of this report, it may be necessary to re-evaluate the nature of the variation in light of the recommendations enclosed herein.

Due to the combination of remoteness, current inaccessibility of heavy excavation equipment (e.g. backhoe, excavator, drill auger), *Albert Frick Associates'* Soil Scientists utilized hand shovels, tile probes and soil augers. *Refusal* or depth limitation to hand operated equipment may be due to bedrock and/or large stone or boulders.

APPENDIX B

Maine Association of Professional Soil Scientists Standards

<u>Class L (Linear) Soil Survey Map</u>

Purpose - This soil survey standard is designed to provide the minimum soil information necessary to allow for the design and construction of long but narrow projects such as access roads, utility lines or trails with little or no adjacent development. In remote, difficult to access sites such as mountains or road-less areas, soil observations may be made entirely by use of a hand shovel, screw or Dutch auger. For areas which are more accessible, deeper soil observations should be made in order to properly classify the soils.

1. Class L soil survey map units shall be made on the basis of parent material, slope, soil texture, soil depth to dense till or bedrock (whichever is shallowest) and soil wetness (drainage class and/or oxyaquic-like conditions) at the Class A High Intensity Map Unit size. The preferred method of naming the soil map units is by assigning a soil series name or names for complexes. If soils are classified to the series level in remote areas not readily accessible to equipment and/or without road cuts, it shall be noted in the narrative that soils were classified by shallow observations only.

2. Scale is 1 inch equals 100 feet or larger (e.g. 1”=50’).

3. Ground Control - base line and test pits for which detailed data are recorded are located to sub-meter accuracy under the direction of a qualified professional.

4. Base map with two foot contour lines.

<u>Class B Soil Survey Map</u>

1. Mapping units of 1 acre or greater
2. Scale of 1” = 200 or larger
3. Up to 35% inclusions in mapping units of which no more than 25% may be dissimilar soils
4. Ground control - test pits located from known, surveyed, control points
5. Base map with 5’ contour lines

APPENDIX C

Soil Map Unit Descriptions

ABRAM
(Frigid Lithic Haplorthods)

SETTING

Parent Material: Thin very shallow mantle of glacial till over bedrock

Landform: On mountains and high elevations

Position in Landscape: Uppermost portions of landscape

Slope Gradient Ranges: **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Well drained to excessively well drained

Typical Profile Description:
Surface layer: Pinkish gray sandy loam, 0-2"
Subsurface layer: Very dusky red to brown sandy loam, 2-10"
Bedrock: Less than 10" (typical)

Hydrologic Group: D (Abram/Rock Outcrop)

Permeability: Moderately rapid in organic layers, moderate or moderately rapid on the mineral horizon

Depth to Bedrock: Very shallow, 0-10"

Hazard to Flooding: None

Erosion Factors: k: .17 - .32

INCLUSIONS
(Within Mapping Unit)

Similar: Ricker (cryic) Knob Lock (frigid), Saddleback, Hogback, Rawsonville, Rock Outcrop, Lyman, Tunbridge

Dissimilar: Naskeag, Dixfield

USE AND MANAGEMENT

Development of Wind Power Projects: Soils within this map unit are generally suited to the proposed use, in that they generally have no limitations due to wetness, and shallow depths to bedrock can provide stable and solid anchoring points for wind turbine bases, or can be a source of road construction material if bedrock is processed.

BRAYTON
(Aeric Haplaquepts)

SETTING

Parent Material: Compact loamy glacial till.

Landform: Depressions and toeslopes of glaciated uplands.

Position in Landscape: Lowest positions on landform.

Slope Gradient Ranges: **(A)** 0-3% **(B)** 3-8%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Poorly drained, with a perched water table 0 to 1.0 feet beneath the soil surface from November through May or during periods of excessive precipitation.

Typical Profile Description:

Surface layer:	Very dark grayish brown sandy loam, 0-5"
Subsurface layer:	Grayish brown sandy loam, 5-15"
Subsoil layer:	Olive gray fine sandy loam, 15-24"
Substratum:	Olive sandy loam, 24-65"

Hydrologic Group: Group C

Surface Run Off: Moderate to moderately rapid.

Permeability: Moderate in solum, moderately slow or slow in dense substratum.

Depth to Bedrock: Deep, greater than 40 inches.

Hazard to Flooding: None

Erosion Factors: K: .24 - .32

INCLUSIONS
(Within Mapping Unit)

Similar: Colonel, Monarda, Telos, and Pillsbury

Dissimilar: Naskeag, Peacham, Waskish

USE AND MANAGEMENT

Development of Wind Power Projects: Soil limiting factor is high ground water table. Brayton is a hydric (wetland) soil. Areas within the Brayton soil series mapping unit may be jurisdictional wetland, if hydrology and wetland vegetation co-exist, and subjected to wetland impact regulations. Roadway and associated development will need to avoid these areas which are designated wetlands, or property addressed with the wetland impact requirements.

BRAYTON-COLONEL COMPLEX
(Aeric Haplaquepts)

SETTING

Parent Material: Compact loamy glacial till.

Landform: Depressions and toeslopes of glaciated uplands.

Position in Landscape: Lowest positions on landform.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Poorly drained (Colonel) to somewhat poorly drained (Brayton), with a perched water table 0 to 1.5 feet beneath the soil surface from November through May or during periods of excessive precipitation.

Typical Profile Description: (for Brayton)

Surface layer: Very dark grayish brown sandy loam, 0-5"
Subsurface layer: Grayish brown sandy loam, 5-15"
Subsoil layer: Olive gray fine sandy loam, 15-24"
Substratum: Olive sandy loam, 24-65"

Typical Profile Description: (for Colonel)

Surface layer: Grayish brown fine sandy loam, 0-2"
Subsurface layer: Dark reddish brown fine sandy loam, 2-12"
Subsoil layer: Light olive brown gravelly fine sandy loam, 12-18"
Substratum: Olive gravelly fine sandy loam, 18-65"

Note: These soils occur in a non-regular, non-repeating pattern, which could not be separated out in mapping. Predominant pit/mound micro-relief typically consists of somewhat poorly drained Colonel soils on mounds, and hydric Brayton soils within pits. Brayton forms the predominant characteristic of the map unit.

Hydrologic Group: Group C

Surface Run Off: Moderate to moderately rapid.

Permeability: Moderate in solum, moderately slow or slow in dense substratum.

Depth to Bedrock: Deep, greater than 40 inches.

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Colonel, Westbury

Dissimilar: Naskeag, Peacham

USE AND MANAGEMENT

Development for wind power projects: The limiting factor for construction of roads and wind power projects is wetness due to a perched water table within one foot of the soil surface for a significant portion of the year. Proper sub-grade drainage or other site modification is recommended for road construction. Diversion of upslope drainage away from project areas will assist in the preparation of road basefills and continued stability of constructed road. Brayton (Poorly Drained) may be classified as wetlands, based on the combined consideration of hydric conditions, hydrology, and vegetation. The stony phase of this map unit has up to 15% of the soil surface covered with stones or boulders, which may present further limitations for vehicular traffic.

