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Grand Portage National Monument Preliminary Soil Survey

Natural Resource Technical Report NPS/GLKN/NRTR—2009/188

ON THE COVER
Markings in a hand-dug pit show the location of soil horizons in profile. Photograph by Ulf Gafvert/NPS.

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Natural Resource Technical Report NPS/GLKN/NRTR—2009/188

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Abstract

A preliminary soil survey has been completed for Grand Portage National Monument, a cultural park located in northeastern Minnesota. Funding was provided by the Midwest Region GIS program through a Natural Resources Preservation Proposal (NRPP), and the Great Lakes Network (GLKN) provided staff to complete the field work, develop the spatial soils layer, soils tabular data (including soil properties and interpretations), and write the final report. High resolution aerial photography was collected in support of this project. A total of 46 soil investigations were made, and three pits were dug to collect samples for lab data. Soils in the Grand Portage area consist primarily of clayey materials, deposited as glacial ice was subsiding, roughly 10,000 years ago. There are a few areas of steep terrain, where igneous dikes cut through the region. Soils on these landforms are sandy to loamy, and shallow to bedrock. The soil survey includes 28 data map units, and 32 soil series. Tabular data for the soils includes physical and chemical properties, as well as interpretations of applicability and limitations of the soils for a wide variety of land uses.

Acknowledgements

We would like to thank Pete Biggam, National Soils Program Coordinator, for funding soil survey equipment and program support. We also thank the staff at Grand Portage National Monument for providing housing, assistance in conducting field work, and data entry, and acknowledge the support and cooperation of the Grand Portage Band of Minnesota Chippewa.

1. Soil Survey Narrative

This study was requested by the park in recognition of the need for soils information to assist in understanding the forest ecosystem, potential fire effects, management of trails and buildings, and for interpreting the Monument's cultural landscape. Existing soils information for Cook County provided only a very broad overview, with little or no field investigation to verify soil types or provide information at a level of detail pertinent to or useful for park needs.

Funding was provided by the Midwest Region GIS program through a Natural Resources Preservation Proposal (NRPP), and the Great Lakes Network (GLKN) provided staff to complete the field work, develop the spatial soils layer, soils tabular data (including soil properties and interpretations), and write the final report. The NRPP funds were used to acquire the aerial photography needed for completing the soil mapping. Imagery acquired was spring, leaf-off, true color at 1:8,000 scale (1 cm = 80 m, or 1 inch = 667 feet).

Grand Portage National Monument is a cultural park in northeastern Minnesota (Lake County), preserving the historic portage trail connecting the waterways of the Canadian northwest with Lake Superior. This was used extensively during the fur trading era in the 1700s to early 1800s. The park encompasses 289 hectares, consisting of a 13.6 km trail, with a 91.4 m buffer on either side, and larger blocks at both ends of the trail that include Fort Charlotte at the northwest end, on the Pigeon River, and the main stockade at Lake Superior.

Ulf Gafvert, GIS Specialist with the GLKN, has a background in soil science and survey, and was the principal investigator for the project. Brian Phillips's report, *Geomorphological and Historical Observations in the Grand Portage National Monument*, provided detailed background information of the geology and glacial history of the area, and was used extensively in correlating landforms and soil properties to glacial processes. Correlation of soils to landforms assisted in the design and drafting of initial landform and soil components onto the raw photo contact prints using stereoscopic analysis, and in completing the field work. The soil delineations were then converted into a geo-referenced polygon soils layer for use in a GIS.

We must stress that this project was a reconnaissance survey, and entailed only cursory field investigations with few samples collected for laboratory analysis. Lab data included soil texture, ph, organic and inorganic carbon, and total mercury. Full characterization, including clay mineralogy, bulk density, linear extensibility, or other chemical and physical properties was not performed. The soils encountered throughout the study area were relatively uniform, clayey materials, though further study would better detail variability which would help to unravel the glacial depositional history. Further study should be conducted to determine soil properties such as depth of the organic layer in the Beaver Meadow or determination of depth to bedrock, which hand tools were unable to verify adequately. The area at the shore of Lake Superior, including the Stockade and open fields, also warrant further study to assist in archeological investigations.

Soil Formation and Classification

There have been many attempts to define what constitutes soil, though any short, concise description proves to be incomplete and inadequate. It is generally accepted to be the unconsolidated material at or near the surface of the earth, wherein plants can grow, and that includes living and dead organic matter, mineral, liquid, and gaseous components. The upper limit is the land surface contact with the atmosphere, and the lower limit is generally accepted as the depth below weathering and other pedogenic processes that have altered the earth's upper crust. Hans Jenny, a renowned soil scientist, described soils as resulting from the interaction of five independent soil-forming variables:

$$s = f(cl, o, r, p, t\ldots)$$

where cl = climate, o = organisms, r = relief or topography, p = parent material, and t = time (Jenny 1941). This apparently simple equation continues to be recognized as guiding the fundamental principles underlying the study of soil genesis and pedology.

Climate

Climate has a tremendous effect on soil forming processes, the most important factors being temperature and precipitation. These drive weathering processes, the rate of decomposition, and the amount of moisture available for plants and other organisms. Freeze-thaw cycles, solar insolation, and wind are all climatic factors that exert strong influence on the character and rate of soil development. The region around Grand Portage National Monument has a continental climate, with average annual precipitation of 74.6 cm, and annual mean air temperature of 3.2° C. Frost-free period ranges from about 119 to 137 days (MRCC Climate Summary Reports).

In the Grand Portage area, upper soil horizons are frozen in winter, resulting in little or no percolation of water, and slow decomposition rates. Frost action directly affects development of soil structure. Slope aspect also has a strong influence, with south-facing slopes receiving more warming and evaporation compared to north-facing slopes, which tend to be cooler and more humid.

Organisms

Living organisms, including plants, fungi, insects, and animals influence soil formation. Plants, in particular, have a profound effect, with roots penetrating soils, extracting nutrients, excreting compounds (often acidic) that break down mineral components, and translocating materials to the surface. As plants die, or shed leaves, plant materials on the surface and within the soil contribute organic matter, which has many effects on soil properties. Organic matter contributes to soil moisture retention and cation exchange capacity; provides a buffer to rapid changes in temperature and moisture; and adds structure to soils that reduce mechanical disruption from rain-splash, traffic, or water runoff. Rodents and earthworms burrow through the soils, providing aeration, reducing bulk density, and providing avenues for plant roots and moisture to penetrate deeper into the soil profile.

Recent studies have shown significant changes in soil properties and plant communities resulting from earthworm activity. Earthworms are recent exotic species to this area, and their activity is altering soil horizonation. Earthworms digest the surface organic (O) horizon, and incorporate that material into the underlying A-horizon. The result is disintegration of the O-horizon, and increased organic matter in the A-horizon. The lack of an organic horizon creates increased susceptibility to erosion from rain-splash, and the creation of a hard, compacted, surface crust. This reduces water infiltration, leaving soils more likely to dry out during drought periods and increasing seedling mortality. Another concern is that nutrient cycling, formerly dominated by fungal communities, is converting to microbial decomposition dominated by micro-fauna. Plant communities which have evolved in symbiosis with fungal communities are threatened, providing opportunities for annual species and exotics to thrive.

The Grand Portage area is dominated by forest, located at the southern edge of the boreal conifer forest ecoregion and northern extent of the deciduous forest ecoregion. The soils typically have thin organic surface horizons, and the acidic nature of plant decomposition strongly affects soil horizonation. The organic acids effectively break down rock material and bind with the mineral components, especially iron and aluminum. Colors of soil are commonly attributed to the iron components in the soil.

Topography

Relief, or topography, exerts a strong influence on how soils form. Runoff from precipitation occurs at a more rapid rate on steep slopes compared to level landscapes, reducing infiltration. As such, soils on sloping areas typically exhibit better internal drainage than the same soil material on a level landscape. Slower runoff on level terrain allows for more infiltration of water, thus soils remain saturated for longer periods of time. Soil profiles are also typically thicker on more level landscapes than strongly sloping areas. Erosion and sedimentation dynamics, as well, are very dependent on slope. Soils on the shoulder position of a slope tend to erode and have thinner surface horizons, as compared to a footslope position, which will typically experience deposition and thickening of the soil profile.

Parent Material

Parent material is the raw, unweathered material in which soil forms and, in large part, determines the chemical, mineralogical, and textural composition of the soil. (Lincoln County Soil Survey 1996) Soil formation starts once a land surface is stable. In the Grand Portage area, this “time zero” began when the glaciers receded, and the glacial deposits became exposed. The diabase dikes were also scoured and abraded, and soil formation on this fresh, exposed bedrock began after the ice retreated. Soil development occurs much more slowly on exposed, igneous bedrock compared to the silty and clayey, unconsolidated glacial till, with soil profiles often only a few centimeters thick, compared to the clayey soils, where profile development is typically one to two meters thick.

Time

The greater amount of time provided for the other soil forming factors to act on a stable land surface, the more pronounced their expression in the soil profile. Physical and chemical weathering, accumulation of organic matter, and percolation of water and other dissolved components deep into the soil profile all require time for these processes to occur. The soils in the Grand Portage area are considered relatively young, being on the order of 10,000 years old or younger, yet this is sufficient time to develop distinct soil horizons and structure. Floodplain areas frequently experience erosion or sedimentation, hence these soils are typically perennially young soils, as the soil development clock is restarted at each instance of overwash deposition or truncation of the profile from erosive forces of the river channel.

Soils are an integration of these variables, and soil formation is an evolving expression of these processes. In this sense, soils retain a long-term record of landscape ecology at a very local, site-specific scale.

Methods

Aerial photography was collected for the Grand Portage area on 2 May 2003 by Ayres and Associates. This was a spring, leaf-off, natural color acquisition. Products included two sets of color contact prints and one set of black-and-white prints, as well as digital scans of the unrectified imagery. Additional funds were later provided by GLKN for Ayres and Associates to complete the ortho-photography necessary for georeferencing the soil polygon layer.

Initial soil delineations were drafted the following year through photo interpretation and stereoscopic analysis using the hardcopy prints. The black-and-white set of prints was produced on matte finish paper to facilitate drawing directly on the photos. These initial delineations extended significantly beyond the park boundary in order to identify differing landforms based on slope and configuration.

Field investigations were carried out during the week of 4 October to 8 October 2004. Soils investigations were carried out only within the park boundary. A total of 46 soil borings were made, with three sites chosen for hand-dug pits to fully describe the morphology and collect samples for lab data. Borings were made using a standard 7.6 cm (3 inch) soil sampling auger with a 152 cm (5 foot) shaft. Soils information recorded included thickness of horizons, soil textures, and Munsell colors. Slope measurements were made (in percent) using a Suunto clinometer. A brief floristic description was completed at all soil borings, and photos were taken in the four cardinal directions. Twenty-three surface samples were also collected at each location for mercury analysis, in part to provide data for inferring fire history.

The field crew consisted of Ulf Gafvert (GLKN GIS Specialist), David Cooper, (GRPO Cultural Resource Specialist), Suzanne Gucciardo (GRPO Ecologist), and Jeremy Ridlbauer, a private GIS Specialist in the area. David Cooper examined areas for cultural artifacts using a detector (described below) prior to any soil disturbance, Ulf Gafvert made the soil borings and described the soil properties, and Suzanne Gucciardo completed the vegetation descriptions. Jeremy Ridlbauer collected GPS coordinates for each sample location and assisted in digging the larger pits for full soil characterization.

Prior to any excavations, David Cooper checked for possible artifacts using a White DFX metal detector with detachable 14 cm and 20.3 cm (5.5-inch and 8-inch) loops (detection coils) operated in the ground exclusion balance/normal non-discriminating mode. Ground exclusion balance was reset at the beginning of each day, and again during the day as dictated by ambient soil magnetism. Use of a headset aided audio-detection.

The soil delineations were refined following the field study, after which mylar overlays were traced from the raw air photo prints for scanning and ortho-rectification. Network staff then used OrthoMapper, a software developed by Professor Frank Scarpase at the University of Wisconsin-Madison, to georeference and orthorectify the scanned overlays. The resulting raster files were then vectorized and joined to create the final soil polygon geodatabase layer.

The soil data map units were copied from existing soil surveys, as the soils closely matched those from recent soil surveys along the south shore of Lake Superior and Isle Royale. The polygons were attributed, and the final polygon layer checked for topological integrity using tools in ArcGIS.

The Network established an interagency agreement with the Natural Resources Conservation Service (NRCS) to assist with developing the legend and entering lab data into the National Soils Information System (NASIS). The data map units were then populated with the soil properties and interpretations from existing data into the final geodatabase product.

