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NEON Site Level Plot Summary
Steigerwaldt Land Services (STEI)

Document Information

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Site Background
This NEON site consists of two geographically separate project areas. The Steigerwaldt Land Services property, where the "tower plots" are located, encompasses 77 acres in Lincoln County, Wisconsin. Elevations range from 1,527 ft (465 m) to 1568 ft (478 m). This site is in Major Land Resource Area (MLRA) 94D - Northern Highland Sandy Drift. The "distributed plots" are within a section of the Chequamegon-Nicolet National Forest in eastern Price County, WI. This site encompasses 5,785 acres. Elevations range from 1565 ft (477 m) to 1742 ft (531 m). This site is in MLRA 90A -Wisconsin and Minnesota Thin Loess and Till, Northern Part.

Site Information
This area is within the Superior Upland Province of the Laurentian Upland. The bedrock consists of primarily Early Proterozoic metavolcanic rock with parts underlain by gneiss. Surficial materials consist of Wildcat Lake Member unsorted loamy till and meltwater stream sediment of the Copper Falls formation (5-70m thick). The landscape at the tower site is best characterized as a low relief ground moraine with depressions and drainageways throughout. The parent material is dominantly sandy loam till. The distributed plot area consists of a combination of water-worked drumlins with a surficial loess influence interspersed by small outwash plains or channels that contain ice-block depressions and Holocene to recent drainageways. The parent materials consist of loamy glacial till, sandy glaciofluvial deposits, loess over loamy till, loamy glaciofluvial deposits over stratified sandy and gravelly outwash, sandy and/or gravelly outwash, and herbaceous and woody organic material.

Plant communities at the distributed plot area are dominated by northern hardwood (sugar maple, red maple, aspen, paper and river birch, beech, and oaks) with intermixed conifers (white, red, jack pine, white spruce, balsam fir, and hemlock). The site also contains acid bogs composed of black spruce and tamarack (larch) and euic fens (high base status) dominated by white cedar and black ash. The tower site is an early successional aspen stand. Climate for MLRA 90A: Mean

Annual Air Temp (MAAT) Low: 3, Mean: 5, High: 8 degrees C; Mean Annual Precipitation (MAP) Low: 690, Mean: 785, High: 910 mm; Frost Free Days (FFD) Low: 80, Mean: 125, High: 150 days. Climate for MLRA 94D: Mean Annual Air Temp (MAAT) Low: 4, Mean: 5, High: 6 degrees C; Mean Annual Precipitation (MAP) Low: 770, Mean: 795, High: 860 mm; Frost Free Days (FFD) Low: 100, Mean: 125, High: 140 days.

Soils at these sites are dominantly classify as Spodosols with lesser proportions classifying as Alfisols, Inceptisols, and Histosols. Diagnostic features present or absent in each individual soil determine the finer taxonomic classification and are noted within the soil descriptions for this project; Relevant diagnostic features for this site include ochric epipedon, albic horizon, spodic horizon, glossic horizon, argillic horizon, densic materials, densic contact, oxyaquic features, and aquic features. A densic contact is common in many of the soils on site where the restrictive nature of the till causes a perched water table. The soils dominantly have particle size control section textures of Coarse-Loamy with lesser proportions having Sandy or Coarse-loamy over sandy or sandy-skeletal. Soil minerology at these sites is mixed.

Analysis of Plots for Sampling

Plots sampled for soil characterization at the STEI site were selected to maximize soil map unit aerial coverage across the site and to obtain a representation of major soils present. These goals had to be achieved using the NEON pre-selected plot locations, which restrict the available map unit delineations and locations available to be sampled in this soil landscape. The main considerations for plot selection were soil map unit name, map unit composition, and geographic distribution within the site. We grouped soil map units for this analysis based on drainage and parent materials to ensure that a range of soil properties and geomorphic settings would be represented by the selected plots. Plots were given more consideration if they occurred on the most extensive map units within the site. Some plots, however were included in the sampling that had soils map units of limited occurrence so that less extensive soils would also be represented in the characterization.