BURNHAM
(Frigid Histic Humaquepts)

SETTING

Parent Material: Coarse-loamy glacial till.

Landform: Nearly level to sloping soils.

Position in Landscape: Occupies lower positions in the landscape, base of long slopes, swales, and depressional areas.

Slope Gradient Ranges: **(A)** 0-3%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Very poorly drained with a perched ground water table 0 to 0.5 feet beneath the soil surface from October to May and during periods of heavy precipitation. May be ponded from time to time.

Typical Profile Description:

Surface layer:	Black to dark reddish brown muck (organic), 0-13"
Subsurface layer:	Mottled gray, gravelly silt loam, 13-34"
Substratum:	Mottled dark grayish brown, gravelly silt loam, 34-65"

Hydrologic Group: Group D

Permeability:

0-2.0"	0.6 - 2.0 in/hr
> 2.0"	0.06 - 2.0 in/hr

Depth to Bedrock: Greater than 60".

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Chesuncook, Monarda, Telos, Biddeford

Dissimilar: Naskeag, Peacham

USE AND MANAGEMENT

Development of wind power projects: The soil limitation of Burnham soil for site development is the very poorly drained characteristic. Burnham soil is hydric and most likely is classified as jurisdictional wetland. Special erosion and sediment control techniques are recommended, due to thick organic surface horizons and seasonal high groundwater tables at or near the soil surface for long durations during the growing season.

CHESUNCOOK
(Typic Haplorthods)

SETTING

Parent Material: Loamy glacial till.

Landform: Glaciated uplands.

Position in Landscape: Side slope.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Moderately well drained, with a perched water table 1.5 to 3.0 feet beneath the existing soil surface March through May and during periods of excessive precipitation.

Typical Profile Description:

Surface layer:	Dark reddish brown organic, 0-3"
Subsurface layer:	Light gray, dark reddish brown to reddish brown and yellowish brown silt loam and loam, 3-14"
Subsoil layer:	Olive brown to grayish brown, gravelly loam, 14-24"
Substratum:	Olive gravelly loam, 24-36"

Hydrologic Group: Group C

Permeability: Moderate in the solum, moderately slow or slow in the compact substratum.

Depth to Bedrock: Very deep, greater than 60 inches.

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Dixfield, Berkshire, Skerry

Dissimilar: Telos, Monson, Thorndike, Elliotsville (less than 40" to bedrock), Tunbridge, Lyman, Colonel

USE AND MANAGEMENT

Development of wind power projects: The limiting factor for site development is wetness due to the presence of a perched water table 1.5 to 3.0 feet beneath the soil surface for some portion of the year. Proper foundation drainage or other site modification is recommended for construction. Chesuncook soil is generally suitable for construction of wind power projects, for both turbine pad placement and road construction.

COLONEL
(Aquic Haplorthods)

SETTING

Parent Material: Compact loamy glacial till.

Landform: Glaciated uplands.

Position in Landscape: Intermediate positions on landform.

Slope Gradient Ranges: **(A)** 0-3% **(B)** 3-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat poorly drained, with a perched water table 1.0 to 1.5 feet beneath the soil surface from November through May or during periods of excessive precipitation.

Typical Profile Description:

Surface layer:	Grayish brown fine sandy loam, 0-2"
Subsurface layer:	Dark reddish brown fine sandy loam, 2-12"
Subsoil layer:	Light olive brown gravelly fine sandy loam, 12-18"
Substratum:	Olive gravelly fine sandy loam, 18-65"

Hydrologic Group: Group C

Surface Run Off: Moderate

Permeability: Moderate in solum and moderately slow or slow in the compact substratum.

Depth to Bedrock: Deep, greater than 40 inches.

Hazard to Flooding: None

Erosion Factor: K: .17 - .24

INCLUSIONS
(Within Mapping Unit)

Similar: Dixfield, Skerry, Westbury, Telos

Dissimilar: Naskeag, Brayton

USE AND MANAGEMENT

Development of Wind Power Projects: The limiting factor of this soil for development of wind power projects is wetness, since Colonel soils exhibit a perched water table within 15" of the ground surface throughout much of the year. Proposed activities near the bottom of long sideslopes may be subject to considerable runoff. Maintaining cross drainage beneath proposed roads will help to assure stable road bases, and to avoid concentration of stormwater flows. The stony phase of these mapping units has up to 15% of the soil surface covered with stones or boulders, which may add further limitations for vehicular traffic.

DIXFIELD
(Typic Haplorthods)

SETTING

Parent Material: Compact loamy glacial till.
Landform: Glaciated uplands and drumlins.
Position in Landscape: Upper portions of landform.
Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Moderately well drained, with a perched water table 1.5 to 2.5 feet beneath the existing soil surface from November through April and during periods of excessive precipitation.

Typical Profile Description:

Surface layer:	Grayish brown and dark brown fine sandy loam, 0-6"
Subsurface layer:	Strong brown and dark yellowish brown fine sandy loam, 6-19"
Subsoil layer:	Light olive brown gravelly fine sandy loam, 19-24"
Substratum:	Light olive brown gravelly sandy loam, 24-65"

Hydrologic Group: Group C

Surface Runoff: Moderate in the solum, moderately slow or slow in the compact substratum.

Permeability: Moderate in the solum, moderately slow or slow in the compact substratum.

Depth to Bedrock: Very deep, greater than 60".

Hazard to Flooding: None

Erosion Factors: K: .17 - .24

INCLUSIONS
(Within Mapping Unit)

Similar: Marlow, Chesuncook

Dissimilar: Colonel, Tunbridge (20-40" to bedrock), Lyman, Elliotsville

USE AND MANAGEMENT

Development with Wind Power Projects: Dixfield soils are generally suited for development of wind power projects, in that these soils are moderately well drained with dense basal till substratum. Depths to seasonal high groundwater table can be overcome by redirection of surface water runoff, and/or importation of coarse granular fill, or by providing adequate cross-drainage techniques.

DIXMONT
(Aquic Haplorthods)

SETTING

Parent Material: Glacial till formed in dark gray fine-grained quartzite, phyllite and some calcareous sandstone.

Landform: Upland sideslopes, toeslopes and low knolls on glaciated plains.

Position in Landscape: Upper or intermediate positions in landscape on convex slopes.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Moderately well drained with a seasonal high groundwater table 1.5 - 3.0 feet beneath the soil surface from November through April and during periods of excessive precipitation.

Typical Profile Description:

Surface layer:	Dark grayish to dark reddish brown silt loam, 0-9"
Subsurface layer:	Brown to dark brown silt loam, 9-17"
Subsoil layer:	Dark grayish brown silt loam, 17-21"
Substratum:	Olive gray silt loam, 21-60".