Results

Grand Portage National Monument lies near the extreme northeast corner of Minnesota. The trail cuts through an area of rugged, forested terrain. Locally, there are two geological formations, the Pigeon River diabase dikes, which are fine-grained, basaltic intrusions that cut through the Rove formation, ancient argillaceous shales and siltstones. The shales are much softer than the adjacent basaltic dikes and more easily eroded over time. Glacial processes were effective in shaping the current landscape in which the dikes typically appear as prominent, steep-sided ridges surrounded by gently rolling to level topography in the valleys. Glacial deposits filled in many of the low-lying areas, while scouring higher landscape positions to bare rock.

Each glacial event would obliterate much of the landforms and unconsolidated deposits laid down by previous events. The last advance, roughly 12,000 years ago, constructed the landforms seen today. Glacial ice from that advance finally melted out ca. <9,000 years ago. This period of ablation also had strong effects on reshaping those landforms, with inundation of the landscape by proglacial lakes, wave action, and moving water redistributing and sorting the sediments. Erosion and sedimentation, along with other soil-forming processes are still active, slowly changing the character of the soils and landforms over time.

The soils of the Grand Portage area consist primarily of clayey soils, often mantled with silty to loamy deposits 15 to 25 cm thick. The unconsolidated sediments in which the soils have formed are largely derived from fine-grained bedrock (both the basalts and shales), which have been repeatedly reworked and deposited during the numerous advances and retreats of glacial ice over the past several hundred-thousand years of the Pleistocene era.

Borings revealed stratified silts and fine sands below 100 cm of clayey material in some areas. The origin of these deposits is from glacial scour and deposition, subsequently reworked by proglacial meltwater lakes, wave action, and local erosion and sedimentation processes. The lacustrine clays have variable amounts of overlying silty, loamy, or sandy deposits reflecting the local depositional environment, duration of inundation, and effects of wave action.

Mount Rose, near the Lake Superior shore, is the only prominent bedrock landform within the park boundary. Several igneous diabase dikes cross the area, though the Portage trail avoids those steep, rocky landforms, favoring a gentle gradient for foot travel. The trail starts at Lake Superior, with an elevation of 183.5 m, rises to just over 402 m, and then drops down slightly to the Pigeon River, at an elevation of 390 m The trail, while avoiding the steep talus slopes of the dikes, traverses primarily high ground, avoiding wetlands with the exception of the Beaver Marsh area. The trail also crosses three minor drainages with relatively steep ravines.

The variation in surface sediments overlying the clays reflects the local depositional environment. As ice was melting, and proglacial lakes were present, the dikes would have been prominent, exposed landforms rising abruptly above the surrounding waters. Wave action and erosion/sedimentation processes would then create shoreline features, more evident if water level duration was stable for a significant period of time. Landforms such as beach lines and wave-cut terraces are subtle, typically evident by a minor rise in the landscape of less than one to two feet, or perhaps merely a break in the slope. Evidence in the soil profile is indicated by sandy or loamy surfaces or the presence of numerous surface stones, where wave action has winnowed out finer materials, leaving a remnant lag of coarser sands and cobbles.

There are several ‘gaps’ in the diabase dikes, and the portage trail exploits these features to maintain a more level traverse. These gaps likely acted as plugs to melting ice, with ice and debris dams holding back meltwaters and forming proglacial lakes. These temporary dams would then burst, catastrophically draining the lakes, which poured out through the gaps. These kinds of processes contributed to the presence of sandy and loamy surface deposits which are most commonly found adjacent to these gaps in the dikes. Silty mantles are common behind the gaps, where calm lake water allowed finer sediments to settle out of suspension.

Soil profiles along the margin of Lake Superior have a morphology consistent with shoreline processes. Water and wave action sorts sediments, and as the elevation of the lake has fluctuated over time, coarser sands and gravels become deposited in the high energy surf zone and finer sediments are either carried higher up on the beach front or carried out to deeper water. Typical profiles along Grand Portage Bay consist of silty material in the upper profile that grades into coarser sands and gravels with depth –evidence that these areas now situated several to tens-of-meters above lake level were at one time the lake’s edge.

A More Detailed View

This narrative section follows the field survey sites. Sample sites are referenced as GRPO-001 through GRPO-046, but they are not in numerical order on the landscape (see Figures 1 - 3). Field work was initiated at Highway 61, and the team progressed up the trail toward Fort Charlotte. The descriptions discussed here follow the same sequence, with soil investigations at the southeastern end completed in the final day of surveying.

GRPO-001

Starting at the trail junction with Highway 61, the first ‘pitch,’ or rise out of the alluvial valley consists of very shallow soils (<10 cm) over bedrock, an area locally known as the Galle (Figure 1). The vegetation consists of juniper and sparse red pine, and slopes range from 10 to 20%. The very shallow soil (a lithic udorthent) is loamy, with little or no organic material or leaf litter and weak horizonation. The shallow soils are nutrient poor, droughty, and present a significant tree-throw hazard.

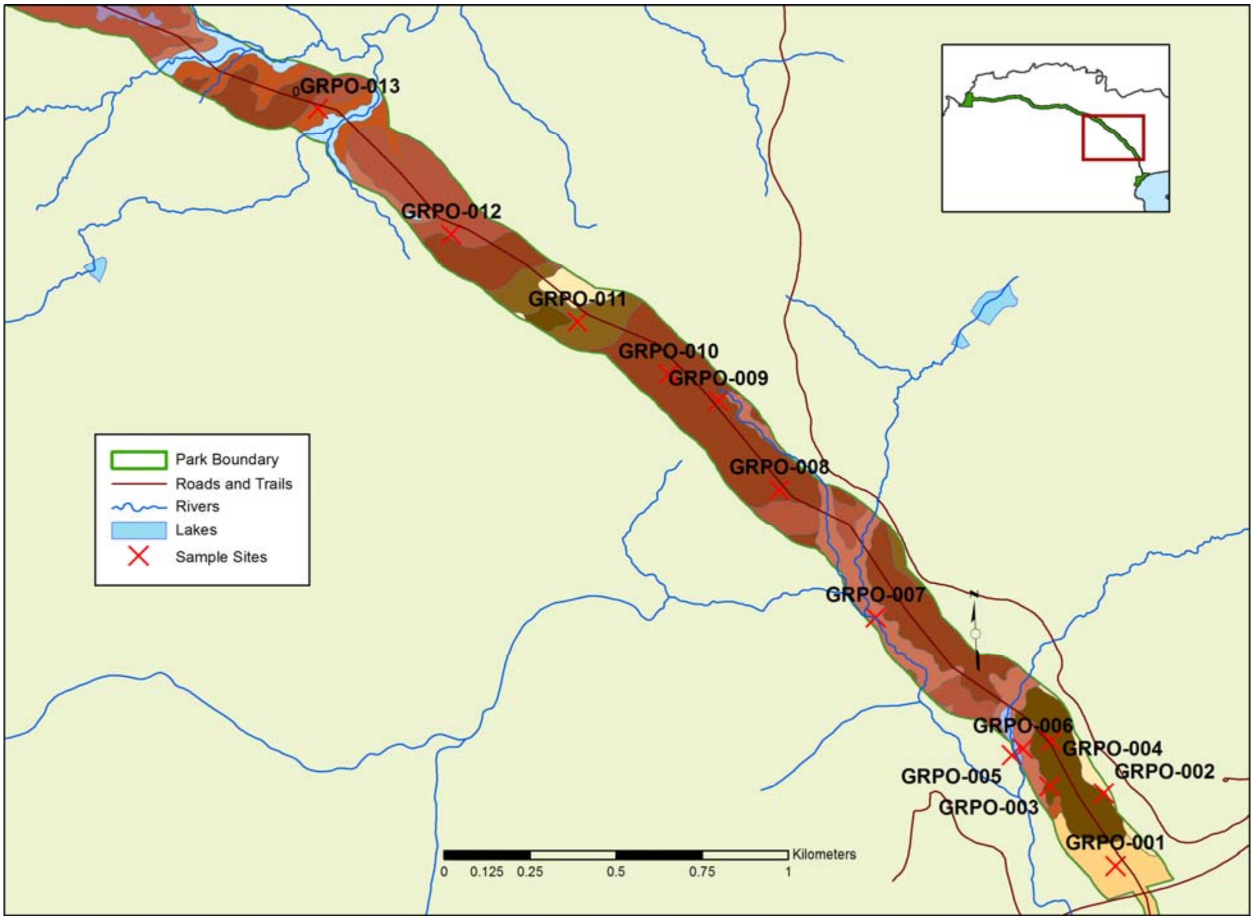

Figure 1. Soil sample locations GRPO-001 through GRPO-013.

GRPO-002-010

As the trail ascends past this bedrock area, it passes between a set of dikes, known locally as the First Gap (GRPO-002 – 004; Figure 1). The soils on this first terrace bench commonly have a loamy cap 12 – 50cm thick over clay loam and silt loam material. A site was chosen in this area (SW ¼ SW ¼ Section 33, T64N R6E) for digging a pit, and samples were collected for laboratory analysis.

This bench is likely an example of a wave-cut terrace landform and is the first area where the portage trail comes near one of the dikes. The more active post-glacial environment, with wave action winnowing the fines around these dikes, occurred during higher lake levels of the Minong (9,500 yrs before present [bp]) and Nipissing (5,500 yrs bp) periods. These areas tend to also have more surface stones as a result of wave-action reworking the sediments.

Three other borings were made in this area (GRPO-005 – 007; Figure 1), though the numerous stones encountered prevented hand auguring beyond 60 cm in depth. Some cursory sampling was done in the minor floodplains. Stratified silty and loamy deposits were found, confirming the active floodplain environment. There was also some evidence of A-horizon development. Further investigations would be valuable in better determining soil properties at greater depths and in defining floodplain characteristics, but there was not sufficient time during this survey effort.

Beyond the dikes, there is a gently sloping valley where an un-named creek (locally known as First River) enters Grand Portage Creek. The soils profiles here (GRPO-008 – 010; Figure 1) are relatively uniform, with silty surface horizons over clay and few coarse fragments. The glacial depositional environment was likely that of a proglacial lake, where fine sediments were able to settle out in the relatively calm water protected behind the dikes, which would have provided a barrier to strong wave action (Phillips 2003).

GRPO-011-016

The trail then follows a narrow cut between a set of dikes, known as the Second Gap (or Notch) (GRPO-011; Figure 2). Once again, there is evidence of a more active post-glacial environment, with wave action having reworked the sediments, leaving sandy loam surface sediments and a lag of coarse fragments. It is also likely that there would have been some current, as fluctuating water levels would have caused waters to slosh back and forth through the narrow cut between the exposed dikes.

Beyond the exposed dikes, the trail enters the Poplar Creek watershed. This area (GRPO-012 – 013; Figure 2) has several steep ravines, where the creek and several small tributaries have incised the fine-grained glacial till and lacustrine deposits. The soils in this valley are predominantly clayey, with silt loam surfaces – evidence that the area was inundated by the proglacial lake. This area was protected from wave action behind the dikes, allowing thicker amounts of sediment to accumulate, and little or no wave action to sort the materials (Phillips 2003).

West of Old Highway 61, the trail climbs up a moderate grade. The soils in this area (GRPO-014-016; Figure 2) have some thin, sandy loam surface materials, with surface cobbles and stones providing evidence of wave action having reworked the glacial sediments. The area was still mapped 480B, Portwing-Herbster complex, as the loamy surface was inconsistent and, where present, <25 cm thick.

GRPO-025-028

The final section of trail before Fort Charlotte trends primarily east-west, across a nearly level landscape (Figure 2). This section of the trail is situated on top of another diabase dike, evidenced by a steep drop-off within 30 to 65 m north of the trail, with several bedrock outcrops and flagstones commonly occurring along the foot of the slope. Soils on this slope are loamy and probably very shallow, though augering was ineffective at getting beyond the numerous stones. Clayey soils remained the dominant type on top of the dike. Bedrock is likely close to the surface along this part of the trail.