The soil survey for the STEI sites contains 34 unique soil map units. Fifteen of the soil map units occur in one or more of the pre-selected plot areas. Fourteen of the 34 plots on the site were selected for characterization and analysis. This quantity of samples and locations provides adequate site characterization by sampling the dominant soils and avoids plots that occur on or near a soil delineation boundary or that represent only a minor fraction of the site.

The 14 plots sampled represent approximately 75 percent of the STEI site's total map-unit (soil) acres. Twelve percent of total map-unit acres did not occur within any of the pre-selected plots. The remaining 13 percent of map-unit acres occurred at or near soil boundaries, were represented by similar map units, or were of soils of limited occurrence on the site.

Plots Selected		
MUSYM	**Map Unit Name**	**Percent Total Acres (5785 acres)**
847B	Newood fine sandy loam, drumlins, 2 to 6 percent slopes, very stony	25%
3456A	Magnor, very stony and Magnor silt loams, 0 to 4 percent slopes	15%
182D	Padus sandy loam, 15 to 30 percent slopes	7%
9051A	Minocqua, Cable, and Pleine soils, 0 to 2 percent slopes, very stony	6%
405A	Lupton, Cathro, and Tawas soils, 0 to 1 percent slopes	5%
9013A	Tipler-Manitowish complex, 0 to 3 percent slopes	3%
182B	Padus sandy loam, 0 to 6 percent slopes	3%
9012D	Sayner-Lindquist complex, 15 to 30 percent slopes	2%
744B	Peeksville fine sandy loam, 0 to 4 percent slopes, very stony	2%
974D	Sayner-Pence-Vilas complex, 15 to 30 percent slopes	2%
644D	Shanagolden fine sandy loam, 15 to 30 percent slopes, very stony	2%
MxB	Moodig sandy loam, 0 to 4 percent slopes	1%
	Total	75%

Plots Not Selected		
MUSYM	**Map Unit Name**	**Percent Total Acres (5785 acres)**
847C	Newood fine sandy loam, drumlins, 6 to 15 percent slopes, very stony	8%
9012C	Sayner-Lindquist complex, 6 to 15 percent slopes	5%
408A	Lupton and Cathro soils, 0 to 1 percent slopes	1%
	Total	13%

Plot Findings

The 14 described and sampled pedons represent 12 uniquely named soil map units (see table). The major soil components of these mapunits are: Newood, Magnor, Padus, Minocqua, Cable, Pleine, Lupton, Cathro, Tawas, Tipler, Manitowish, Pence, Sayner, Lindquist, Peeksville, Vilas, Shanagolden, and Moodig. Upon field description, soils that were described at plot locations were: Moodig, Capitola, Cathro taxadjunct, Springstead, Newot, Newot taxadjunct, Padus taxadjunct, Pesabic, Pence taxadjunct, Newood taxadjunct, Loxley, and Worcester taxadjunct. A taxadjunct is a soil outside the range of properties defined for a soil series. The differences in properties between a taxajunct and a named series is small so that soil interpretations for use and management are not affected. Plots were dominantly forested with northern hardwoods being the most common upland cover type for coarse-loamy soils. The plots on sandier outwash soils typically had intermixed hardwoods and conifer cover. One acid bog was sampled, which had stunted conifers (tamarack and black spruce). The euic swamp sampled had an alder subcanopy with a coniferous overstory.

Parent material – Plots STEI_005, 011, 012, 053, and 059 were soils formed in coarse-loamy till. Plot STEI_026 was a soil formed in loamy alluvium. Plot STEI_010 was a soil formed in loamy alluvium and/or loess over coarse-loamy till. Plot STEI_006 was a soil formed in loamy alluvium over sandy till. Plot STEI_019 was a soil formed in loamy glaciofluvial deposits over dense sandy basal till. Plot STEI_015 was a soil formed in loamy glaciofluvial deposits over sandy and gravelly outwash. Plot STEI_017 was a soil formed in loamy till over dense loamy basal till. Plot STEI_008 was a soil formed in sandy and gravelly outwash. Plot STEI_024 was a soil formed in woody organic material. Plot STEI_022 was a soil formed in woody organic material over loamy alluvium.