Hydrologic Group: Group C

Surface Run Off: Medium

Permeability: Moderate in solum, moderately slow to slow in substratum

Depth to Bedrock: Deep, greater than 60"

Hazard to Flooding: None

Erosion factors (Kf): 0-5"-.24
5-65"-.32

INCLUSIONS
(Within Mapping Unit)

Similar: Dixfield, Chesuncook

Dissimilar: Rock Outcrop, Thorndike, Elliotsville, Telos, and Colonel

USE AND MANAGEMENT

Development of Wind Power Projects: The limiting factor for development of wind power projects is wetness, due to the presence of a seasonal high groundwater table 1.5 to 3.0 feet beneath the soil surface from November through April and during periods of excessive precipitation.

ELLIOTSVILLE
(Frigid Typic Haplorthods)

SETTING

Parent Material: Loamy glacial till.

Landform: Glaciated uplands.

Position in Landscape: Upper positions on landform.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20% **(D)** 20+%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Well drained, with no evidence of a water table, or only inches from the bedrock surface during spring and during periods of heavy precipitation.

Typical Profile Description:

Surface layer:	Black and dark reddish brown silt loam to loam, 0-4"
Subsurface layer:	Dark reddish brown silt loam to loam, 4-10"
Subsoil layer:	Dark reddish brown loam, 10-15"
Substratum layer:	Light olive brown to olive, 15-20". Bedrock at 20-40".

Hydrologic Group: Group B

Surface Run Off: Rapid

Permeability: Moderate or moderately rapid, 0.6 to 2.0 inches/hour.

Depth to Bedrock: Moderately deep, 20-40".

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Dixfield, Tunbridge, Chesuncook, Dixmont

Dissimilar: Lyman, Naskeag

USE AND MANAGEMENT

Development of wind power projects: The limiting factor for development of wind power projects and proposed roads is depth to bedrock. Moderately deep depths to bedrock are suitable for anchoring wind turbines.

ELLIOTSVILLE (Variant) (SWP)

SETTING

Parent Material: Loamy glacial till.

Landform: Glaciated uplands.

Position in Landscape: Upper positions on landform.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: While Elliotsville is typically well drained, with no evidence of a water table, or only inches from the bedrock surface during spring and during periods of heavy precipitation. However, this mapping unit consists of moderately deep (20-40") soils that are predominantly somewhat poorly drained with seasonal high groundwater table within 15" of the soil surface.

Typical Profile Description:

Surface layer:	Black and dark reddish brown silt loam to loam, 0-4"
Subsurface layer:	Dark reddish brown silt loam to loam, 4-10"
Subsoil layer:	Dark reddish brown loam, 10-15"
Substratum layer:	Light olive brown to olive, 15-20". Bedrock at 20-40".

Hydrologic Group: Group B

Surface Run Off: Rapid

Permeability: Moderate or moderately rapid, 0.6 to 2.0 inches/hour.

Depth to Bedrock: Moderately deep, 20-40".

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Dixfield, Tunbridge, Thorndike

Dissimilar: Lyman Variant, Naskeag

USE AND MANAGEMENT

Development of wind power projects: The limiting factor for development of wind power projects and proposed roads is wetness, due to the presence of seasonal high groundwater table within 15" of the soil surface. Redirecting surface water and/or the use of sound engineering practices can overcome limitations due to drainage. Moderately deep depths to bedrock are suitable for anchoring wind turbines.

LYMAN (Hollis)
(Lithic Haplorthods)

SETTING

Parent Material: Derived from glacial till.

Landform: Rocky hills and high plateaus.

Position in Landscape: Occupies the higher positions in the landscape on knolls, hills and mountains.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat excessively drained. Water table usually not present but may exist on top of the underlying bedrock in concave pockets in places during prolonged wet periods.

Typical Profile Description:

Surface layer:	Black loam, 0-2"
Subsurface layer:	Reddish gray fine sandy loam, 2-4"
Subsoil layer:	Very dusky red, dark red to brown loam to sandy loam, 10-20"

Hydrologic Group:

Group C:	When bedrock is known to be cracked or impervious.
Group D:	When bedrock is impervious or if soil is in the extremely rocky class.

Surface Run Off: Slow to rapid depending on slope and bedrock exposure.

Permeability: Moderately rapid.

Depth to Bedrock: Shallow, 8-20".

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Tunbridge, 20-40" to bedrock, Dixfield (greater than 40" to bedrock)

Dissimilar: Rock outcrop, Naskeag

USE AND MANAGEMENT

Development of Wind Power Projects: Lyman soil is generally well-suited for construction of wind power projects, in that it generally exhibits no seasonal water table and the shallow to bedrock soil depths can provide for solid anchoring points into the bedrock surface.

LYMAN-TUNBRIDGE COMPLEX

SETTING

Parent Material: Loamy glacial till.

Landform: Glaciated uplands.

Position in Landscape: Upper positions on landform.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat excessively to well drained, with no evidence of a water table, or only inches from the bedrock surface during spring and periods of heavy precipitation.

Typical Profile Description:

Surface layer:	Black & reddish brown loam & fine sandy loam, 0-4"
Subsurface layer:	Very dusky red loam, 4-6"
Subsoil layer:	Dark red loam, 6-10"
Substratum layer:	Dark brown to brown loam, 10-20"

Hydrologic Group: Group C/D

Surface Run Off: Rapid

Permeability: Moderate or moderately rapid.

Depth to Bedrock: Shallow (Lyman, 10-20") to moderately deep (Tunbridge, 20-40").

Hazard to Flooding: None

Erosion Factors: K: .20 - .32

INCLUSIONS
(Within Mapping Unit)

Similar: Dixfield (deeper than 40" to bedrock), Elliotsville

Dissimilar: Naskeag (in depressional areas), Colonel, Brayton

USE AND MANAGEMENT

Development of Wind Power Projects: Lyman and Tunbridge soils are generally well-suited for construction of wind power projects, in that they generally exhibit no seasonal water table and the shallow to bedrock soil depths can provide for solid anchoring points into the bedrock surface.

LYMAN-TUNBRIDGE-ROCK OUTCROP COMPLEX

SETTING

Parent Material: Loamy glacial till.

Landform: Glaciated uplands.

Position in Landscape: Uppermost locations on landform; sideslopes, shoulders, and crests of ridges.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat excessively drained (Lyman) to well drained (Tunbridge) with no apparent water table other than run off across the bedrock surface occasionally, during spring and periods of heavy precipitation. These soils occur in a non-repeating pattern with exposed bedrock outcrop, and cannot be separated in mapping.

Typical Profile Description:

Surface layer:	Black & reddish brown loam & fine sandy loam, 0-4"
Subsurface layer:	Very dusky red loam, 4-6"
Subsoil layer:	Dark red loam, 6-10"
Substratum layer:	Dark brown to brown loam, 10-20"

Hydrologic Group: Group C/D

Surface Run Off: Slow to rapid depending on slope and bedrock exposure.

Permeability: Moderately rapid.

Depth to Bedrock: Shallow (Lyman 10-20") to moderately deep (Tunbridge 20-40").

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Dixfield (deeper than 40" to bedrock)

Dissimilar: Colonel (greater than 40" to bedrock), Naskeag (in micro-depressions)

USE AND MANAGEMENT

Development of Wind Power Projects: The limiting factor for site development is wetness due to the presence of a water table 1.5 to 3.5 feet beneath the soil surface for some period during the year and bedrock in Tunbridge soils that is less than 40" from the soil surface.