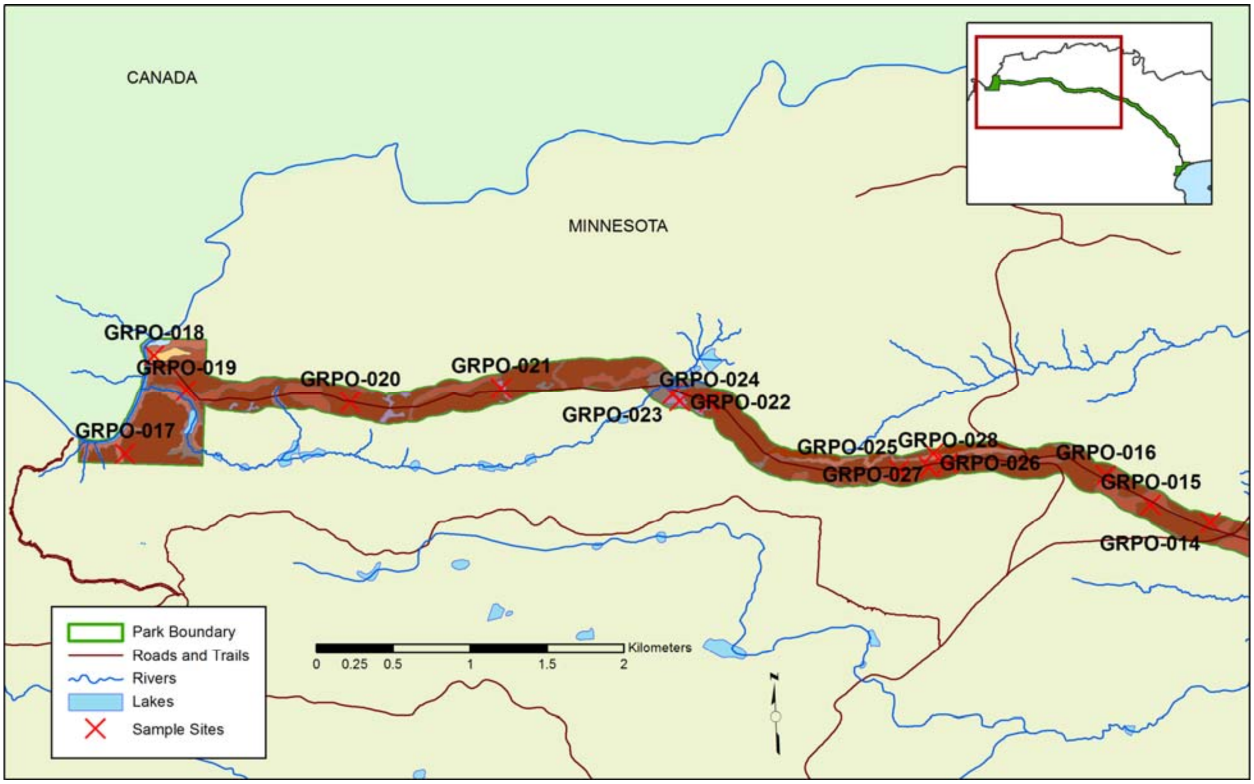

Figure 2. Soil sample locations GRPO-014 through GRPO-028.

Whereas bedrock outcrops occur occasionally along the trail, no bedrock was apparent within the auger depth of 150 cm during borings. No borings were made directly within the trail corridor, but borings adjacent to these small outcrops did not reveal underlying bedrock. Here again, further investigations could confirm depth to bedrock, but determination could not be made with hand augering. The presence of coarse fragments prevented sampling to the 150 cm depth of the auger.

GRPO-022-024

The trail drops into a low valley along this part of the trail and crosses a sizeable wetland, known as the Beaver Marsh (Figure 2). This is an organic bog, saturated to the surface, with some areas of open water. There is a boardwalk here, providing a good opportunity to view the wetland. Soils were sampled at the edge of the wetland area, where the organic material at the surface was thin. Soil texture was clay in all upper horizons, and strongly mottled, indicating poorly drained conditions. Below 70 cm, there was evidence of stratification, with thin (<0.3 cm) strata of silts and clays. This provides evidence that these sediments were laid down by water, during alternating periods of moving and calm water.

The clayey materials just above the stratified sediments also contain secondary accumulations of calcium carbonate, in the form of soft masses and concretions. Calcium carbonate accumulations have been found throughout the clayey soils of the Lake Superior basin, and the presumed origin on the southern shore is ancient limestone deposits, which have dissolved or eroded over time. The only evidence for this is the occasional cherty fossils found along the lakeshore and the secondary carbonates found in the clays. The origin of carbonates on the north shore is most likely from the argillaceous shales of the Rove formation.

The primary significance of the carbonates is that they raise the pH in these horizons to >8, and plant roots reaching these horizons can bring these bases (necessary plant nutrients) to the surface. They are also significant in soil development, as the carbonates must be translocated into deeper horizons before clays will become mobile and move downward in the profile. This is because carbonates bind clay particles together (flocculation) and prevent downward movement.

Soils within the wetland area are histosols, having >40 cm of organic material above mineral soil. A core was sampled in September 2006 by Mark Edlund of the Saint Croix Watershed Research Station. This core consisted of 43 cm of peat and fibrous organic materials over pink, mottled clay.

GRPO-017-021
Fort Charlotte, situated on the Pigeon River, is the northwestern outpost and terminus of the Grand Portage Trail. This is where the voyageurs would begin paddling toward the watersheds flowing north toward Hudson Bay. Though still within the Lake Superior watershed, the canoes could be paddled upstream from this point, having bypassed the unnavigable waterfalls and cascades downstream.

The soils are distinctly different at the Fort Charlotte site (Figure 2). Bedrock is at or near the surface, as can be readily seen along the banks of the river. There is a thin mantle of silt and fine sand overlying the bedrock. One boring was made to 107 cm, at which point bedrock was likely encountered. Further investigation should be completed in this area to confirm the extent of silts and fine sands, as well as depth to bedrock. Soils to the south of the fort area along the Pigeon River are again clayey, and more detailed investigations would be valuable in better delineating the extent of coarser textured soils.

GRPO-029-040
The soils along the section of trail south of Highway 61 are quite variable, reflecting the complex post-glacial history along Lake Superior's shoreline and having undergone significant disturbance by human activity over the past 200 years or more. The modern trail follows along the east side of Grand Portage Creek. The portion of the trail immediately below the highway crossing descends a moderate slope.

The soils here are thin, loamy textures over bedrock, continuing the landform described earlier as the Galle (Figure 3). At an elevation of 238 m – 244 m, the slope becomes more gradual, with thicker clay soils appearing again; the trail then follows a level landform. This is most likely a terrace from a former floodplain of Grand Portage Creek, or a deltaic deposit when Lake Superior was at a higher elevation. As lake levels dropped subsequent to glacial melt-out, the creek channel has cut down through these alluvial sediments laid down when the creek was just beginning to flow. Soil materials on this terrace are typically silty with some sandy strata within the profile.

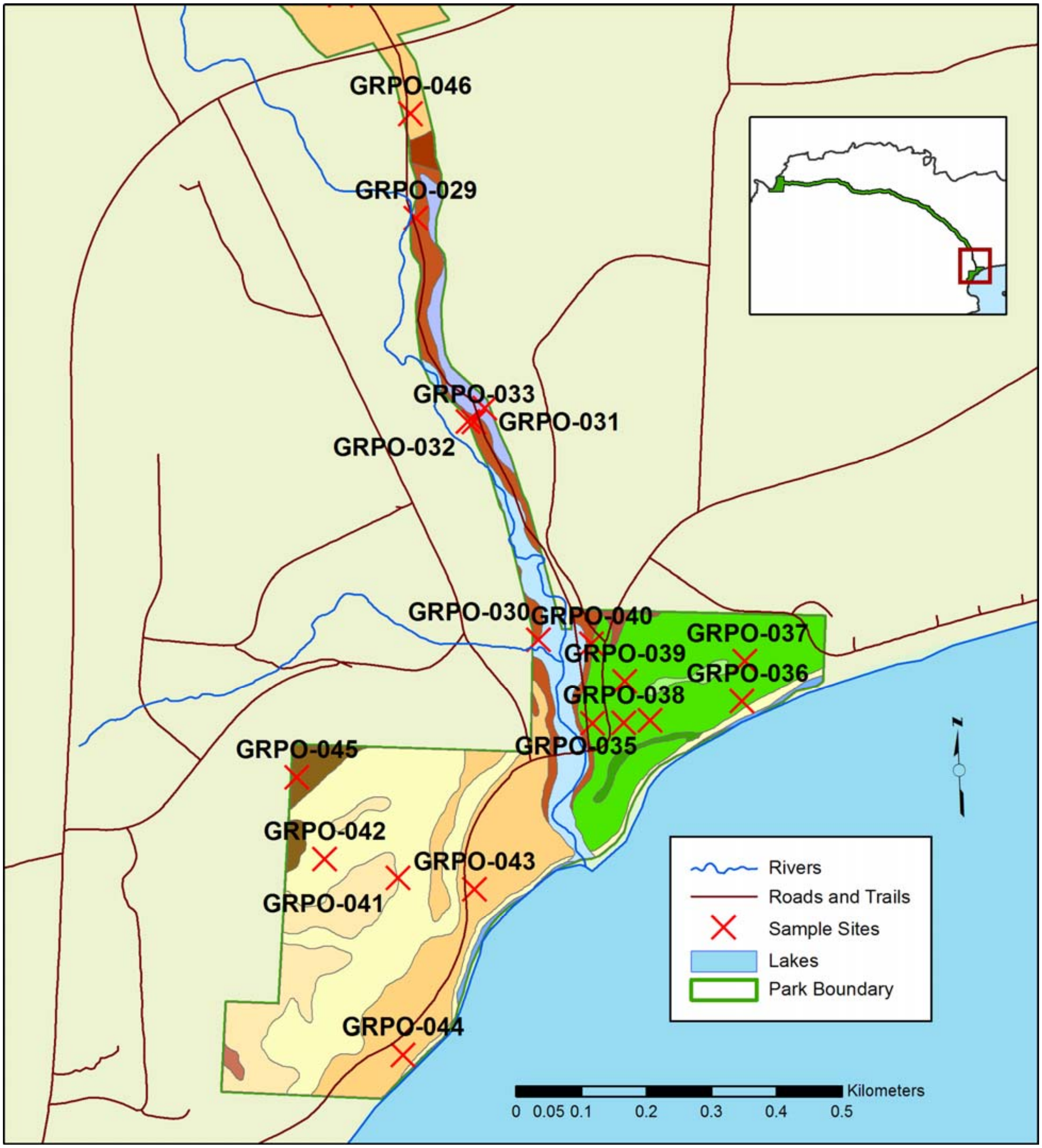

Figure 3. Soil sample locations GRPO-029 through GRPO-046.

Once onto the level-to-gently sloping landscape, which includes the open field, stockade, maintenance buildings, and other infrastructure, the soils are clearly formed by the active margin of the lake. Soils are commonly silty at the surface, grading to sands and coarser textures with depth. These are likely lake terrace landforms, though Grand Portage Creek likely had a significant influence. Many areas were too gravelly and cobbly to auger through. There is clear evidence of human disturbance, and horizonation may be missing or truncated. Further investigations could provide further clues to divulging the history of human impacts in this portion of the park.

One interesting note here is the sampling completed just southwest of the current location of the maintenance building. David Cooper had some anecdotal information that a road existed where there is now 40-year-old pine. A few borings revealed compacted soils, gravels, and little to no organic matter in the upper A-horizon.

GRPO-041-046

Mount Rose is a prominent knob very near the lakeshore at the southwest edge of the park boundary. This bedrock landform is composed primarily of the Rove Formation, though several minor diabase dikes have intruded the area and likely contributed to the prominence of the landform today. Soil investigations were relatively futile along the upper portions of the landform, as abundant talus flagstones and exposed bedrock prevented sampling to any appreciable depth.

Soil borings made along the base of Mount Rose facing the lake revealed bedrock near the surface and proved impenetrable with hand tools (Figure 3). Wave action when the lake was above its current elevation has likely removed most unconsolidated materials, and recent talus covers much of the surface. Soils along the foot of Mount Rose on the north side, away from the lake, had loamy surfaces over clay to clay loam, with some evidence of spodic horizons in the upper profile. This is a fairly unique area within the Monument, as the area receives little sunlight but significant amounts of water from runoff and percolation off of Mount Rose. Forest growth here indicates a somewhat richer habitat type than seen elsewhere in the park.

Conclusions

The soils of the Grand Portage National Monument are predominantly formed from two strikingly different parent materials: igneous bedrock and clayey glacial till. The bedrock outcrops form the steep topography characteristic of the region, with the clayey soils filling in the valleys and more level landforms. Clay soils dominate within the Monument boundary, as maintaining a lower gradient was desirable in negotiating the portage. This must have proven problematic during wet periods, as foot traffic and equipment would readily become mired in the heavy, sticky clay.

The clays have high available water capacity and moderate permeability in the thin silty or loamy surface, and moderate to moderately low available water capacity and slow to very slow permeability in the clayey subsoil. These soils typically have good inherent fertility, as the clays have a high cation exchange capacity, but are also typically somewhat acidic in the upper profile, potentially making many nutrients less available to uptake by vegetation. However, in a forested condition, high organic matter in the surface litter and upper A-horizon can support good tree growth. Fungal mycorhizzal associations can also substantially improve forest health, as fungi tend to be more prevalent as decomposers than microfauna in the cool, acidic soil conditions in the Grand Portage area.