Summary of Soils

Soils sampled at the STEI site were dominated by glacial till or loamy mantled outwash soils with material ranging from sandy to loamy, many of which had a considerable amount of coarse fragments including gravels, cobbles, and stones up to 600 mm in diameter. This quantity of coarse fragments led to many series being classified as taxadjuncts based on the particle size control sections being skeletal (>35% coarse fragments as a weighted average). Upland soils at this site also lacked the typical organic surface formed from leaf litter. This is common in loamier soils that have been infested with earthworms. The worms tend incorporate the organic layer with the upper part of the mineral soil, creating an over thickened mineral A horizon. Soils formed in glacial till at this site typically had surface fragments ranging from 250 to 1000 mm in diameter covering between 0.001-0.5 percent of the surface.

Two plots (STEI_006 and STEI_019) were identified as the Springstead soil series. STEI_006 was located within a Peeksville fine sandy loam, 0 to 4 percent slopes, very stony map unit and STEI_019 was located within a Sayner-Pence-Vilas complex, 15 to 30 percent slopes map unit. In neither of these map units was Springstead identified as a named major, or minor, soil component. In plot STEI_006 the map unit delineation was relatively narrow resembling an upland drainageway through a better drained soil. The plot occurred in a small sloping area that was unable to be shown at the mapping scale of the survey. The Springstead soil was formed in similar parent materials as a named minor component, Shanagolden, which composes 0-10% of this map unit. Shanagolden soils are moderately well drained and have a seasonal perched water table as opposed to the well drained Springstead which does not have a seasonal water table. There may have been redoximorphic features indicating a water table present below 100cm, but sampling depth restrictions did not allow this to be determined. Both soils are underlain by dense till, but in the Shanagolden soil redox is moderately deep (> 1 m), whereas the Springstead soils redox are deeper than 1.5 m. Shanagolden soils have loamier textures (coarse-loamy), typically sandy loam or fine sandy loam vs. the Springstead soil which is sandy with sand, fine sand, or loamy sand textures. The sandier material is associated with the till being water worked, and in this case there appeared to be a layer of sandy outwash material overlying the till. Another notable difference was the lack of an argillic horizon that is generally associated with the Shanagolden soils. An argillic horizon forms from the illuviation of clay and must meet specific clay increase requirement from the overlying horizons. In this instance there was very little clay in the upper portion of the soil to begin with, so the only form of illuviation observed was in the form of sesquioxides forming the spodic horizons. In plot STEI_019 the Springstead soil observed did not fit the concept of the 3 named soil components in the Sayner-Pence-Vilas complex, 15 to 30 percent slopes map unit. This area appeared to be a complex landscape typical of disintegration moraines where outwash soils surround small islands of till. The upper portion of this soil resembled the named Pence soil with outwash characteristics and some local loess influence. The till underlies most of this area at varying depths. There are several map units that illustrate this till-outwash complex situation, but overall this delineation appeared to be dominantly outwash with two small till knolls that would be considered a minor component.