MADE LAND

SETTING

Parent Material: Variable

Landform: Variable

Position in Landscape: Variable

Slope Gradient Ranges: **(A)** 0-3% **(B)** 3-8%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: None assigned

Typical Profile Description:	**Surface layer:**	) Typically this map unit
	Subsurface layer:	) consists of areas
	Subsoil layer:	) excavated and reworked
	Substratum:	) by man, then smoothed.

Hydrologic Group: None assigned

Surface Run Off: Variable

Permeability: Variable

Depth to Bedrock: Variable

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Filled Land, Udorthents

Dissimilar: Small 'made' depressions that contain standing water or have other drainage implications. These may be caused by compaction by vehicular traffic, which are not synonymous with seasonal water tables.

USE AND MANAGEMENT

This map unit consists of areas reworked by man, so that the soils are no longer taxonomically classifiable. Limiting factor for development is soil drainage, though somewhat difficult to determine in these map units. Proper drainage or other site alterations recommended for construction.

MASARDIS
(Typic Haplorthods)

SETTING

Parent Material: Glacio-fluvial deposits.

Landform: Terraces, kames, eskers, and outwash plains.

Position in Landscape: Upper portions of landforms.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Excessively drained, with no observed water table within 6 feet of the soil surface.

Typical Profile Description:

Surface layer:	Light grayish brown gravelly fine sand, 0-9"
Subsurface layer:	Dark reddish brown gravelly sandy loam, 9-22"
Subsoil layer:	Yellowish brown gravelly sand, 22-36"
Substratum:	Olive very gravelly sand, 36-50"

Hydrologic Group: Group A

Surface Run Off: Slow

Permeability: Rapid or very rapid in the solum, very rapid in the substratum.

Depth to Bedrock: Very deep, greater than 60".

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Hermon, Adams, Colton

Dissimilar: Sheepscot, Croghan

USE AND MANAGEMENT

Development of Wind Power Projects: Masardis soils are suitable for subsurface wastewater disposal in accordance with State of Maine Rules for Subsurface Wastewater Disposal, and the development of wind power projects. This map unit may provide suitable materials for use as road subgrades, etc.

MONARDA
(Aeric Haplaquepts)

SETTING

Parent Material: Loamy glacial till.

Landform: Nearly level to sloping soils.

Position in Landscape: Occupies lower positions in the landscape, base of long slopes, swales, and depressional areas.

Slope Gradient Ranges: **(A)** 0-3% **(B)** 3-8%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Poorly drained with a perched groundwater table 0 to 1.5 feet beneath the soil surface from October through May and during periods of heavy precipitation.

Typical Profile Description:

Surface layer:	Black organic layer, 0-4"
Subsurface layer:	Light brownish gray, gravelly silt loam, 4-9"
Subsoil layer:	Gray, olive gray and olive, gravelly silt loam, 9-33"
Substratum:	Gray, gravelly silt loam, 33"+

Hydrologic Group: Group D

Permeability: Moderate to moderately slow in the solum, moderately slow to slow in the substratum.

Depth to Bedrock: Deep, greater than 60".

Hazard to Flooding: None, except adjacent to small waterbodies

Erosion Factors (KF): 0-6"-20-.28
6"-65" .32

INCLUSIONS
(Within Mapping Unit)

Similar: Brayton, Telos, Colonel
Dissimilar: Peacham, Elliotsville (Variant)

USE AND MANAGEMENT

Development of wind power projects: The limiting factor for building site development is wetness due to the presence of a high perched water table 0 to 1.5 feet below the existing the soil surface for a significant portion of the year. Monarda soil may be classified as wetlands, based on the combined consideration of hydric conditions, hydrology, and vegetation.

MONSON

SETTING

Parent Material: Coarse-loamy glacial till.

Landform: Glaciated uplands, ridge tops.

Position in Landscape: Uppermost positions of landforms, ridgetops

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat excessively well drained with no water table observed throughout the growing season.

Typical Profile Description:

Surface layer: Dark reddish brown organic material, 0-4"
Subsurface layer: Light gray channery silt loam, 4-5"
Subsoil layer: Dark reddish to yellowish brown silt loam, 6-11"
Substratum: Light olive brown channery silt loam, 11-19"
Slate bedrock @ 19"

Hydrologic Group: Group C/D

Surface Run-off: Rapid

Permeability: 0.6 - 2.0 in/hr

Depth to Bedrock: shallow 10-20"

Hazard to Flooding: None

Erosion Factors (Kf):

0-8" -.28
8"-bedrock surface -.37

INCLUSIONS
(Within mapping unit)

Similar: Telos, Chesuncook, B slope inclusions within C/D map units, Thorndike, Elliotsville

Dissimilar: Naskeag (Variant)

Development of wind power projects: The limiting factor for site development is bedrock, due to depths varying from zero to within 40" of the mineral soil surface. This map unit provides for stable anchoring for tower/turbine construction. Proper foundation drainage or other site modification is recommended for construction.

MONSON-ELLIOTSVILLE COMPLEX

SETTING

Parent Material: Fine-textured glacial till derived from slate and meta sandstone.

Landform: Crests and sideslopes of glaciated uplands.

Position in Landscape: Uppermost of intermediate positions in the landscape.

Slope Gradient Ranges: **(B)** 0-8% **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat excessively to well drained, with no evidence of a water table, except on the bedrock surface for short duration during spring and periods of excessive rainfall. The Monson and Elliotsville soils occur in a non-repeating pattern that cannot be separated out in mapping.

Typical Profile Description: (for Monson)

Surface layer: Dark reddish brown organic material, 0-4"
Subsurface layer: Light gray channery silt loam, 4-5"
Subsoil layer: Dark reddish to yellowish brown silt loam, 6-11"
Substratum: Light olive brown channery silt loam, 11-19"
Slate bedrock @ 19"
Note: Monson soils are 10-20" to bedrock with no dense basal till.

(for Elliotsville)

Surface layer: Pinkish-gray silt loam, 0-2"
Subsurface layer: Dark reddish-brown and strong brown silt loam or loam, 2-11"
Subsoil layer: Light olive brown channery loam, 11-17"
Substratum: Olive channery loam, 17-26"

Hydrologic Group: Group C/D depending on depth to bedrock

Surface Run-off: Moderately rapid to rapid (on exposed bedrock)

Permeability: Moderate to rapid (on exposed bedrock surfaces)

Depth to Bedrock: 0" (rock outcrop) to moderately deep (40")

Hazard to Flooding: None

INCLUSIONS
(Within mapping unit)

Similar: Chesuncook, Dixfield, Lyman, Tunbridge, Thorndike

Dissimilar: D-slopes in C-slope map units, Naskeag, Telos, Monarda

Development for Wind Power Project: The limiting factor for development of wind power projects is depth to bedrock. These soils are generally suited to the proposed use with ample potential for solid anchoring points for wind turbines.

MONSON-RICKER

SETTING

Parent Material: Coarse-loamy glacial till.