Clay soils tend to be saturated at or near the surface in early spring, after snowmelt and frost is out of the ground, due to the slow permeability in the subsoil. After leaf-out, evapotranspiration rapidly reduces the moisture levels, and by mid-summer, vegetation may be under drought stress, as water is held tightly in the fine pore space of fine-textured soils. The average wilting point for many plants is 15 bar negative pressure, (the suction applied by plant roots to extract moisture), and heavy clay soils may retain as much as 30% moisture by volume at this point.

Engineering interpretations tend to be severe or very limiting for clay soils, as they have poor strength when wet, high shrink-swell properties, are subject to compaction, are often saturated at or near the surface during wet periods, and are susceptible to erosion. Other interpretations specific to campgrounds, paths, and trails, (motorized and non-motorized), are also very limited for the same reasons.

Soils formed on the bedrock dikes are typically shallow to moderately deep, very stony, and relatively coarse-textured. They have considerably less available water capacity, lower cation exchange capacity, and rapid permeability. Forest communities on these shallow soils tend to be susceptible to windthrow and have higher seedling mortality due to droughty conditions. Once established, though, tree roots can exploit deep fractures, gaining access to water and nutrients and good anchoring from wind stress.

Interpretations are severe or very limiting for these soils, primarily due to high gravel and cobble content, shallow depth to bedrock, and steep slopes typical of these landforms. Care should be taken with these shallow soils to prevent erosion, and they should be protected from logging because of their fragile nature.

2. Soil Classification and Descriptions for Grand Portage National Monument

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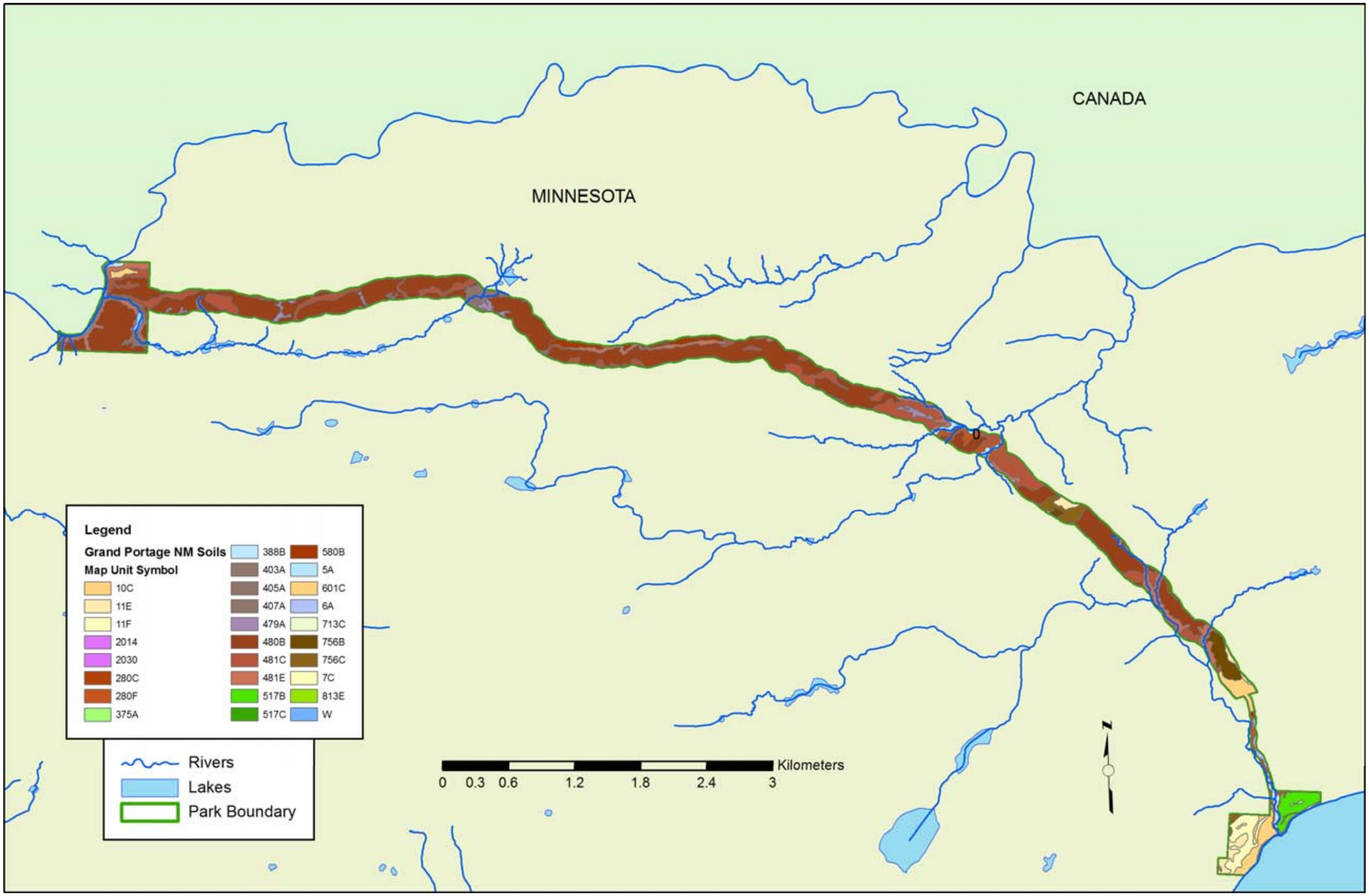


Figure 4. Overview soils map for Grand Portage National Monument. See Table 1 for map unit names and Figure 5 for color symbology.
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Table 1. Soils map unit names and sizes at Grand Portage National Monument. MUSYM = map unit symbol.

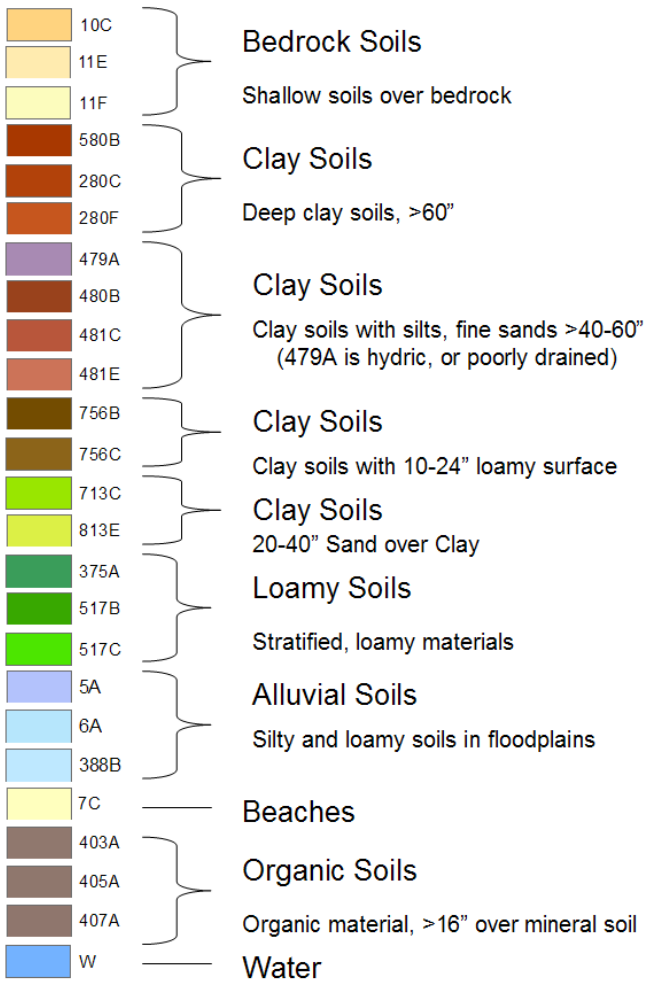
Map Unit Symbol	Map Unit Name	Hectares	Acres	# of Map Units
5A	Arnheim mucky silt loam, 0 to 1% slopes, frequently flooded	7.37	18.21	1
6A	Moquah fine sandy loam, 0 to 3% slopes, frequently flooded	6.10	15.07	2
7C	Beaches, 2 to 12% slopes	1.19	2.93	2
10C	Quetico-Minong-Rock outcrop complex, 1 to 12% slopes, very stony	28.29	69.90	4
11E	Quetico-Peshekee-Rock outcrop complex, 12 to 50% slopes, very stony	67.43	166.62	11
11F	Quetico-Peshekee-Rock outcrop complex, 10 to 90% slopes	58.58	144.76	13
280C	Odanah silt loam, 6 to 15% slopes	6.59	16.29	2
280F	Odanah silt loam, 25 to 60% slopes	72.99	180.37	9
375A	Robago fine sandy loam, lake terrace, 0 to 3% slopes	0.21	0.51	1
388B	Pelkie, occasionally flooded-Dechamps, frequently flooded, complex, 0 to 4% slopes	26.67	65.91	7
403A	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	34.35	84.88	1
405A	Lupton, Cathro, and Tawas soils, 0 to 1% slopes	13.28	32.82	1
407A	Seelyeville and Markey soils, 0 to 1% slopes	69.02	170.55	8
479A	Lerch-Herbster complex, 0 to 3% slopes	47.61	117.66	17
480B	Portwing-Herbster complex, 0 to 6% slopes	727.35	1797.33	26
481C	Cornucopia silt loam, 6 to 15% slopes	201.62	498.22	40
481E	Cornucopia silt loam, 15 to 45% slopes	173.64	429.08	30
517B	Annalake fine sandy loam, lake terrace, 2 to 6% slopes	12.08	29.85	2
517C	Annalake fine sandy loam, lake terrace, 6 to 15% slopes	0.24	0.59	1
580B	Sanborg-Badriver complex, 0 to 6% slopes	56.84	140.45	3
601C	Ishpeming-Rock outcrop complex, 5 to 20% slopes, very stony	7.14	17.65	3
713C	Kellogg-Allendale-Ashwabay complex, 6 to 15% slopes	1.72	4.25	1
756B	Superior-Sedgwick complex, 0 to 6% slopes	8.08	16.79	3
756C	Superior-Sedgwick complex, 6 to 15% slopes	87.25	215.60	5

Table 1. Soils map unit names and sizes at Grand Portage National Monument (continued).

MUSYM	Map Unit Name	Hectares	Acres	# of Map Units
813E	Manistee-Kellogg-Ashwabay complex, 15 to 45% slopes	7.99	19.74	1
2014	Pits, quarry, hard bedrock	7.47	18.45	1
2030	Udorthents and Udipsamments, cut or fill	2.93	7.24	1
W	Water	32.43	80.15	2
	Total area	1766.47	4361.85	198

Table 2. Taxonomic classification of the soils at Grand Portage National Monument.

Soil name	Family or higher taxonomic classification
Allendale	Sandy over clayey, mixed, semiactive, frigid Alfic Epiaquods
Annalake	Coarse-loamy, mixed, superactive, frigid Alfic Oxyaquic Haplorthods
Arnheim	Coarse-loamy, mixed, superactive, nonacid, frigid Typic Fluvaquents
Ashwabay	Sandy, isotic, frigid Alfic Oxyaquic Haplorthods
Badriver	Fine, mixed, active, frigid Aeric Glossaqualfs
Beseman	Loamy, mixed, dysic, frigid Terric Haplosaprists
Cathro	Fine, mixed, active, frigid Haplic Glossudalfs
Dawson	Sandy or sandy-skeletal, mixed, dysic, frigid Terric Haplosaprists
Dechamps	Sandy, mixed, frigid Aquic Udifluvents
Herbster	Fine, mixed, active, frigid Aeric Glossaqualfs
Ishpeming	Sandy, mixed, frigid Entic Haplorthods
Kellogg	Sandy over clayey, mixed, active, frigid Alfic Oxyaquic Haplorthods
Lerch	Very-fine, mixed, active, nonacid, frigid Vertic Epiaquepts
Loxley	Dysic, frigid Typic Haplosaprists
Lupton	Euic, frigid Typic Haplosaprists
Manistee	Sandy over clayey, mixed, active, frigid Alfic Haplorthods
Markey	Sandy or sandy-skeletal, mixed, euic, frigid Terric Haplosaprists
Minong	Euic, frigid Lithic Udifolists
Moquah	Coarse-loamy, mixed, superactive, nonacid, frigid Typic Udifluvents
Odanah	Fine, mixed, active, frigid Haplic Glossudalfs
Pelkie	Mixed, frigid Oxyaquic Udipsamments
Peshekee	Loamy, mixed, semiactive, frigid Lithic Haplorthods
Portwing	Fine, mixed, active, frigid Oxyaquic Glossudalfs
Quetico	Loamy, isotic, acid, frigid Lithic Udorthents
Robago	Coarse-loamy, mixed, superactive, frigid Argic Endoaquods
Sanborg	Fine, mixed, active, frigid Oxyaquic Glossudalfs
Sedgwick	Coarse-loamy over clayey, mixed, active, frigid Alfic Epiaquods
Seelyeville	Euic, frigid Typic Haplosaprists
Superior	Coarse-loamy over clayey, mixed, active, frigid Alfic Oxyaquic Haplorthod
Tawas	Sandy or sandy-skeletal, mixed, euic, frigid Terric Haplosaprists
Udipsamments	Udipsamments
Udorthents	Udorthents



Soil map unit symbols have a numeric component indicating the soil type, and a letter component indicating the landform slope class. These slope classes are assigned in percentages, as follows:

A	0-1%, or 1-3%
B	0-6%, 2-4%, or 2-6%
C	2-12%, 6-15%, or 5-20%
E	12-50%, 15-45%
F	10-90%, or 25-60%

Variation in slope groupings is due to differences in map unit design. Slope groupings for each map unit are designed to reflect the range of slopes on which the soils occur. No soils in this survey were assigned D slope class.

