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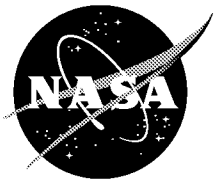

Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall, Editor

Volume 109

BOREAS Regional Soils Data in Raster Format and AEAC Projection

Bryan Monette, Agriculture Canada, Ottawa, Ontario, Canada
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National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

September 2000

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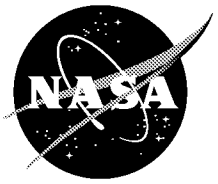

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BOREAS Regional Soils Data in Raster Format and AEAC Projection

Bryan Monette, David Knapp

Summary

This data set was gridded by BORIS Staff from a vector data set received from the Canadian Soil Information System (CanSIS). The original data came in two parts that covered Saskatchewan and Manitoba. The data were gridded and merged into one data set of 84 files covering the BOREAS region. The data were gridded into the AEAC projection. Because the mapping of the two provinces was done separately in the original vector data, there may be discontinuities in some of the soil layers because of different interpretations of certain soil properties. The data are stored in binary, image format files.

Note that the binary files of this data set on the BOREAS CD-ROMs have been compressed using the Gzip program. See Section 8.2 for details.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS Regional Soils Data in Raster Format and AEAC Projection

1.2 Data Set Introduction

The Inventory Section of the Land Resource Research Centre (LRRC) undertook an effort to compile a computerized data base to record the attributes of the soil and land for all of Canada and to prepare maps from this information at a scale of 1:1,000,000. The compilation was done by standard methods, and the maps were divided into unit areas called polygons. Each polygon is described in terms of a standard set of attributes. These attributes are the factors considered most important for plant growth, general land management, regional planning, terrain sensitivity, and environmental sustainability. The array of attributes that describe a distinct type of soil and its associated

characteristics, such as landform, slope, water table, permafrost, and lakes, is called a soil landscape. A polygon may contain one or two distinctive soil landscapes, as well as small but contrasting inclusions. These vector data from LRRC served as the basis for this raster format data product.

The original manual documents the standard methods and descriptors used by all provinces for compilation of a national soil landscape data base at a scale of 1:1,000.000.

1.3 Objective/Purpose

These raster format soils data are provided as part of the BOReal Ecosystem-Atmosphere Study (BOREAS) Staff Science Geographic Information System (GIS) Data Collection Program, which included the collection of pertinent map data in both hardcopy and digital form. This data set, originally provided as vector polygons with attributes, has been processed to provide raster files that can be used for modeling or for comparisons.

1.4 Summary of Parameters

The parameters contained in the 82 files of the raster soil data include:

Provincial Code
Polygon Number
Kind of Rock Outcrop or other material at the surface
Percentage distribution of soil landscapes
Regional landform
Local surface form
Slope gradient class
Parent material mode of deposition
Parent material texture
Soil development
Surface texture of mineral soil to 15 cm
Coarse fragment content in control section
Rooting depth, unrestricted
Kind of compacted, consolidated, or contrasting layer
Depth to compacted, consolidated, or contrasting layer
Drainage class
Available water capacity in upper 120 cm
Depth to water table, average
Ice type
Ice content
Permafrost occurrence
Active layer depth in soils with permafrost
Kind of patterned ground in soils with permafrost
pH of upper 15 cm of soil ($CaCl_2$)
pH of upper 15 cm of soil (water)
Organic carbon of upper 15 cm
Nitrogen content of upper 15 cm of soil
Thickness of humus layer
Calcareous class of parent material
Inclusions 1
Inclusions 2
Vegetative cover and/or land use
Lake size from Landsat
Water bodies from Landsat as percentage of polygon
Reliability class of polygon
Complexity class of polygon
Soil name 1
Soil name 2
Parent material textural group

1.5 Discussion

The documentation for the original data listed the following uses for which these data were intended:

- Assess the productivity of the land nationally or over large regions.
- Find areas that have actual or potential problems affecting land use, such as salinity or susceptibility to erosion, and assess the severity.
- Locate general areas that may be suitable for particular types of land use, which can be selected for more detailed investigations.
- Apply general research findings and agrotechnology procedures that are successful in one part of the country to other areas that have similar attributes.
- Link soil and land information with other data bases, such as information on climate, economics, or census, for assessing land use on a regional, national, or even an international scale.
- Educate geography students at colleges or universities.