Landform: Glaciated uplands, ridge tops.

Position in Landscape: Uppermost positions of landforms, ridgetops

Slope Gradient Ranges: **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat excessively well drained with no water table observed throughout the growing season.

Typical Profile Description:

Surface layer:	Dark reddish brown organic material, 0-4"
Subsurface layer:	Light gray channery silt loam, 4-5"
Subsoil layer:	Dark reddish to yellowish brown silt loam, 6-11"
Substratum:	Light olive brown channery silt loam, 11-19"
Slate bedrock @ 19"	

Hydrologic Group: Group C/D

Surface Run-off: Rapid

Permeability: 0.6 - 2.0 in/hr

Depth to Bedrock: shallow 10-20"

Hazard to Flooding: None

Erosion Factors (Kf):

0-8"	-.28
8"-bedrock surface	-.37

INCLUSIONS
(Within mapping unit)

Similar: Lyman, Abram

Dissimilar: Elliotsville, Tunbridge, Naskeag (Variant)

Development of wind power projects: The limiting factor for site development is bedrock, due to depths varying from zero to within 40" of the mineral soil surface. This map unit provides for stable anchoring for tower/turbine construction. Proper foundation drainage or other site modification is recommended for construction.

MONSON-ROCK OUTCROP COMPLEX

SETTING

Parent Material: Fine-textured glacial till derived from slate and meta sandstone.

Landform: Crests and sideslopes of glaciated uplands.

Position in Landscape: Uppermost of intermediate positions in the landscape.

Slope Gradient Ranges: **(B)** 0-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat excessively to well drained, with no evidence of a water table, except on the bedrock surface for short duration during spring and periods of excessive rainfall. The Monson soils occur in a non-repeating pattern along with the rock outcrop that cannot be separated out in mapping.

Typical Profile Description:

Surface layer: Dark reddish brown organic material, 0-4"
Subsurface layer: Light gray channery silt loam, 4-5"
Subsoil layer: Dark reddish to yellowish brown silt loam, 6-11"
Substratum: Light olive brown channery silt loam, 11-19"
Slate bedrock @ 19"

Hydrologic Group: Group C/D depending on depth to bedrock

Surface Run-off: Moderately rapid to rapid (on exposed bedrock)

Permeability: Moderate to rapid (on exposed bedrock surfaces)

Depth to Bedrock: 0" (rock outcrop) shallow (<20")

Hazard to Flooding: None

INCLUSIONS
(Within mapping unit)

Similar: Chesuncook, Dixfield, Lyman, Tunbridge, Thorndike, Elliotsville

Dissimilar: D-slopes in C-slope map units, Naskeag, Telos, Monarda

Development for Wind Power Projects: The limiting factor for development of wind power projects is depth to bedrock, which is generally less than 20" beneath the soil surface. These soil map units are suited to the proposed use, since they provide for solid anchoring points for wind turbines, with no further limitation due to drainage.

NASKEAG
(Aeric Haplaquods)

SETTING

Parent Material: Loamy and sandy glacial till.

Landform: Depressions of glaciated bedrock ridges.

Position in Landscape: Lowest positions in depressions or concavities in landform.

Slope Gradient Ranges: **(A)** 0-3% **(B)** 3-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat poorly to poorly drained, with a perched water table 0-1.5 feet beneath the soil surface.

Typical Profile Description:

Surface layer:	Very dusky red muck, 0-5"
Subsurface layer:	Light brownish gray and brown sandy loam or loamy sand, 5-16"
Subsoil layer:	Dusky red loamy sand, 10-26"
Substratum:	Light yellowish brown gravelly sandy loam to loamy sand, 26-38"

Hydrologic Group: Group C

Surface Run Off: Moderate or moderately rapid (across bedrock surface)

Permeability: Rapid

Depth to Bedrock: Moderately deep, 20-40" to bedrock surface.

Hazard to Flooding: None, but may be ponded for short duration in spring and during periods of excessive rainfall.

Erosion Factors: .10

INCLUSIONS
(Within Mapping Unit)

Similar: Lyman, Tunbridge, Colonel, Brayton, Swanton, Pillsbury

Dissimilar: Rock Outcrop, Peacham, Naskeag (Variant-V.P.D.)

USE AND MANAGEMENT

Development of Wind Power Projects: The limiting factors for wind power site development are depth to bedrock (generally less than 40") and wetness, due to a water table perched above the bedrock surface. Proper drainage or other site modification is recommended for construction. Naskeag (poorly drained) may be classified as wetlands, based on the combined consideration of hydric conditions, hydrology, and vegetation. The shallow to bedrock soils depth can provide for solid anchoring points into bedrock surface. Additional considerations for engineering may be indicated for cross-drainage and special consideration for heavy equipment traffic during periods of heavy precipitation and/or soils wetness in the Collector Line corridor.

PILLSBURY/PEACHAM COMPLEX

SETTING

Parent Material: **Pillsbury:** Loamy glacial till formed from mica schist and phyllite, with some granite and gneiss.

Peacham: Organic depositions underlain by compact loamy glacial till.

Landform: **Pillsbury:** Concave slopes with glaciated uplands.

Peacham: Depressions and drainageways on glaciated uplands.

Position in Landscape:

Pillsbury: Depressional areas and shallow drainage ways.

Peacham: Lowest positions and depressions on landform.

Slope Gradient Ranges: **(A)** 0-3% **(B)** 3-8%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: **Pillsbury:** Poorly to somewhat poorly drained, with a perched water table at or near the surface from 7-9 months a year.

Peacham: Very poorly drained, with a perched water table within 0.5 feet of the soil surface from November through May.

Typical Profile Description:

Pillsbury:

Surface layer: Black loam, 0-5"
Subsurface layer: Dark grayish brown fine sandy loam , 5-12"
Subsoil layer: Dark grayish brown fine sandy loam, 12-22"
Substratum: Olive brown fine sandy loam, 22-65"

Peacham:

Surface layer: Black organic material, 0-7"
Subsurface layer: Olive gray loam, 7-10"
Substratum: Dark greenish gray loam, 10-65"

Hydrologic Group:

Pillsbury: Group C

Peacham: Group D

Surface Run Off: **Pillsbury:** Slow to medium

Peacham: Moderately rapid to rapid.

Permeability: **Pillsbury:** Moderate in solum, slow in substratum

Peacham: Moderate or moderately slow in upper layers, and slow or very slow in the dense substratum.

Depth to Bedrock: Deep, greater than 40”.

Hazard to Flooding:

Pillsbury: None

Peacham: None, although may be ponded during spring time and periods of excessive precipitation.