Figure 5. Soil color table and slope classifications for Grand Portage soil map (Figure 4).

The soil color table is intended to represent distinct properties of the soil types in order to facilitate interpretation of the map.

Bedrock soils are tan, to represent rock material
Red colors are clay soils, (loamy surface is brown), to represent the red color of the clays
Green colors are loamy soils, to represent the richer habitat type, higher available
water and nutrients
Blue colors represent the floodplain soils,
Purple represents wetland soil
Gray tones represent the organic, wetland soils

Within any soil grouping, soils on steeper slopes are progressively lighter in tone to represent a typically thinner soil profile, lower available water, and less rich habitat type.

Soil Descriptions

Note: Data applies to the entire extent of the map unit within the survey area. Map unit and soil properties for a specific parcel of land may vary somewhat and should be determined by on-site investigation.

5A - Arnheim mucky silt loam, 0 to 1 percent slopes, frequently flooded

Arnheim and similar soils

Extent: 80 to 100 percent of the unit
Landform(s): flood plains
Slope gradient: 0 to 1 percent
Parent material: loamy alluvium
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: frequent
Ponding Hazard: frequent

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: poorly drained
Hydric soil: yes
Hydrologic group: D
Potential frost action: high

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
A -- 0 to 5 in	mucky silt loam	moderately rapid	0.6 to 1.8 in	5.1 to 7.3	.37	.37
Cg -- 5 to 10 in	silt loam	moderate	0.9 to 1.0 in	5.1 to 7.3	.37	.37
C1 -- 10 to 15 in	very fine sandy loam	moderate	0.7 to 1.1 in	5.1 to 7.3	.37	.37
C2 -- 15 to 24 in	silt loam	moderate	1.3 to 2.0 in	5.1 to 7.3	.37	.37
C3 -- 24 to 60 in	stratified loamy fine sand to fine	moderate	5.0 to 7.9 in	5.1 to 7.3	.37	.37

Minor Components

Moquah and similar soils: 0 to 10 percent of the unit
Dechamps and similar soils: 0 to 15 percent of the unit

6A - Moquah fine sandy loam, 0 to 3 percent slopes, frequently flooded

Moquah and similar soils

Extent: 80 to 100 percent of the unit
Landform(s): flood plains
Slope gradient: 0 to 3 percent
Parent material: loamy alluvium
Restrictive feature(s): none
Seasonal high water table: approximately 30 inches

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 4w
Drainage class: moderately well drained
Hydric soil: no

Flooding hazard: frequent

Ponding Hazard: none

Hydrologic group: C

Potential frost action: moderate

Representative soil profile:

Horizon	Depth	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 5 in	fine sandy loam	moderate	0.7 to 1.1 in	4.5 to 7.8	.28	.28
C1 --	5 to 19 in	stratified fine sandy loam to silt loam to fine sand	moderate	1.7 to 3.0 in	4.5 to 7.8	.24	.24
C2 --	19 to 48 in	stratified very fine sandy loam to silt loam to fine sand	moderate	3.5 to 6.4 in	4.5 to 7.8	.24	.24
C3 --	48 to 55 in	silt loam	moderate	1.4 to 1.6 in	4.5 to 7.8	.37	.37
C4 --	55 to 60 in	stratified sand to fine sand	moderate	0.2 to 0.3 in	4.5 to 7.8	.15	.15

Minor Components

Arnheim and similar soils: 0 to 10 percent of the unit

Dechamps and similar soils: 0 to 15 percent of the unit

7C - Beaches, 2 to 12 percent slopes

Beaches

Extent: 95 to 100 percent of the unit

Landform(s):

Slope gradient: 2 to 12 percent

Parent material:

Restrictive feature(s): none

Seasonal high water table: greater than 60 inches

Flooding hazard: none

Ponding Hazard: none

Soil loss tolerance (T factor):

Wind erodibility group (WEG):

Wind erodibility index (WEI):

Land capability class, non-irrigated: 8s

Drainage class:

Hydric soil: no

Hydrologic group:

Potential frost action:

Representative soil profile:

	Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

Psammaquents and similar soils: 0 to 5 percent of the unit

10C - Quetico-Minong-Rock outcrop complex, 1 to 12 percent slopes, very stony

Quetico, very stony and similar soils

Extent: about 40 percent of the unit
Landform(s): knobs
Slope gradient: 1 to 12 percent
Parent material: loamy till
Restrictive feature(s): lithic bedrock at 4 to 10 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 1
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 7s
Drainage class: well drained
Hydric soil:
Hydrologic group: D
Potential frost action: low

Representative soil profile:

		Texture	Permeability	Available Water Capacity	pH	Kw	Kf
A --	0 to 2 in	loam	moderately rapid	0.2 to 0.5 in	4.5 to 6.0	.32	.32
Bw --	2 to 7 in	loam	moderately rapid	0.4 to 1.2 in	4.5 to 6.0	.32	.32
2R --	7 to 7 in	bedrock	very slow				

Minong, very stony and similar soils

Extent: about 30 percent of the unit
Landform(s): knobs
Slope gradient: 1 to 12 percent
Parent material: shallow woody organic material over thin loamy till over bedrock
Restrictive feature(s): lithic bedrock at 1 to 20 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 1
Wind erodibility group (WEG): 7
Wind erodibility index (WEI): 38
Land capability class, non-irrigated: 7s
Drainage class: well drained
Hydric soil:
Hydrologic group: D
Potential frost action: high

Representative soil profile:

		Texture	Permeability	Available Water Capacity	pH	Kw	Kf
Oi --	0 to 1 in	peat	rapid	0.3 to 0.5 in	5.0		
Oe --	1 to 7 in	mucky peat	moderate	2.0 to 3.7 in	5.4		
C --	7 to 9 in	sandy loam	moderately rapid	0.1 to 0.2 in	5.5	.28	.28
R --	9 to 9 in	bedrock	very slow				

Rock outcrop

Extent: about 15 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil:
Hydrologic group:
Potential frost action:

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
none						

Minor Components

Arcadian and similar soils: 10 percent of the unit
Bugcreek, taxadjunct and similar soils: 5 percent of the unit

11E - Quetico-Peshekee-Rock outcrop complex, 12 to 50 percent slopes, very stony

Quetico, very stony and similar soils

Extent: about 35 percent of the unit
Landform(s): knobs
Slope gradient: 1 to 12 percent
Parent material: loamy till
Restrictive feature(s): lithic bedrock at 4 to 10 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 1
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 7s
Drainage class: well drained
Hydric soil:
Hydrologic group: D
Potential frost action: low

Representative soil profile:

	Depth	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
A --	0 to 2 in	loam	moderately rapid	0.2 to 0.5 in	4.5 to 6.0	.32	.32
Bw --	2 to 7 in	loam	moderately rapid	0.4 to 1.2 in	4.5 to 6.0	.32	.32
2R --	7 to 7 in	bedrock	very slow				

Peshekee and similar soils

Extent: about 30 percent of the unit
Landform(s): ridges on moraines, hills on moraines, escarpments on moraines
Slope gradient: 1 to 18 percent
Parent material: loamy till over conglomerate and/or basalt
Restrictive feature(s): lithic bedrock at 10 to 20 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 7s
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:

	Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A -- 0 to 3 in	loam	moderate	0.3 to 0.8 in	4.5 to 6.0	.32	.37
Bhs1 -- 3 to 8 in	fine sandy loam	moderate	0.4 to 1.0 in	4.5 to 6.0	.24	.28
Bhs2 -- 8 to 15 in	sandy loam	moderate	0.6 to 1.6 in	4.5 to 6.0	.24	.28
2R -- 15 to 60 in	bedrock	very slow				

Rock outcrop

Extent: about 25 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil:
Hydrologic group:
Potential frost action:

Representative soil profile:

	Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

Arcadian and similar soils: 5 percent of the unit
Michigamme and similar soils: 5 percent of the unit

11F - Quetico-Peshekee-Rock outcrop complex 10 to 90 percent slopes

Quetico and similar soils

Extent: about 35 percent of the unit
Landform(s):
Slope gradient: 10 to 65 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil:
Hydrologic group:
Potential frost action:

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Peshekee and similar soils

Extent: about 30 percent of the unit
Landform(s):
Slope gradient: 12 to 50 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil:
Hydrologic group:
Potential frost action:

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Rock outcrop

Extent: about 25 percent of the unit
Landform(s):
Slope gradient: 10 to 90 percent
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil:
Hydrologic group:

Ponding Hazard: none

Potential frost action:

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
none						

Minor Components

Arcadian and similar soils: 5 percent of the unit
Michigamme and similar soils: 5 percent of the unit

280C - Odanah silt loam, 6 to 15 percent slopes

Odanah and similar soils

Extent: 85 to 100 percent of the unit
Landform(s): till plains
Slope gradient: 6 to 15 percent
Parent material: clayey till
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 4e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
A -- 0 to 4 in	silt loam	moderate	0.7 to 0.9 in	4.5 to 7.3	.37	.37
E/B -- 4 to 8 in	silt loam	moderate	0.5 to 0.8 in	4.5 to 7.3	.37	.37
B/E -- 8 to 12 in	clay	moderately slow	0.4 to 0.6 in	4.5 to 7.3	.32	.32
Bt -- 12 to 30 in	clay	slow	1.4 to 2.5 in	5.1 to 7.8	.32	.32
Btk -- 30 to 80 in	clay	slow	4.0 to 7.0 in	7.9 to 9.0	.32	.32

Minor Components

Sanborg and similar soils: 0 to 5 percent of the unit
Badriver and similar soils: 0 to 5 percent of the unit
Cornucopia and similar soils: 0 to 10 percent of the unit

280F - Odanah silt loam, 25 to 60 percent slopes

Odanah and similar soils

Extent: 90 to 100 percent of the unit
Landform(s): till plains
Slope gradient: 25 to 60 percent
Parent material: clayey till
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 7e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:

	Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A -- 0 to 4 in	silt loam	moderate	0.7 to 0.9 in	4.5 to 7.3	.37	.37
E/B -- 4 to 8 in	silt loam	moderate	0.5 to 0.8 in	4.5 to 7.3	.37	.37
B/E -- 8 to 12 in	clay	moderately slow	0.4 to 0.6 in	4.5 to 7.3	.32	.32
Bt -- 12 to 30 in	clay	slow	1.4 to 2.5 in	5.1 to 7.8	.32	.32
Btk -- 30 to 80 in	clay	slow	4.0 to 7.0 in	7.9 to 9.0	.32	.32

Minor Components

Cornucopia and similar soils: 0 to 5 percent of the unit
Moquah and similar soils: 0 to 5 percent of the unit

375A - Robago fine sandy loam, lake terrace, 0 to 3 percent slopes

Robago and similar soils

Extent: 80 to 100 percent of the unit
Landform(s): lake plains
Slope gradient: 0 to 3 percent
Parent material: stratified sandy and loamy glaciofluvial and glaciolacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 6 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 2w
Drainage class: somewhat poorly drained
Hydric soil: no
Hydrologic group: C
Potential frost action: high