The framework for the legend development, map compilation, and attribute characterization is established by the following concepts and definitions:

- The maps are composed of map delineations called polygons, each of which is described in terms of a standard set of attributes.
- The full array of polygon attributes that describe a distinct type of soil and its associated landscape attributes, such as surface form, slope, water table, permafrost, and lakes, is called a soil landscape.
- A polygon may contain one or two distinctive soil landscapes (dominant or subdominant) and may also contain a small but contracting proportion of inclusions.
- The dominant (or most prominent) soil landscape represents at least 40% of the polygon area, whereas the subdominant soil landscape represents only from 16 to <40% of the polygon; inclusions represent a maximum of 15% of the polygon. A more detailed description of the complex map polygons is given in Section 7.
- One or two inclusions can be recorded for each dominant and subdominant soil landscape, but in total they represent only a maximum of 15% of the polygon area.
- The attributes that separate one polygon from another include (a) soil development, (b) soil parent material mode of deposition, (c) texture class of parent material, (d) local surface form, (e) slope gradient class in percent, (f) kind of rock or surface material except water, and (g) spatial occurrence of these attributes within a polygon. These attributes may apply to either the dominant or subdominant soil landscape.
- The minimum size of the soil landscape area (or polygon) should be about 1 x 1 cm at the 1:1,000,000 scale (100 km^2); however, smaller, isolated areas that can be conveniently displayed and labeled on the map are permitted when needed.

1.6 Related Data Sets

Agriculture Canada Central Saskatchewan Vector Soils Data
BOREAS Soils Data over the SSA in Raster Format and AEAC Projection
CanSIS Regional Soils Data in Vector Format

2. Investigator(s)

2.1 Investigator(s) Name and Title

BOREAS Staff Science

2.2 Title of Investigation

BOREAS Staff Science GIS Data Collection Program

2.3 Contact Information

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3. Theory of Measurements

The Inventory Section of the LRRC compiled a computerized data base to record the attributes of the soil and land for all of Canada and to prepare maps from this information at a scale of 1:1,000,000. The compilation was done by standard methods, and the maps were divided into unit areas called polygons. Each polygon is described in terms of a standard set of attributes. These attributes are the factors considered most important for plant growth, general land management, regional planning, terrain sensitivity, and environmental sustainability. The array of attributes that describe a distinct type of soil and its associated characteristics, such as landform, slope, water table, permafrost, and lakes, is called a soil landscape. A polygon may contain one or two distinctive soil landscapes, as well as small but contrasting inclusions. The original uses for which these data were intended include:

- Assess the productivity of the land nationally or over large regions.
- Find areas that have actual or potential problems affecting land use, such as salinity or susceptibility to erosion, and assess the severity.
- Locate general areas that may be suitable for particular types of land use, which can be selected for more detailed investigations.
- Apply general research findings and agrotechnology procedures that are successful in one part of the country to other areas that have similar attributes.
- Link soil and land information with other data bases, such as information on climate, economics, or census, for assessing land use on a regional, national, or even an international scale.
- Educate geography students at colleges or universities.

4. Equipment

4.1 Sensor/Instrument Description

It is known that the original vector data were compiled by interpreting Landsat images, conducting aircraft and field traverses, and digitizing the compiled maps. The exact equipment and related specifications are unknown.

4.1.1 Collection Environment

Unknown.

4.1.2 Source/Platform
Unknown.

4.1.3 Source/Platform Mission Objectives
Unknown.

4.1.4 Key Variables
The key variables that are in this raster data set include:

Provincial Code
Polygon Number
Kind of Rock Outcrop or other material at the surface
Percentage distribution of soil landscapes
Regional landform
Local surface form
Slope gradient class
Parent material mode of deposition
Parent material texture
Soil development
Surface texture of mineral soil to 15 cm
Coarse fragment content in control section
Rooting depth, unrestricted
Kind of compacted, consolidated, or contrasting layer
Depth to compacted, consolidated, or contrasting layer
Drainage class
Available water capacity in upper 120 cm
Depth to water table, average
Ice type
Ice content
Permafrost occurrence
Active layer depth in soils with permafrost
Kind of patterned ground in soils with permafrost
pH of upper 15 cm of soil ($CaCl_2$)
pH of upper 15 cm of soil (water)
Organic carbon of upper 15 cm
Nitrogen content of upper 15 cm of soil
Thickness of humus layer
Calcareous class of parent material
Inclusions 1
Inclusions 2
Vegetative cover and/or land use
Lake size from Landsat
Water bodies from Landsat as percentage of polygon
Reliability class of polygon
Complexity class of polygon
Soil name 1
Soil name 2
Parent material textural group