Erosion Factors: **Pillsbury:** K: .24 - .32

Peacham: K: .28

INCLUSIONS
(Within Mapping Unit)

Similar: Brayton, Colonel, Whately

Dissimilar: Naskeag, Waskish

USE AND MANAGEMENT

Development of Wind Power Projects: The limiting factor of this soil for development of wind power projects is wetness, due to the presence of seasonal high groundwater table at or near the mineral soil surface for a considerable period of the year. Redirecting runoff and subsurface drainage away from project areas, or importation of loose granular fill, can help overcome limitations for construction due to drainage. Pillsbury soils may also have further limitations and permitting implications, since these areas may also include wetlands on the combined basis of hydric soils, hydrology and hydrophytic vegetation. Adequate hydrologic cross-drainage under roadways is appropriate for this soil map unit (i.e. rock sandwich, culvert cross-drainage, adequate road sub base, etc.). Peacham soil is considered a wetland (hydric) soil, and usually is subjected to wetland permitting requirements, if it is proposed to be impacted. Avoidance of this area, and/or consideration within the environmental wetland permits (DEP NRPA and U.S. ACOE) is recommended.

RICKER
(Dysic Lithic Cryofolists)

SETTING

Parent Material: Thin organic deposits underlain by a thin mineral horizon over bedrock

Landform: On mountains and hills

Position in Landscape: Uppermost portions of landscape

Slope Gradient Ranges: **(C)** 8-20% **(D)** 20%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Well drained to excessively well drained

Typical Profile Description: (Ricker)	**Surface layer:**	Dark reddish brown to black peat, 7-0"
	Subsurface layer:	Dark bluish gray, very channery silt loam, 0 9"
	Substratum:	Bedrock
Hydrologic Group:	**D**	**Note:** NRCS rates as "A", however, Ricker profile in project setting is anticipated to have "D"-like run-off, due to shallow depths to bedrock.

Surface Runoff: Rapid

Permeability: Moderately rapid in organic layers, moderate or moderately rapid on the mineral horizon

Depth to Bedrock: Very shallow

Hazard to Flooding: None

Erosion Factors: K: .17 - .49

INCLUSIONS
(Within Mapping Unit)

Similar: Knob Lock (frigid-slightly warmer than Ricker), Abram, Hogback, Rawsonville, Thorndike, Rock Outcrop, Lyman, Tunbridge

Dissimilar: Naskeag

USE AND MANAGEMENT

Development of Wind Power Projects: The soils within this map unit is generally suited to the development of wind power projects. The shallow depths to bedrock can provide for stable and solid anchoring points for wind tower bases.

TELOS
(Typic Haplorthods)

SETTING

Parent Material: Loamy dense basal till.

Landform: Lower side slopes in glaciated uplands.

Position in Landscape: Nearly level to steeply sloping soils on upland till ridges.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat poorly drained, with a seasonal water table generally 9-15" beneath the soil surface in spring and during wettest seasons.

Typical Profile Description

Surface layer:	Pinkish gray silt loam, 0-4"
Subsurface layer:	Dark reddish to yellowish brown silt loam, 4-15"
Subsoil layer:	Light olive brown silt loam, 15-20"
Substratum:	Olive gravelly silt loam, 20-65"

Hydrologic Group: Group C

Surface Run Off: Slow

Permeability: Moderate in the solum, and slow or very slow in the substratum.

Depth to Bedrock: Very deep, greater than 65".

Hazard to Flooding: None

INCLUSIONS
(Within Mapping Unit)

Similar: Chesuncook, Colonel

Dissimilar: Brayton, Monarda

USE AND MANAGEMENT

Development of wind power projects: The limiting factors for development of wind power projects is wetness. Proper road foundation drainage, or importation of coarse granular fill may be needed to overcome soil drainage limitations.

TELOS-CHESUNCOOK COMPLEX

SETTING

Parent Material: Coarse-loamy glacial till.

Landform: Glaciated uplands.

Position in Landscape: Side slopes.

Slope Gradient Ranges: **(C)** 8-20%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat poorly drained (Telos) to moderately well drained (Chesuncook), with a perched water table 0.5 to 3.0 feet beneath the existing soil surface March through May and during periods of excessive precipitation.

Typical Profile Description: (for Telos)

Typical Profile Description: (for Telos)	**Surface layer:**	Black organic material, 0-2"
	Subsurface layer:	Pinkish gray, gravelly silt loam, 2-5"
	Subsoil layer:	Dark brown, dark yellowish brown, olive, gravelly silt loam, 5-52"
	Substratum:	Olive gravelly silt loam, 52-60"
(for Chesuncook)	**Surface layer:**	Dark reddish brown organic, 0-3"
	Subsurface layer:	Light gray, dark reddish brown to reddish brown and yellowish brown silt loam and loam, 3-14"
	Subsoil layer:	Olive brown to grayish brown, gravelly loam, 14-24"
	Substratum:	Olive gravelly loam, 24-36"
	Note:	These soils occur on the landscape in a regular repeating pattern that was not separated out at the scale provided.

Hydrologic Group: Group C

Surface Run-off: Rapid

Permeability:

Permeability:	Chesuncook:	0-21"	0.6 - 2.0 in/hr
		> 21"	< 0.2 in/hr
	Telos:	0-18”	0.6-2.0 in/hr
		>18”	0.0-0.2 in/hr

Depth to Bedrock: Very deep, greater than 60 inches.

Hazard to Flooding: None

Erosion Factors (Kf): 0-8” -.28
8-65” -.37

INCLUSIONS
(Within Mapping Unit)

Similar: Dixfield, Colonel

Dissimilar: Telos, Monson, Elliotsville (less than 40" to bedrock), D slopes in C slope map units, stony and very stony phase inclusions, Monarda

USE AND MANAGEMENT

Development of wind power projects: The limiting factor for site development is wetness due to the presence of a perched water table 1.0 to 3.0 feet beneath the soil surface for some portion of the year. Proper drainage or other site modification is recommended for construction.

THORNDIKE
(Lithic Haplorthods)

SETTING

Parent Material: Dark gray fine-grained quartzite, slate, phyllite, and some calcareous sandstone glacial till.

Landform: Moderately to strongly sloping ridges and mountaintops.

Position in Landscape: Uppermost portions of landforms, upper sideslopes.

Slope Gradient Ranges: **(C)** 8-15% **(D)** 15-25% **(E)** 25%+

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat excessively drained, generally with no seasonal high groundwater table observed within the soil profile. Drainage water may be present on the bedrock surface for short durations after significant snowmelt or major rainfall events.

Typical Profile Description:

	Surface layer:	Grayish brown channery silt loam, 0-3"
	Subsurface layer:	Dark reddish brown very channery silt loam, 3-10"
	Subsoil layer:	Light olive brown very channery silt loam, 10-18" Bedrock at 18".

Hydrologic Group: Group C/D depending on bedrock exposure.

Surface Run Off: Slow to rapid, depending on slope and bedrock exposure

Permeability: Moderate

Depth to Bedrock: Shallow, 10-20" to bedrock

Hazard to Flooding: None

Erosion factors (Kf): .24

INCLUSIONS
(Within Mapping Unit)

Similar: Elliotsville, Chesuncook, Dixmont, Lyman, Tunbridge

Dissimilar: Monson, Rock Outcrop, Abram, Ricker

USE AND MANAGEMENT

Development of Wind Power Projects: The limiting factor for development of wind power projects is shallow depth to bedrock (10"-20"). Blasting or ripping of the more fractured and weathered bedrock is required for deep excavation. Slopes in excess of 25% may have limitations for vehicular traffic. Thorndike soils generally can provide for substantial anchoring points, since depths to bedrock are practical.