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*

Oa --	0 to 2 in	highly decomposed plant material	rapid	0.7 to 0.9 in	3.6 to 6.0	.02	.02
E --	2 to 7 in	fine sandy loam	moderate	0.8 to 0.9 in	3.6 to 6.0	.28	.28
Bs --	7 to 17 in	fine sandy loam	moderate	1.2 to 1.9 in	3.6 to 6.0	.24	.24
E' --	17 to 20 in	fine sandy loam	moderate	0.4 to 0.6 in	3.6 to 6.0	.24	.24
E/B --	20 to 27 in	fine sandy loam	moderate	0.9 to 1.3 in	5.1 to 7.3	.24	.24
B/E --	27 to 38 in	fine sandy loam	moderate	1.3 to 2.1 in	5.1 to 7.3	.24	.24
C --	38 to 62 in	stratified very fine sandy loam to silt loam to very fine sand to fine sand	moderate	1.2 to 5.2 in	6.1 to 7.3	.24	.24

Minor Components

Iosco and similar soils: 0 to 10 percent of the unit
Tonkey and similar soils: 0 to 10 percent of the unit
Annalake and similar soils: 0 to 10 percent of the unit

388B - Pelkie, occasionally flooded-Dechamps, frequently flooded, complex, 0 to 4 percent slopes

Pelkie and similar soils

Extent: 30 to 70 percent of the unit
Landform(s): flood plains
Slope gradient: 0 to 4 percent
Parent material: sandy alluvium
Restrictive feature(s): none
Seasonal high water table: approximately 30 inches
Flooding hazard: frequent
Ponding Hazard: occasional

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 2
Wind erodibility index (WEI): 134
Land capability class, non-irrigated: 4w
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: A
Potential frost action: low

Representative soil profile:

		Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 8 in	loamy very fine sand	rapid	1.3 to 1.4 in	4.5 to 6.5	.43	.43
C1,C2 --	8 to 32 in	fine sand	rapid	1.2 to 2.2 in	4.5 to 6.5	.05	.05
C3 --	32 to 60 in	sand	rapid	1.4 to 2.5 in	4.5 to 6.5	.05	.05

Dechamps and similar soils

Extent: 15 to 40 percent of the unit
Landform(s): flood plains
Slope gradient: 0 to 2 percent
Parent material: predominantly loamy alluvium
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 4w
Drainage class: somewhat poorly drained
Hydric soil: no

Flooding hazard: frequent
Ponding Hazard: none

Hydrologic group: A/D
Potential frost action: moderate

Representative soil profile:

	Depth	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
A --	0 to 3 in	fine sandy loam	moderately rapid	0.4 to 0.4 in	5.6 to 6.5	.28	.28
C1 --	3 to 8 in	fine sandy loam	moderately rapid	0.6 to 0.7 in	5.6 to 7.8	.32	.32
C2,C3 --	8 to 49 in	stratified fine sandy loam to fine sand	rapid	2.5 to 4.5 in	5.6 to 7.8	.17	.17
C4 --	49 to 80 in	stratified fine sand to silt loam	rapid	1.9 to 3.4 in	5.6 to 7.8	.17	.17

Minor Components

Moquah and similar soils: 0 to 15 percent of the unit
Arnheim and similar soils: 0 to 15 percent of the unit

403A - Loxley, Beseman, and Dawson soils, 0 to 1 percent slopes

Loxley and similar soils

Extent: 0 to 100 percent of the unit
Landform(s): depressions on disintegration moraines
Slope gradient: 0 to 1 percent
Parent material: herbaceous organic material more than 51 inches thick
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: occasional

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: very poorly drained
Hydric soil: yes
Hydrologic group: A/D
Potential frost action: high

Representative soil profile:

	Depth	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
Oe --	0 to 13 in	mucky peat	rapid	7.1 to 8.4 in		.02	.02
Oa --	13 to 60 in	muck	moderately rapid	16.4 to 21.1 in		.02	.02

Beseman and similar soils

Extent: 0 to 100 percent of the unit
Landform(s): depressions on disintegration moraines
Slope gradient: 0 to 1 percent
Parent material: herbaceous organic material 16 to 51 inches thick over loamy till
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: very poorly drained
Hydric soil: yes
Hydrologic group: A/D
Potential frost action: high

Ponding Hazard: occasional

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oa -- 0 to 36 in	muck	moderately rapid	12.5 to 16.1 in		.02	.02
Cg -- 36 to 60 in	loam	moderately slow	2.2 to 5.3 in	3.5 to 7.3	.43	.43

Dawson and similar soils

Extent: 0 to 100 percent of the unit
Landform(s): depressions on disintegration moraines
Slope gradient: 0 to 1 percent
Parent material: sphagnum moss and herbaceous organic material 16 to 51 inches thick over sandy or sandy and gravelly deposits
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: very poorly drained
Hydric soil: yes
Hydrologic group: A/D
Potential frost action: high

Ponding Hazard: occasional

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oi -- 0 to 8 in	peat	rapid	4.3 to 5.1 in		.02	.02
Oa -- 8 to 38 in	muck	moderately rapid	10.6 to 13.6 in		.02	.02
A -- 38 to 40 in	silt loam	moderate	0.4 to 0.4 in	3.5 to 4.4	.37	.37
2C -- 40 to 60 in	sand	rapid	0.6 to 1.4 in	3.5 to 6.5	.15	.15

Minor Components

Uskabwanka and similar soils: 0 to 5 percent of the unit

405A - Lupton, Cathro, and Tawas soils, 0 to 1 percent slopes

Lupton and similar soils

Extent: 0 to 100 percent of the unit
Landform(s): depressions on disintegration moraines
Slope gradient: 0 to 1 percent
Parent material: herbaceous and woody organic material more than 51 inches thick
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: very poorly drained
Hydric soil: yes
Hydrologic group: A/D

Flooding hazard: none
Ponding Hazard: frequent

Potential frost action: high

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oa -- 0 to 65 in	muck	moderately rapid	22.7 to 29.2 in		.02	.02

Cathro and similar soils

Extent: 0 to 100 percent of the unit
Landform(s): depressions on disintegration moraines
Slope gradient: 0 to 1 percent
Parent material: herbaceous organic material 16 to 51 inches thick underlain by loamy deposits
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: frequent

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: very poorly drained
Hydric soil: yes
Hydrologic group: A/D
Potential frost action: high

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oa -- 0 to 28 in	muck	moderately rapid	9.8 to 12.6 in		.02	.02
Cg1 -- 28 to 49 in	loam	moderate	2.3 to 4.6 in	5.6 to 7.3	.28	.28
Cg2 -- 49 to 60 in	sandy loam	moderate	1.2 to 2.4 in	5.6 to 7.3	.28	.28

Tawas and similar soils

Extent: 0 to 100 percent of the unit
Landform(s): depressions on disintegration moraines
Slope gradient: 0 to 1 percent
Parent material: herbaceous organic material 16 to 51 inches thick over sandy deposits
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: frequent

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: very poorly drained
Hydric soil: yes
Hydrologic group: A/D
Potential frost action: high

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oa -- 0 to 31 in	muck	moderately rapid	10.9 to 14.0 in		.02	.02
Cg -- 31 to 60 in	fine sand	rapid	0.6 to 2.9 in	5.6 to 8.4	.15	.15

Minor Components

Seelyeville and similar soils: 0 to 15 percent of the unit

407A - Seelyeville and Markey soils, 0 to 1 percent slopes

Seelyeville and similar soils

Extent: 0 to 100 percent of the unit
Landform(s): depressions on lake plains, depressions on outwash plains, drainageways on outwash plains
Slope gradient: 0 to 1 percent
Parent material: herbaceous organic material more than 51 inches thick
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: frequent

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: very poorly drained
Drainage class: very poorly drained
Hydric soil: yes
Hydrologic group: A/D
Potential frost action: high

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oa --	0 to 80 in	muck	moderately rapid	28.0 to 36.0 in		.02	.02

Markey and similar soils

Extent: 0 to 100 percent of the unit
Landform(s): depressions on lake plains, depressions on outwash plains, drainageways on outwash plains
Slope gradient: 0 to 1 percent
Parent material: herbaceous organic material 16 to 51 inches thick overlying sandy deposits
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: frequent

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 8
Wind erodibility index (WEI): 0
Land capability class, non-irrigated: 7w
Drainage class: very poorly drained
Drainage class: very poorly drained
Hydric soil: yes
Hydrologic group: A/D
Potential frost action: high

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oa --	0 to 32 in	muck	moderate	11.2 to 14.4 in		.02	.02
Cg --	32 to 60 in	sand	rapid	0.8 to 2.8 in	5.6 to 8.4	.10	.15

Minor Components

Newson and similar soils: 0 to 15 percent of the unit
Dawson and similar soils: 0 to 10 percent of the unit

479A - Lerch-Herbster complex, 0 to 3 percent slopes

Lerch and similar soils

Extent: 40 to 70 percent of the unit
Landform(s): lake plains, till plains
Slope gradient: 0 to 2 percent
Parent material: clayey till and/or clayey lacustrine deposits modified by wave action over loamy and/or sandy stratified lacustrine depositss
Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: frequent

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 4
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 6w
Drainage class: poorly drained
Hydric soil: yes
Hydrologic group: D
Potential frost action: high

Representative soil profile:

	Depth	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
Oa --	0 to 3 in	muck	rapid	1.1 to 1.4 in	5.1 to 6.5	.02	.02
Bg --	3 to 7 in	clay	very slow	0.4 to 0.5 in	5.1 to 6.5	.20	.20
Btg --	7 to 12 in	clay	very slow	0.5 to 0.7 in	5.1 to 6.5	.28	.28
Btk --	12 to 29 in	clay	very slow	1.6 to 2.3 in	7.4 to 8.4	.28	.28
Bk --	29 to 56 in	clay	very slow	2.1 to 3.2 in	7.4 to 8.4	.28	.28
2C --	56 to 80 in	stratified silt loam to very fine sandy loam to loamy fine sand	moderately rapid	1.9 to 5.3 in	7.4 to 8.4	.24	.24

Herbster and similar soils

Extent: 25 to 45 percent of the unit
Landform(s): till plains
Slope gradient: 0 to 3 percent
Parent material: clayey till and underlying loamy and sandy stratified lacustrine deposits
Restrictive feature(s): abrupt textural change at 40 to 60 inches
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 3w
Drainage class: somewhat poorly drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:

	Depth	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
A --	0 to 5 in	silt loam	moderate	0.9 to 1.1 in	5.1 to 7.3	.37	.37
E --	5 to 10 in	silt loam	moderate	0.6 to 0.9 in	5.1 to 6.5	.37	.37
B/E --	10 to 13 in	silty clay loam	moderately slow	0.3 to 0.6 in	5.1 to 7.3	.37	.37
Bt1 --	13 to 28 in	clay	very slow	1.3 to 1.9 in	6.1 to 7.8	.24	.24

2Bt2 --	28 to 33 in	stratified silty clay loam to clay to silty clay	very slow	0.5 to 0.7 in	6.1 to 7.8	.32	.32
2Btk --	33 to 55 in	stratified silty clay loam to clay to silty clay	very slow	2.0 to 2.9 in	7.4 to 9.0	.32	.32
3C --	55 to 80 in	stratified very fine sandy loam to silt loam to loamy very fine sand	moderate	2.5 to 4.0 in	7.4 to 8.4	.24	.24

Minor Components

Munuscong and similar soils: 0 to 10 percent of the unit
Shag and similar soils: 0 to 10 percent of the unit
Pickford and similar soils: 0 to 10 percent of the unit

480B - Portwing-Herbster complex, 0 to 6 percent slopes

Portwing and similar soils

Extent: 45 to 65 percent of the unit
Landform(s): till plains
Slope gradient: 2 to 6 percent
Parent material: clayey till over underlying stratified loamy and sandy lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 12 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 3e
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:

		Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 4 in	silt loam	moderate	0.7 to 0.9 in	4.5 to 7.3	.43	.43
E/B --	4 to 9 in	silt loam	moderate	0.6 to 1.0 in	5.1 to 7.3	.37	.37
Bt --	9 to 32 in	clay	slow	1.8 to 3.2 in	6.1 to 7.8	.24	.24
Btk --	32 to 51 in	clay	slow	1.5 to 2.7 in	7.4 to 9.0	.24	.24
2C --	51 to 80 in	stratified very fine sand to silt	moderate	2.9 to 4.3 in	6.1 to 8.4	.24	.24

Herbster and similar soils

Extent: 25 to 45 percent of the unit
Landform(s): till plains
Slope gradient: 0 to 3 percent
Parent material: clayey till and underlying loamy and sandy stratified lacustrine deposits
Restrictive feature(s): abrupt textural change at 40 to 60 inches
Seasonal high water table: approximately 0 inches

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 3w
Drainage class: somewhat poorly drained
Hydric soil: no
Hydrologic group: D