Three plots (STEI_011, 012 and 017) were identified as the Newot soil series. Plots STEI_011 and 017 were classified as Newot taxadjuncts. Plot STEI_011 occurred within a Shanagolden fine sandy loam, 15 to 30 percent slopes, very stony map unit, STEI_012 occurred within a Newood fine sandy loam, drumlins, 2 to 6 percent slopes, very stony map unit, and plot STEI_017 occurred within a Tipler-Manitowish complex, 0 to 3 percent slopes map unit. In none of these map units was Newot identified as a named major, or minor, soil component. In plots STEI_011 and 017 the soil was classified as a taxadjunct based on the particle size control section having a weighted average of coarse fragments (>2mm) greater than 35% putting it into the Loamy-skeletal class as opposed to Newot series which is Coarse-loamy. The other reason for using a taxadjunct was the lack of an argillic horizon which requires the presence of clay films from the illuviation of clay and must meet specific clay increase requirement from the overlying horizons. The lab data results will confirm this, but there was no evidence of this in the field. The Shanagolden soil named in the map unit in plot STEI_011 classifies as a Coarse-loamy, isotic, frigid Alfic Oxyaquic Haplorthods. The soil described differed from the named Shanagolden soil based on the taxonomic criteria listed above, as well as the lack of indicators of a seasonal perched water table that is present above the dense till in the Shanagolden series. Within taxonomy the term oxyaquic is used to denote this water table. To meet this criteria the soil needs to have saturation in one or more layers within the upper 100 cm of the mineral soil for 20 or more consecutive days, or 30 or more cumulative days. Several factors can explain the lack of a seasonal perched water table in this soil including subsurface drainage due to slope, quantity of coarse fragments which improve drainage, and/or the presence of fractures or sand lenses within the dense till creating conduits for internal drainage. The soil described and sampled in plot STEI_012 only differed from the named Newood series based on the lack of water table indicators required to meet oxyaquic criteria as described above. Plot STEI_017 was located within a complex of two moderately well drained, loamy mantled outwash soils. The soil described was well drained and formed in loamy till over dense basal till. The surface of this soil resembled the loamy mantle with loess influence that is associated with the Manitowish and Tipler soil series, but the underlying parent material is of a different origin. The Newot taxadjunct in this instance would be considered an unnamed minor component soil due to the fact it is not commonly found within every delineation of this map unit and does not add to the overall understanding of the map unit.

One plot (STEI_005) was identified as the Newood soil series. This plot occurred within the Newood fine sandy loam, drumlins, 2 to 6 percent slopes, very stony map unit. This soil was classified as a taxadjunct to the series. Named soils within map unit also include similar soils, which this would be considered. The reason for using a taxadjunct was the lack of an argillic horizon which requires the presence of clay films from the illuviation of clay and must meet specific clay increase requirement from the overlying horizons. The lab data results will confirm this, but there was no evidence of this in the field. Argillic horizons are typically weakly expressed in these soils where there is very little clay to be translocated and this quantity of coarse fragment. Field indications of this are generally limited to clay bridging of sand grains which can only be seen though a hand lense.

One plot (STEI_015) was identified as the Padus soil series. This plot occurred within the Padus sandy loam, 15 to 30 percent slopes map unit. This soil was classified as a taxadjunct to the series based on the particle size control section having a weighted average of coarse fragments (>2mm) greater than 35% by volume placing it into the Loamy-skeletal class as opposed to Padus series which is Coarse-loamy.

One plot (STEI_008) was identified as the Pence soil series. This plot occurred within the Sayner-Lindquist complex, 15 to 30 percent slopes map unit. This soil was classified as a taxadjunct to the series based on the particle size control section having a weighted average of coarse fragments (>2mm) greater than 35% by volume putting it into the Sandy-skeletal class as opposed to Pence series which is Sandy. This soil does not fit any of the named major components in this map unit. The Pence series is listed as a minor component with its composition ranging from 0-5 percent. The soil sampled had 8 cm of fine sandy loam surface making it an intergrade between the Sayner series which does not allow textures of fine sandy loam in the upper part, and the Pence series which requires 25-50 cm of loamy material over the sandy and gravelly outwash. Overall this soil falls within the range of variability in this soil map unit. The thin loamy mantle is the result of loess influence or possibly slope alluvium from a nearby loamy upland.

One plot (STEI_026) was identified as the Worcester soil series. This plot occurred within the Padus sandy loam, 0 to 6 percent slopes map unit. This soil was classified as a taxadjunct to the series. A Worcester soil component is listed as a minor component for this map unit with its composition ranging from 0-5 percent. It did not meet the taxonomic classification of the Worcester series, which is a Coarse-loamy, mixed, superactive, frigid Argic Endoaquods, based on the lack of an argillic horizon which requires the presence of clay films from the illuviation of clay and must meet specific clay increase requirement from the overlying horizons, and the lack of spodic material required for the Spodosols soil order. This was a somewhat poorly drained soil with redoximorphic features observed at a depth of 35 cm. The plot was located within a drainageway which explains the wetness of the soil, the variability in materials throughout, and lack pedogenic development.