THORNDIKE (Variant-SWP)

SETTING

Parent Material: Coarse-loamy glacial till materials, formed from fine-grained quartzite, slate and some granite.

Landform: Glaciated upland ridges and sidesloping areas above toeslopes.

Position in Landscape: Uppermost and sidesloping shoulders of till ridges and knolls.

Slope Gradient Ranges: **(B)** 3-8% **(C)** 8-15%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Somewhat poorly drained Thorndike with a seasonal high groundwater table 0.5' – 1.0' beneath the soil surface in spring and during periods of excessive precipitation. It is estimated that the Thorndike (Variant-SWP) soils occupy up to 60% of the map unit area. These soils are similar to Naskeag soils, but are found only in the uppermost concavities on large ridgetop landforms.

Typical Profile Description: (for Thorndike)

- **Surface layer:** Grayish brown channery silt loam, 0-3"
- **Subsurface layer:** Dark reddish brown very channery silt loam, 3-10"
- **Subsoil layer:** Light olive brown very channery silt loam, 10-18"
  Bedrock at 18".

Hydrologic Group: Group C/D depending on bedrock exposure.

Surface Run Off: Medium

Permeability: Moderate above fragipan and moderately slow in the fragipan.

Depth to Bedrock: Very deep, greater than 60" for Howland, <40" for Thorndike.

Hazard to Flooding: None

Erosion factors (Kf): 0"-6"-.24
6"-65"-.28

INCLUSIONS
(Within Mapping Unit)

Similar: Bangor, Colonel, Dixmont

Dissimilar: Monarda, Naskeag

USE AND MANAGEMENT

Development of Wind Power Projects: The limiting factor for development of wind power projects and road construction is depth to seasonal high groundwater table, which is 0.5' – 1.0' beneath the soil surface. Regrading or other site modifications may be necessary to mitigate concerns over sheet flow drainage, which can be perched on top of the dense substratum. Proper foundation drainage or import of sandy granular fill is recommended for construction. Slopes in excess of 25% may have limitations for vehicular traffic. Thorndike soils generally can provide for substantial anchoring points, since depths to bedrock are practical.

WONSQUEAK
(Terric Borosaprists)

SETTING

Parent Material: Organic materials over loamy mineral soils depressions.

Landform: Outwash plains, deltas, and terraces.

Position in Landscape: Occupies pockets and low-lying depressions in landform.

Slope Gradient Ranges: **(A)** 0-3%

COMPOSITION AND SOIL CHARACTERISTICS

Drainage Class: Very poorly drained with an apparent water table at or within 0.5 feet of the soil surface for more than six months of the year. These soils occur in a repeating pattern on the landscape and were not separated out in mapping.

Typical Profile Description:

Surface layer: Very dark gray muck, 0-8"
Subsurface layer: Black muck, 8-32"
Substratum: Gray silt loam, 32"+

Hydrologic Group: Group D

Surface Run Off: Slow, or the soil is intermittently ponded.

Permeability: Rapid or very rapid in mineral horizons.

Depth to Bedrock: Very deep, greater than 60".

Hazard to Flooding: Rare, through flooding may occur during spring and periods of excessive rainfall.

INCLUSIONS
(Within Mapping Unit)

Similar: Naumburg Variant - very poorly drained, B slopes in A-slope map unit, Searsport, Brayton

Dissimilar: Organic soils (> 60" deep), Waskish

USE AND MANAGEMENT

Development of Wind Power Projects: The limiting factors for the proposed use are wetness and instability, due to the presence of seasonal high groundwater table at or near the surface for a significant portion of the year, and thick mucky surface horizons. Construction mats may be required for vehicular traffic. Wonsqueak soils are generally classified as wetlands, on the combined basis of wet hydrology, hydrophytic vegetation and hydric soil conditions.

APPENDIX D

Soil Profile Descriptions

APPENDIX E

Glossary Of Soil Terminology

Depth Classes

These refer to the depth of the particle control section used to describe the central concept of each taxonomic unit. These are as follows:

Very shallow	less than 10” to bedrock
Shallow	10” to 20” to bedrock
Moderately deep	20” to 40” to bedrock
Deep	40” to 60” deep
Very deep	greater than 60”

Drainage Class

Drainage class is a reference to the frequency and duration of periods of soil saturation and/or action by seasonal groundwater tables, as evidenced by soil morphologic features identified within each respective soil profile.

Seven classes of soil drainage are recognized:

Excessively drained	water is removed from the soil very rapidly. These are commonly very coarse-textured, rocky or shallow. All are free of soil mottling related to wetness.
Somewhat excessively drained	water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy-textured and very pervious/porous. Some are shallow. Some occur on steep slopes where much of the water they receive is lost as runoff. These too are free of observed mottling due to wetness.
Well drained	Water is removed from the soil readily, but not rapidly. It may be available for plant growth at the deepest rooting depths, and not so wet as to inhibit the growth of plant roots for significant periods during most growing seasons. Well drained soils are often medium textured, or contain restrictive sub horizons generally below 24”. They are mainly free of mottling related to wetness.
Moderately well drained	water is removed from the spoils somewhat slowly during wet periods and spring seasons. Moderately well drained soils are saturated in the

	upper soil profile for short duration during the growing season. Often, they contain a slowly pervious (or restrictive) layer beneath the solum, and may receive additional runoff from upslope areas.
Somewhat poorly drained	water is removed so slowly that the soil is wet for significant periods during the growing season. Somewhat poorly drained soils commonly have an impervious substratum that contributes to a perched water table, additional water through side slope seeps, long continuous sheet flows below large watershed areas with few or no outlets, or a combination of these together.
Poorly drained	water is removed from these soils so slowly that the soil is saturated during the growing season or remains wet for long durations. Water is present during the growing season which may be prohibitive to plant root growth, due to anaerobic/saturated conditions. These soils are classified as hydric, and may also have implications as wetlands.
Very poorly drained	water is removed from these soils so slowly that free water can be observed at or very near the mineral soil surface for long durations during the growing season. These commonly occur on nearly level slopes or in depressional areas, and can be frequently ponded. Often they include thick organic surface horizons.

Hydrologic Soil Groups

A hydrologic soil group is a class of numerous soil series that all have the same runoff potential under similar climate and vegetative conditions. Soil properties that can influence runoff are those that affect minimum infiltration rates for a bare soil after prolonged wetting and with no frozen ground surface. Most important are depth to seasonal high groundwater table, permeability rates after prolonged wetting, and depth to slowly permeable (restrictive) layer.