Flooding hazard: none
Ponding Hazard: none

Potential frost action: moderate

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 5 in	silt loam	moderate	0.9 to 1.1 in	5.1 to 7.3	.37	.37
E --	5 to 10 in	silt loam	moderate	0.6 to 0.9 in	5.1 to 6.5	.37	.37
B/E --	10 to 13 in	silty clay loam	moderately slow	0.3 to 0.6 in	5.1 to 7.3	.37	.37
Bt1 --	13 to 28 in	clay	very slow	1.3 to 1.9 in	6.1 to 7.8	.24	.24
2Bt2 --	28 to 33 in	stratified silty clay loam to clay to silty clay	very slow	0.5 to 0.7 in	6.1 to 7.8	.32	.32
2Btk --	33 to 55 in	stratified silty clay loam to clay to silty clay	very slow	2.0 to 2.9 in	7.4 to 9.0	.32	.32
3C --	55 to 80 in	stratified very fine sandy loam to silt loam to loamy very fine sand	moderate	2.5 to 4.0 in	7.4 to 8.4	.24	.24

Minor Components

Badriver and similar soils: 0 to 5 percent of the unit
Allendale and similar soils: 0 to 5 percent of the unit
Sedgwick and similar soils: 0 to 5 percent of the unit
Sanborg and similar soils: 0 to 5 percent of the unit
Lerch and similar soils: 0 to 10 percent of the unit
Cornucopia and similar soils: 0 to 10 percent of the unit

481C - Cornucopia silt loam, 6 to 15 percent slopes

Cornucopia and similar soils

Extent: 70 to 100 percent of the unit
Landform(s): till plains
Slope gradient: 6 to 15 percent
Parent material: clayey till and underlying stratified loamy and sandy lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 4e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 3 in	silt loam	moderate	0.5 to 0.7 in	4.5 to 6.5	.43	.43
E/B --	3 to 10 in	very fine sandy loam	moderate	0.8 to 1.3 in	5.1 to 7.3	.43	.43

Bt --	10 to 32 in	clay	slow	1.8 to 3.1 in	5.6 to 7.8	.24	.24
Btk --	32 to 45 in	clay	slow	1.0 to 1.8 in	7.4 to 9.0	.24	.24
2Bk --	45 to 50 in	stratified very fine sandy loam to silt loam	moderate	0.5 to 0.8 in	7.4 to 8.4	.24	.24
2C --	50 to 72 in	stratified very fine sand to silt loam	moderate	2.2 to 3.3 in	6.1 to 8.4	.24	.24

Minor Components

Superior and similar soils: 0 to 10 percent of the unit
Odanah and similar soils: 0 to 10 percent of the unit
Manistee and similar soils: 0 to 10 percent of the unit
Portwing and similar soils: 0 to 10 percent of the unit

481E - Cornucopia silt loam, 15 to 45 percent slopes

Cornucopia and similar soils

Extent: 70 to 100 percent of the unit
Landform(s): till plains
Slope gradient: 15 to 45 percent
Parent material: clayey till and underlying stratified loamy and sandy lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 7e
Drainage class: well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 3 in	silt loam	moderate	0.5 to 0.7 in	4.5 to 6.5	.43	.43
E/B --	3 to 10 in	very fine sandy loam	moderate	0.8 to 1.3 in	5.1 to 7.3	.43	.43
Bt --	10 to 32 in	clay	slow	1.8 to 3.1 in	5.6 to 7.8	.24	.24
Btk --	32 to 45 in	clay	slow	1.0 to 1.8 in	7.4 to 9.0	.24	.24
2Bk --	45 to 50 in	stratified very fine sandy loam to silt loam	moderate	0.5 to 0.8 in	7.4 to 8.4	.24	.24
2C --	50 to 72 in	stratified very fine sand to silt loam	moderate	2.2 to 3.3 in	6.1 to 8.4	.24	.24

Minor Components

Manistee and similar soils: 0 to 10 percent of the unit
Moquah and similar soils: 0 to 10 percent of the unit
Portwing and similar soils: 0 to 10 percent of the unit
Odanah and similar soils: 0 to 10 percent of the unit

517B - Annalake fine sandy loam, lake terrace, 2 to 6 percent slopes

Annalake and similar soils

Extent: 80 to 100 percent of the unit
Landform(s): lake terraces
Slope gradient: 2 to 6 percent
Parent material: stratified sandy and loamy glaciofluvial and glaciolacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 30 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 2e
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: B
Potential frost action: moderate

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 3 in	fine sandy loam	moderate	0.5 to 0.6 in	4.5 to 6.0	.28	.28
E --	3 to 6 in	fine sandy loam	moderate	0.4 to 0.6 in	4.5 to 6.0	.24	.24
Bs1,Bs2 --	6 to 17 in	fine sandy loam	moderate	1.4 to 2.4 in	4.5 to 6.0	.24	.24
E/B --	17 to 31 in	fine sandy loam	moderate	1.7 to 2.7 in	5.1 to 7.3	.24	.24
Bt --	31 to 39 in	sandy loam	moderate	0.9 to 1.5 in	5.1 to 7.3	.24	.24
C --	39 to 60 in	stratified fine sand to silt loam	moderate	1.0 to 4.6 in	5.1 to 8.4	.24	.24

Minor Components

Neconish and similar soils: 0 to 5 percent of the unit
Cublake and similar soils: 0 to 5 percent of the unit
Alcona and similar soils: 0 to 10 percent of the unit
Robago and similar soils: 0 to 10 percent of the unit

517C - Annalake fine sandy loam, lake terrace, 6 to 15 percent slopes

Annalake and similar soils

Extent: 75 to 100 percent of the unit
Landform(s): lake terraces
Slope gradient: 6 to 15 percent
Parent material: stratified sandy and loamy glaciofluvial and glaciolacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 30 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 3e
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: B
Potential frost action: moderate

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 3 in	fine sandy loam	moderate	0.5 to 0.6 in	4.5 to 6.0	.28	.28
E --	3 to 6 in	fine sandy loam	moderate	0.4 to 0.6 in	4.5 to 6.0	.24	.24
Bs1,Bs2 --	6 to 17 in	fine sandy loam	moderate	1.4 to 2.4 in	4.5 to 6.0	.24	.24
E/B --	17 to 31 in	fine sandy loam	moderate	1.7 to 2.7 in	5.1 to 7.3	.24	.24
Bt --	31 to 39 in	sandy loam	moderate	0.9 to 1.5 in	5.1 to 7.3	.24	.24
C --	39 to 60 in	stratified fine sand to silt loam	moderate	1.0 to 4.6 in	5.1 to 8.4	.24	.24

Minor Components

Alcona and similar soils: 0 to 10 percent of the unit
Karlin and similar soils: 0 to 10 percent of the unit
Robago and similar soils: 0 to 10 percent of the unit
Neconish and similar soils: 0 to 10 percent of the unit

580B - Sanborg-Badriver complex, 0 to 6 percent slopes

Sanborg and similar soils

Extent: 40 to 60 percent of the unit
Landform(s): till plains
Slope gradient: 0 to 6 percent
Parent material: clayey till
Restrictive feature(s): none
Seasonal high water table: approximately 12 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 5
Wind erodibility index (WEI): 56
Land capability class, non-irrigated: 3e
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
E --	0 to 5 in	silt loam	moderate	1.0 to 1.2 in	4.5 to 6.5	.43	.43
E/B --	5 to 9 in	silt loam	moderate	0.5 to 0.8 in	4.5 to 7.3	.37	.43
B/E --	9 to 17 in	silty clay loam	moderately slow	0.8 to 1.3 in	4.5 to 7.3	.32	.32
Bt --	17 to 35 in	clay	slow	1.4 to 2.5 in	6.1 to 7.8	.32	.32
Btk --	35 to 49 in	silty clay	slow	1.1 to 1.9 in	7.9 to 9.0	.32	.32
BC --	49 to 80 in	silty clay	slow	2.5 to 4.4 in	7.9 to 9.0	.32	.32

Badriver and similar soils

Extent: 20 to 50 percent of the unit
Landform(s): till plains
Slope gradient: 0 to 3 percent
Parent material: clayey till

Soil loss tolerance (T factor): 5
Wind erodibility group (WEG): 4
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 3w

Restrictive feature(s): none
Seasonal high water table: approximately 0 inches
Flooding hazard: none
Ponding Hazard: none

Drainage class: somewhat poorly drained
Hydric soil: no
Hydrologic group: D
Potential frost action: moderate

Representative soil profile:

		Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 3 in	clay loam	moderate	0.5 to 0.6 in	4.5 to 7.3	.32	.32
E/B --	3 to 10 in	clay loam	moderate	0.8 to 1.3 in	4.5 to 6.0	.37	.37
B/E --	10 to 24 in	clay	moderately slow	1.4 to 2.3 in	4.5 to 6.0	.32	.32
Btk --	24 to 53 in	clay	slow	2.3 to 4.1 in	7.9 to 9.0	.32	.32
C --	53 to 60 in	clay loam	slow	0.5 to 0.9 in	7.9 to 9.0	.32	.32

Minor Components

Herbster and similar soils: 0 to 5 percent of the unit
Portwing and similar soils: 0 to 10 percent of the unit
Sedgwick and similar soils: 0 to 5 percent of the unit
Pickford and similar soils: 0 to 10 percent of the unit
Odanah and similar soils: 0 to 10 percent of the unit

601C - Ishpeming-Rock outcrop complex, 5 to 20 percent slopes, very stony

Ishpeming and similar soils

Extent: 50 to 70 percent of the unit
Landform(s): ground moraines
Slope gradient: 5 to 20 percent
Parent material: glaciofluvial deposits and sandy till overlying igneous and metamorphic bedrock
Restrictive feature(s): lithic bedrock at 20 to 40 inches
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 2
Wind erodibility group (WEG): 1
Wind erodibility index (WEI): 220
Land capability class, non-irrigated: 6s
Drainage class: somewhat excessively drained
Hydric soil: no
Hydrologic group: C
Potential frost action: low

Representative soil profile:

		Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oe --	0 to 2 in	moderately decomposed plant material	rapid	0.9 to 1.1 in	3.6 to 5.5	.02	.02
E --	2 to 6 in	sand	rapid	0.3 to 0.4 in	4.5 to 6.0	.02	.02
Bs --	6 to 13 in	sand	rapid	0.5 to 0.9 in	4.5 to 6.0	.02	.02

BC --	13 to 24 in	sand	rapid	0.7 to 1.2 in	4.5 to 6.5	.02	.02
C --	24 to 38 in	loamy fine sand	rapid	0.9 to 1.6 in	4.5 to 6.5	.10	.10
R --	38 to 60 in	unweathered bedrock	very slow				

Rock outcrop

Extent: 20 to 50 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated: 8s
Drainage class:
Hydric soil: no
Hydrologic group:
Potential frost action:

Representative soil profile:

	Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

Metonga and similar soils: 0 to 10 percent of the unit
Croswell and similar soils: 0 to 10 percent of the unit

713C - Kellogg-Allendale-Ashwabay complex, 6 to 15 percent slopes

Kellogg and similar soils

Extent: 30 to 60 percent of the unit
Landform(s): lake plains
Slope gradient: 6 to 15 percent
Parent material: sandy lacustrine or outwash sediments and underlying clayey lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 18 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 4
Wind erodibility group (WEG): 1
Wind erodibility index (WEI): 220
Land capability class, non-irrigated: 4s
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: low

Representative soil profile:

		Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oe --	0 to 2 in	moderately decomposed plant material	rapid	1.1 to 1.3 in	3.6 to 5.5	.02	.02
E --	2 to 6 in	sand	rapid	0.2 to 0.4 in	4.5 to 6.0	.02	.02
Bs --	6 to 26 in	sand	rapid	1.2 to 2.0 in	4.5 to 6.5	.15	.15

2B/E --	26 to 29 in	silty clay	slow	0.3 to 0.5 in	6.1 to 7.8	.32	.32
2Bt --	29 to 40 in	silty clay	slow	1.0 to 1.9 in	6.1 to 7.8	.32	.32
2C --	40 to 80 in	silty clay	slow	3.6 to 6.8 in	6.1 to 8.5	.32	.32

Allendale and similar soils

Extent: 15 to 45 percent of the unit
Landform(s): ground moraines, lake plains, lake terraces, outwash plains
Slope gradient: 6 to 12 percent
Parent material: sandy sediments and underlying clayey lacustrine or till deposits
Restrictive feature(s): none
Seasonal high water table: approximately 6 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 4
Wind erodibility group (WEG): 2
Wind erodibility index (WEI): 134
Land capability class, non-irrigated: 3w
Drainage class: somewhat poorly drained
Drainage class: somewhat poorly drained
Hydric soil: no
Hydrologic group: C
Potential frost action: moderate