4.1.5 Principles of Operation
Unknown.

4.1.6 Sensor/Instrument Measurement Geometry
Unknown.

4.1.7 Manufacturer of Sensor/Instrument
Unknown.

4.2 Calibration

4.2.1 Specifications
Unknown.

4.2.1.1 Tolerance
Unknown.

4.2.2 Frequency of Calibration
Unknown.

4.2.3 Other Calibration Information
Unknown.

5. Data Acquisition Methods

The original vector soils data were compiled using various data sources and techniques including:

- Interpretation of Landsat images (it is unknown whether the Landsat images were from the Multispectral Scanner (MSS) or Thematic Mapper (TM) instruments)
- Soil survey maps produced from field traverses at wide intervals (up to 10 km) and without the use of aerial photographs
- Maps produced by inspections using fixed-wing aircraft or helicopter and aided by interpretation of Landsat imagery
- Systematic traverses by helicopter and interpretation of stereoscopic aerial photographs
- Modern soil survey procedures, which include traversing existing accessible roads in wilderness areas, and aided by interpretation of stereoscopic aerial photographs
- Modern soil survey maps produced from field traverses at <1.6-km intervals and with the aid of stereoscopic aerial photographs.

The original data were acquired in ARC/INFO EXPORT format in a vector form. The dominant and subdominant attributes were included in a separate table that was linked to the digital map data by the polygon number.

6. Observations

6.1 Data Notes
The original vector data are documented fully in:

Soil Landscapes of Canada
Procedures Manual and User's Handbook
J.A. Shields, C. Tarnocai, K.W.G. Valentine, and K.B. MacDonald
Land Resource Research Centre
Ottawa, Ontario

6.2 Field Notes
See: derived from reading:

Soil Landscapes of Canada
Procedures Manual and User's Handbook
J.A. Shields, C. Tarnocai, K.W.G. Valentine, and K.B. MacDonald
Land Resource Research Centre
Ottawa, Ontario

BOREAS Information System (BORIS) personnel assume that extensive field notes exist from compiling the soils information into maps. The details of these notes are unknown.

7. Data Description

7.1 Spatial Characteristics

The original vector data in ARC/INFO format were gridded into a binary image format for the BOREAS region (1,000 x 1,000 km). The original data were digitized from maps at a scale of 1:1,000,000. The cell size at which these data are gridded is 1,000 meters on a side. There are 40 attributes or "items" that describe the dominant and 40 of many of the same attributes for the subdominant soil characteristics. Most of the items were gridded, with the exception of a few items that were inappropriate to grid (e.g., urban areas, water).

7.1.1 Spatial Coverage

These data cover the 1,000-km x 1,000-km area defined as the BOREAS Grid Region. It forms a rectangle that roughly straddles the Saskatchewan/Manitoba border with corner coordinates of 0.0, 0.0 and 1000.0, 1000.0 in the Albers Equal-Area Conic (AEAC) projection described in the BOREAS Experiment Plan. The following are the corner coordinates of the BOREAS region, given in the North American Datum of 1983 (NAD83):

	Longitude	Latitude
Northwest	111.000 W	59.979 N
Northeast	93.502 W	58.844 N
Southeast	96.970 W	50.089 N
Southwest	111.000 W	51.000 N

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

These data were gridded to a cell size of 1,000 meters in the AEAC projection.

7.1.4 Projection

The area mapped is projected in the ellipsoidal version of the AEAC projection. The projection has the following parameters:

```
Datum:  NAD83
Ellipsoid:  GRS80 or WGS84
Origin:   111.000°W   51.000°N
Standard Parallels:  52° 30' 00" N
                     58° 30' 00" N
Units of Measure:  kilometers
```

7.1.5 Grid Description

The data are gridded in 1,000-m intervals based on the ellipsoidal version of the AEAC projection with standard parallels of 52° 30' N and 58° 30' N and a lower left origin of 51° N and 111° W.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

The booklet that describes the original vector data set was published in 1991:
Soil Landscapes of Canada
Procedures Manual and User's Handbook
J.A. Shields, C. Tarnocai, K.W.G. Valentine, and K.B. MacDonald
Land Resource Research Centre
Ottawa, Ontario

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

These data likely represent a compilation of soils information that was completed over a period of several years. BORIS views the data set as a single point reference source that can be used for soil and other studies. BORIS is not aware of any updates that have been made to the original data set.

7.3 Data Characteristics

The various gridded layers and the codes that describe their characteristics are listed under Section 7, Data Description.