Permeability

Permeability is the soil property which enables water to move downward through the soil profile. It is measured as the number of inches per hour of water that can be added to a particular soil as it moves downward through the unsaturated soil. Terminology and ranges are as flows:

Very slow	less than 0.06 in./hr
Slow	0.06 to 0.20 in./hr
Moderately slow	0.20 to 0.60 in./hr
Moderate	0.6 to 2.0 in./hr
Moderately rapid	2.0 to 6.0 in./hr
Rapid	6.0 to 20 in./hr

Soil Erodibility (K Factor)

The measure of soil erodability, or K factor, is the susceptibility of a soil particle to detachment and transport by rainfall. K factors for soil in Maine vary from 0.02 to 0.69. The higher the value, the more susceptible the named soil is to sheet or rill erosion by water.

Soil properties which influence erosion are those that can affect infiltration rates, movement of water through the soil profile and the water storage capacity of a soil. Other soil properties can affect the dispersion and mobility of soil particles by rainfall ad/or runoff. Some of the most important of these properties include soil layer, and the size and stability of the soil structural aggregates in the exposed faces of subsoils. Background levels of soil moisture and the presence of frozen soil horizons also can influence erosion.

Soil Texture

Soil texture refers to the USDA classification for the relative proportions by weight of the several soil particle size classes that are finer than 2 millimeters in diameter, which form the fine earth fraction. (Materials larger than 2 mm. in diameter are considered rock fragments).

Soil texture can influence on plant growth, or the soil mechanics of a particular site when used as construction and/or backfill material for foundations, etc. It influences such physical properties as load bearing strength, permeability, shrink/swell potential (frost action or due to wetness), compressibility and compaction. Rock fragment size and content can also affect applications for use as construction materials.

Soil Texture Modifiers

Named soil texture classes can be further modified by the addition of appropriate adjectives when rock fragment content approaches 15% by volume (i.e. gravelly sandy loam). “Mucky” or “peaty” are modifying terms used when organic matter content reaches 40% (i.e. mucky silt/loam).

Surface Runoff

Surface runoff is water that flows away from the soil over the surface of the site without infiltrating into the ground surface. It may originate from precipitation, or as drainage water from adjacent, upslope areas. The rate and amount of runoff are affected by internal physical characteristics of the soil as well as slope gradient ranges and landform shape (i.e. concave vs. convex slopes). Runoff can be significantly different on a given soil under natural vegetation, cultivation by man, or other kinds of management. Runoff from a particular site can also be affected by other factors such as rainfall amounts, snow pack accumulation or other climatic fluctuations. Surface runoff is usually significantly greater on frozen ground surfaces.

Six categories for runoff rates are provided:

Ponded	little or none of the precipitation and run-on (from surrounding, higher elevations) escapes the site as runoff. Free water stands on or above the existing soil surface for significant periods of time. Ponding normally appears on level to nearly level (i.e. <3%) slopes, in depressions or within concavities in a pit/mound micro-relief topography. Water depth may vary considerably throughout the year, or from year to year. Often this is consistent with very poorly drained soils.
Very slow	surface water flows away slowly, and free water may be present at the soil surface for portions of the year, or may infiltrate slowly into the soil surface when not ponded. These soils may be consistent with very poorly drained, or poorly drained soils that are coarser textured and somewhat porous.
Slow	surface water flows away from the soil quickly enough, either due to slope or the porosity of the soils, so that free water can be observed at the soil surface for moderate periods immediately following spring snowmelt or prolonged storm rainfall events. Most of the water passes through the soil, is used by plants, or evaporates.
Medium	surface water flows away quickly enough due to slope or soil porosity that water is observed at or near the soil surface for short durations, usually during spring snowmelt or immediately following significant storm rainfall events.
Rapid	surface water flows away quickly enough that any period of saturation is brief, and free water does not stand on the soil surface. Only a small portion of the water enters the soil as infiltration, either due to steep slopes and/or fine textures with slow rates of absorption.
Very rapid	surface water flows away so quickly that duration of any event is brief, and water never stands on the soil surface. Only a very small portion of the available moisture enters the soil as infiltration.

ADDITIONAL SOIL TERMS

Flooding (Hazard to flooding)
Flooding is the temporary covering of the soil surface by flowing water from any source, including but not limited to: streams or rivers overflowing their banks, runoff from adjacent or upslope areas, inflow from high tide action, or a combination of sources. Water due to snowmelt is excluded from this definition, as is standing or ponded water that forms a permanent or semi-permanent cover above the soil surface.

Flooding hazard is further expressed by frequency classes, duration, and the time of year that the flooding occurs. The velocity and depth of the floodwater are also important factors.

Oxyaquic Soil drainage conditions that imply soil saturation for prolonged periods, which are rich in dissolved oxygen and therefore do not exhibit the anaerobic conditions necessary to create hydric soil morphology.

Ponding Ponding is standing water in a closed depression. The water is removed only by evaporation, transpiration by plants, or percolation through the ground.

Soil complex A map unit that consist of two or more kinds of soils (i.e. soil series/taxonomic unit) that occur on a non-regular, non-repeating pattern that cannot be separated out at the scale provided. The order of the soils named are generally in order of predominance within the map unit.

Soil map unit A collection of soils or soil areas that are delineated during soils mapping. It generally is an aggregate of several soil entities with a predominant named soil type. Kinds of soil map units may include complexes, consociations, or associations.

Soil slope gradient range
The slope identified for any given map unit, based on the immediate topography within a specific portion of the mapping site. Designations generally are as follows:

A	0-3%	nearly level to level
B	3-8%	gently sloping
C	8-20%	moderately sloping
D	20%+	steeply sloping

Stoniness This is a phase of surface characteristic that may be identified in soils mapping, ranging from stony or bouldery (0.01 to 0.1% of soil surface covered with stones) to rubbly or rubble land, in which up to 75% of the soil surface is covered with stones. Extremely stony sites or sites with rubble land may have additional limitations for use of mechanized equipment.

Stony — The areas have enough stones at or near the surface to be a continuing nuisance during operations that mix the surface layer, but they do not make most such operations impractical. Conventional, wheeled vehicles can move with reasonable freedom over the area. Stones may damage both the equipment that mixes the soil and the vehicles that move on the surface. Usually these areas have Class 1 stoniness. If necessary in a highly detailed survey, these areas may be designated as “slightly stony” and “moderately stony”.

Very Stony — The areas have so many stones at or near the surface that operations which mix the surface layer either require heavy equipment or use of implements that can operate between the larger stones. Tillage with conventionally powered farm equipment is impractical. Wheeled tractors and vehicles with high clearance can operate on carefully chosen routes over and around the stones. Usually, these areas have Class 2 stoniness.

Extremely Stony — The areas have so many stones at or near the surface that wheeled power equipment, other than some special types, can operate only along selected routes. Tracked vehicles may be used in most places, although some routes have to be cleared. Usually, these areas have Class 3 stoniness.

Rubbly — The areas have so many stones at or near the surface that tracked vehicles cannot be used in most places. Usually, these areas have class 4 or 5 stoniness. If necessary in a highly detailed survey, they may be designated as “rubbly” and “very rubbly’.

If the soil has stones, boulders, and smaller fragments, the name includes the kind of rock fragment that are most limiting in the use or management of the soil. This is not necessarily the kind that is most abundant or the kind that is used to modify texture class of horizons in the profile description.