One plot (STEI_10) was identified as the Pesabic soil series. This plot occurred within the Magnor, very stony and Magnor silt loams, 0 to 4 percent slopes map unit. The Pesabic soil is listed as a minor component for this map unit with its composition ranging from 0-5 percent. The main differences between the Magnor and Pesabic soil series is that Pesabic meets the criteria for the Spodosols soil order, while Magnor is an Alfisol. The Spodosol classification was based on field observations, but will require lab data to verify it meets the criteria. Another notable difference is that Magnor soils have a silty mantle (silt loam textures) ranging from 30 to 90 cm thick and the Pesabic soil described had a loam and fine sandy loam mantle. Similarities between these soils include a coarse-loamy particle size class, both are somewhat poorly drained with a perched water table occurring at 15 to 60 cm for 1 month or more, and both are deep (100-150 cm) to a densic contact.

One plot (STEI_022) was identified as the Cathro soil series. This plot occurred within the Lupton, Cathro, and Tawas soils, 0 to 1 percent slopes map unit. This soil was classified as a taxadjunct to the series based on not meeting the organic material thickness requirement for the Histosols soil order. The sampled soil classified as a Coarse-loamy, mixed, superactive, frigid Humaqueptic Endoaquents, whereas Cathro is a Loamy, mixed, euic, frigid Terric Haplosaprists. This map unit is an undifferentiated group, meaning they consist of two or more taxa components that are not consistently associated geographically and, therefore, do not always occur together in the same map delineation. These taxa are included as the same named map unit because use and management are the same or very similar for common uses. Generally, they are included together because some common feature such as steepness, stoniness, or flooding determines use and management. In this plot, the soil sampled had an organic horizon that was 16 cm too thin to meet the Cathro series. This wetland area had a hummocky surface with a variable O-horizon thickness. The sampled soil would be considered similar for use and management due to wetness.

One plot (STEI_024) was identified as the Loxley soil series. This plot occurred within the Minocqua, Cable, and Pleine soils, 0 to 2 percent slopes, very stony map unit, which is an undifferentiated group of poorly and very poorly drained mineral soils, some having thin muck surfaces up to 38 cm thick, with parent materials ranging from outwash to till depending on the landform they occur on. A mineral substratum was not observed in this soil due to the depth of observation restriction of 100 cm. The Loxley series was not identified as a major or minor component within this map unit. The closest fit to the Loxley series is the Cathro minor component that is identified as occupying 0 to 15 percent of this map unit. Cathro is considered Terric meaning the thickness of organic material ranges from 40 to 130 cm in thickness and also has a Euic reaction class (pH of 4.5 or greater in one or more layers of organic material within the control section), as opposed to the Loxley series which is Typic meaning the organic material thickness is greater than 130 cm and it also has a Dysic reaction class (pH less than 4.5). The pH of the soil was not measured in the field, but can generally be inferred by presence or absence of indicator plant species. In this instance plant species that indicated acidic conditions where a continuous mat of sphagnum moss, leatherleaf, Labrador tea, and stunted black spruce and tamarack.

One plot (STEI_059) was identified as the Moodig soil series. This plot occurred within the Moodig sandy loam, 0 to 4 percent slopes map unit which lists Moodig as the major component occupying 95 percent of the composition. The upper 100 cm of this soil was representative of the Moodig series with only slight differences in horizonation such as the absence of a Bhs-horizon which forms from the illuviation of organic matter and sesquioxides.

One plot (STEI_053) was identified as the Capitola soil series. This plot occurred within the Moodig sandy loam, 0 to 4 percent slopes map unit. The Capitola soil is a minor component within this map unit occupying 5 percent of the composition. Capitola soils are the poorly and very poorly drained catena member to the somewhat poorly drained Moodig series. The plot was located in a small depressional area of minor extent within the map unit delineation. The main differences between this soil and the Moodig series is the water table is at the surface to 30 cm below at some time in normal years, where Moodig has a perched water table at 15 to 60 cm. Another difference is the Capitola soils have a densic contact at 50 to 100 cm and Moodig soils do not recognize this condition. Since this was a tower plot where the observation was limited to a bucket auger, the density of the till was difficult to surmise. The perching of water was observed with redoximorphic accumulations and depletions noted at 13 cm, and assumed to be caused by an increase in density at some depth below 1 m.