Representative soil profile:

Horizon	Depth	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 3 in	loamy fine sand	rapid	0.3 to 0.4 in	3.5 to 7.3	.10	.10
E --	3 to 10 in	sand	rapid	0.4 to 0.7 in	4.5 to 7.3	.02	.02
Bhs --	10 to 13 in	sand	rapid	0.2 to 0.3 in	4.5 to 6.0	.02	.02
Bs --	13 to 26 in	sand	rapid	0.8 to 1.3 in	4.5 to 6.5	.02	.02
E' --	26 to 28 in	sand	rapid	0.1 to 0.2 in	4.5 to 7.3	.02	.02
2Bt --	28 to 34 in	clay	very slow	0.5 to 0.7 in	6.1 to 8.4	.28	.28
2C --	34 to 60 in	clay	very slow	2.1 to 3.1 in	6.1 to 8.4	.28	.28

Ashwabay and similar soils

Extent: 15 to 25 percent of the unit
Landform(s): ground moraines, lake plains, outwash plains
Slope gradient: 6 to 15 percent
Parent material: sandy outwash or beach deposits underlain by clayey till or lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 30 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 4
Wind erodibility group (WEG): 1
Wind erodibility index (WEI): 220
Land capability class, non-irrigated: 6s
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: B
Potential frost action: low

Representative soil profile:

Horizon	Depth	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 4 in	loamy sand	rapid	0.4 to 0.5 in	5.1 to 6.5	.10	.10
E --	4 to 5 in	sand	rapid	0.1 to 0.1 in	4.5 to 6.5	.17	.17
Bhs --	5 to 12 in	sand	rapid	0.3 to 0.7 in	4.5 to 6.0	.17	.17
Bs --	12 to 32 in	sand	rapid	1.0 to 2.2 in	5.6 to 7.3	.17	.17

Bw --	32 to 45 in	sand	rapid	0.5 to 1.0 in	6.1 to 7.3	.17	.17
2Bt1 --	45 to 62 in	clay	slow	1.4 to 2.0 in	6.1 to 7.3	.28	.28
2Bt2 --	62 to 80 in	stratified clay to silt to sand	slow	1.4 to 2.2 in	6.1 to 7.3	.28	.28

Minor Components

Portwing and similar soils: 0 to 10 percent of the unit
Cublake and similar soils: 0 to 10 percent of the unit
Wakeley and similar soils: 0 to 5 percent of the unit

756B - Superior-Sedgwick complex, 0 to 6 percent slopes

Superior and similar soils

Extent: 30 to 70 percent of the unit
Landform(s): lake plains
Slope gradient: 2 to 6 percent
Parent material: loamy water-laid deposits and underlying clayey lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 6 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 3e
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: moderate

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 3 in	fine sandy loam	moderate	0.4 to 0.6 in	5.1 to 7.3	.37	.37
E --	3 to 6 in	sandy loam	moderate	0.3 to 0.5 in	5.1 to 7.3	.28	.28
Bs --	6 to 14 in	sandy loam	moderate	0.9 to 1.6 in	4.5 to 6.0	.28	.28
2B/E --	14 to 19 in	clay	very slow	0.4 to 0.6 in	5.1 to 6.0	.28	.28
2Bt --	19 to 26 in	clay	very slow	0.6 to 0.9 in	5.1 to 7.3	.28	.28
2C --	26 to 60 in	clay	very slow	2.4 to 4.4 in	7.4 to 8.4	.28	.28

Sedgwick and similar soils

Extent: 20 to 40 percent of the unit
Landform(s): till plains
Slope gradient: 0 to 3 percent
Parent material: loamy alluvium and underlying clayey till
Restrictive feature(s): none
Seasonal high water table: approximately 6 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 3w
Drainage class: somewhat poorly drained
Hydric soil: no
Hydrologic group: D
Potential frost action: high

Available Water

Representative soil profile:		*Texture*	*Permeability*	*Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 5 in	loamy sand	moderate	0.5 to 0.8 in	4.5 to 7.3	.10	.10
E --	5 to 8 in	loamy sand	moderate	0.2 to 0.5 in	4.5 to 6.0	.24	.24
Bs --	8 to 16 in	sandy loam	moderate	0.8 to 1.4 in	4.5 to 6.0	.28	.28
2B/E --	16 to 19 in	clay	moderate	0.2 to 0.4 in	5.1 to 7.3	.43	.43
2Bt --	19 to 53 in	clay	slow	2.4 to 5.5 in	7.4 to 9.0	.28	.28
2Btk --	53 to 80 in	silty clay	slow	1.9 to 4.3 in	7.4 to 9.0	.28	.28

Minor Components

Allendale and similar soils: 0 to 15 percent of the unit
Portwing and similar soils: 0 to 10 percent of the unit
Herbster and similar soils: 0 to 5 percent of the unit
Munuscong and similar soils: 0 to 5 percent of the unit

756C - Superior-Sedgwick complex, 6 to 15 percent slopes

Superior and similar soils

Extent: 30 to 70 percent of the unit
Landform(s): lake plains
Slope gradient: 6 to 15 percent
Parent material: loamy water-laid deposits and underlying clayey lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 6 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86
Land capability class, non-irrigated: 4e
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: moderate

Representative soil profile:		*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 3 in	fine sandy loam	moderate	0.4 to 0.6 in	5.1 to 7.3	.37	.37
E --	3 to 6 in	sandy loam	moderate	0.3 to 0.5 in	5.1 to 7.3	.28	.28
Bs --	6 to 14 in	sandy loam	moderate	0.9 to 1.6 in	4.5 to 6.0	.28	.28
2B/E --	14 to 19 in	clay	very slow	0.4 to 0.6 in	5.1 to 6.0	.28	.28
2Bt --	19 to 26 in	clay	very slow	0.6 to 0.9 in	5.1 to 7.3	.28	.28
2C --	26 to 60 in	clay	very slow	2.4 to 4.4 in	7.4 to 8.4	.28	.28

Sedgwick and similar soils

Extent: 20 to 40 percent of the unit
Landform(s): till plains
Slope gradient: 0 to 15 percent

Soil loss tolerance (T factor): 3
Wind erodibility group (WEG): 3
Wind erodibility index (WEI): 86

Parent material: loamy alluvium and underlying clayey till
Restrictive feature(s): none
Seasonal high water table: approximately 6 inches
Flooding hazard: none
Ponding Hazard: none

Land capability class, non-irrigated: 3w
Drainage class: somewhat poorly drained
Hydric soil: no
Hydrologic group: D
Potential frost action: high

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
A -- 0 to 5 in	loamy sand	moderate	0.5 to 0.8 in	4.5 to 7.3	.10	.10
E -- 5 to 8 in	loamy sand	moderate	0.2 to 0.5 in	4.5 to 6.0	.24	.24
Bs -- 8 to 16 in	sandy loam	moderate	0.8 to 1.4 in	4.5 to 6.0	.28	.28
2B/E -- 16 to 19 in	clay	moderate	0.2 to 0.4 in	5.1 to 7.3	.43	.43
2Bt -- 19 to 53 in	clay	slow	2.4 to 5.5 in	7.4 to 9.0	.28	.28
2Btk -- 53 to 80 in	silty clay	slow	1.9 to 4.3 in	7.4 to 9.0	.28	.28

Minor Components

Kellogg and similar soils: 0 to 15 percent of the unit
Cornucopia and similar soils: 0 to 10 percent of the unit
Allendale and similar soils: 0 to 5 percent of the unit
Lerch and similar soils: 0 to 5 percent of the unit

813E - Manistee-Kellogg-Ashwabay complex, 15 to 45 percent slopes

Manistee and similar soils

Extent: 30 to 50 percent of the unit
Landform(s): lake plains
Slope gradient: 15 to 45 percent
Parent material: sandy lacustrine and outwash sediments underlain by clayey lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 4
Wind erodibility group (WEG): 1
Wind erodibility index (WEI): 220
Land capability class, non-irrigated: 7s
Drainage class: well drained
Hydric soil: no
Hydrologic group: A
Potential frost action: low

Representative soil profile:

	Texture	Permeability	Available Water Capacity	pH	Kw	Kf
A -- 0 to 3 in	sand	rapid	0.3 to 0.4 in	4.5 to 7.3	.02	.02
E -- 3 to 11 in	sand	rapid	0.5 to 0.8 in	4.5 to 7.3	.02	.02
Bs -- 11 to 28 in	sand	rapid	1.0 to 1.7 in	5.1 to 6.5	.02	.02
E' -- 28 to 30 in	sand	rapid	0.1 to 0.2 in	5.1 to 7.3	.02	.02
2Bt -- 30 to 38 in	clay	very slow	0.7 to 1.0 in	5.1 to 7.3	.32	.32

2C --	38 to 60 in	clay	slow	1.7 to 3.5 in	6.6 to 8.4	.32	.32

Kellogg and similar soils

Extent: 20 to 40 percent of the unit
Landform(s): lake terraces
Slope gradient: 15 to 30 percent
Parent material: sandy lacustrine or outwash sediments and underlying clayey lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 18 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 4
Wind erodibility group (WEG): 1
Wind erodibility index (WEI): 220
Land capability class, non-irrigated: 7s
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: C
Potential frost action: low

Representative soil profile:

		Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
Oe --	0 to 2 in	moderately decomposed plant material	rapid	1.1 to 1.3 in	3.6 to 5.5	.02	.02
E --	2 to 6 in	sand	rapid	0.2 to 0.4 in	4.5 to 6.0	.02	.02
Bs --	6 to 26 in	sand	rapid	1.2 to 2.0 in	4.5 to 6.5	.15	.15
2B/E --	26 to 29 in	silty clay	slow	0.3 to 0.5 in	6.1 to 7.8	.32	.32
2Bt --	29 to 40 in	silty clay	slow	1.0 to 1.9 in	6.1 to 7.8	.32	.32
2C --	40 to 80 in	silty clay	slow	3.6 to 6.8 in	6.1 to 8.5	.32	.32

Ashwabay and similar soils

Extent: 15 to 35 percent of the unit
Landform(s): ground moraines, lake plains, outwash plains
Slope gradient: 15 to 45 percent
Parent material: sandy outwash or beach deposits underlain by clayey till or lacustrine deposits
Restrictive feature(s): none
Seasonal high water table: approximately 30 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor): 4
Wind erodibility group (WEG): 1
Wind erodibility index (WEI): 220
Land capability class, non-irrigated: 7s
Drainage class: moderately well drained
Hydric soil: no
Hydrologic group: B
Potential frost action: low

Representative soil profile:

		Texture	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
A --	0 to 4 in	loamy sand	rapid	0.4 to 0.5 in	5.1 to 6.5	.10	.10
E --	4 to 5 in	sand	rapid	0.1 to 0.1 in	4.5 to 6.5	.17	.17
Bhs --	5 to 12 in	sand	rapid	0.3 to 0.7 in	4.5 to 6.0	.17	.17
Bs --	12 to 32 in	sand	rapid	1.0 to 2.2 in	5.6 to 7.3	.17	.17
Bw --	32 to 45 in	sand	rapid	0.5 to 1.0 in	6.1 to 7.3	.17	.17
2Bt1 --	45 to 62 in	clay	slow	1.4 to 2.0 in	6.1 to 7.3	.28	.28
2Bt2 --	62 to 80 in	stratified clay to silt to sand	slow	1.4 to 2.2 in	6.1 to 7.3	.28	.28

Minor Components

Sultz and similar soils: 0 to 5 percent of the unit
Cornucopia and similar soils: 0 to 5 percent of the unit
Superior and similar soils: 0 to 10 percent of the unit

2014 - Pits, quarry, hard bedrock

Pits, quarry, hard bedrock

Extent: about 100 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil: no
Hydrologic group:
Potential frost action:

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

2030 - Udorthents and Udipsamments, cut or fill

Udorthents, cut or fill and similar soils

Extent: 0 to 100 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil: no
Hydrologic group:
Potential frost action:

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

W - Water

Water

Extent: 100 to 100 percent of the unit
Landform(s):
Slope gradient:
Parent material:
Restrictive feature(s): none
Seasonal high water table: greater than 60 inches
Flooding hazard: none
Ponding Hazard: none

Soil loss tolerance (T factor):
Wind erodibility group (WEG):
Wind erodibility index (WEI):
Land capability class, non-irrigated:
Drainage class:
Hydric soil: unranked
Hydrologic group:
Potential frost action:

Representative soil profile:	*Texture*	*Permeability*	*Available Water Capacity*	*pH*	*Kw*	*Kf*
none						

Minor Components

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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