7.3.1 Parameter/Variable

Provincial Code
Polygon Number
Surface material
Percentage distribution of dominant and subdominant soil landscapes
Regional landform
Local surface form
Slope gradient class
Soil parent material mode of deposition (or origin)
Parent material texture
Soil development
Surface texture of mineral soil to 15 cm
Coarse fragment content of mineral soils
Rooting depth, unrestricted
Kind of compacted, consolidated, or contrasting layer
Depth to compacted, consolidated, or contrasting layer
Drainage class
Available water capacity in upper 120 cm
Average depth to water table
Ice type
Ice content
Permafrost occurrence
Active layer depth in soils with permafrost
Kind of patterned ground in soils with permafrost
pH of upper 15 cm of soil measured in $CaCl_2$
pH of upper 15 cm of soil measured in water
Organic carbon of upper 15 cm of soil
Nitrogen content of upper 15 cm of soil
Thickness of humus layer (L, F, H)
Calcareous class of parent material
Inclusions 1
Inclusions 2

```
Vegetative cover or land use, or both
Lake size estimated from Landsat imagery
Reliability class of polygon
Complexity class of polygon  (8-bit integers)
Soil name numbers file 1
Soil name numbers file 2
Parent material textural group
Soil Names Supplemental Information for Saskatchewan (ASCII)
Soil Names Supplemental Information for Manitoba (ASCII)
```

7.3.2 Variable Description/Definition

The following information was extracted (with modifications) from:

Soil Landscapes of Canada
Procedures Manual and User's Handbook
J.A. Shields, C. Tarnocai, K.W.G. Valentine, and K.B. MacDonald
Land Resource Research Centre
Ottawa, Ontario

Provincial Code

The value that designates whether the area is geographically located within Saskatchewan or Manitoba. In the provincial code file, the following values are used to represent Saskatchewan and Manitoba:

Pixel Value	Description
1	Saskatchewan
2	Manitoba

Polygon Number

In the original data sets, the polygons composing the entire area were numbered 1 to n. This value represents the polygon number from the original vector data and may not be useful to the user of this raster product.

Surface material

The type of material at the top of the soil in the area. In the dominant and subdominant surface material files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	IC	Ice and snow.
2	OR	Organic Soil. Contains >30% organic matter by weight.
3	R1	Soft rock, undifferentiated. Rock that can be dug with shovel, e.g., shales, Upper Cretaceous, and Tertiary materials.
4	R2	Hard rock, acidic. Granite.
5	R3	Hard rock, carbonaceous. Limestone.
6	R4	Hard rock, undifferentiated. Hard rock of unspecified origin and properties
7	SO	Mineral soil. Dominantly mineral particles, contains <30% organic matter by weight.
8	WA	Water.
9	UR	Urban areas.

		Note: Only a few major urban area polygons are shown on maps; do not use for tabulating urban areas.
10	#	Not applicable.
11	-	Attribute does not occur.

Percentage distribution of dominant and subdominant soil landscapes: The values in the dominant and subdominant raster files represent the percentage of that soil landscape in the area.

Regional landform

The type of landform on which the area exists (e.g., mountain, hill, tableland). In the dominant and subdominant regional landform files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	B	Tableland (or plateau) dominated. Comparatively flat areas of great extent commonly bounded on at least one side by an abrupt escarpment, or may be terminated by mountains; may be dissected by deep valleys and deeply incised rivers; may be tectonic, erosional, or volcanic in origin; may be step-faulted; slopes generally <10%, in some places 10-15%; relief generally <50 m.
2	H	Hilland dominated. Natural elevations rising prominently above the surrounding plain and having a recognizably denser pattern of generally higher knolls or crest lines with an irregular or chaotic surface form composed of upper surface convexity and lower concavity; includes hummocky morainal material, volcanic cones, and conical hills of lava; slopes generally 10-30%; relief generally <100 m.
3	M	Mountain dominated. Erosional and volcanic landscapes with relief (vertical distance between higher and lower parts) >300 m with most of the area comprising valley to summit terrain; slopes generally >30%. In general, the terrain has a restricted summit area and steep sides, irregular shape and considerable bare rock surface, or very thin soil cover; occurs as a single, isolated feature or in a group forming a long chain or range; major scarps are relatively steep, with straight cliff-like slopes of considerable linear extent separate surfaces such as plateaus lying at different levels.
4	O	Organic wetland dominated. Areas dominated by organic material >40 cm thick; contains >30% organic matter by weight; occurs in a variety of wetland surface forms.
5	P	Plain dominated. Flat to very gently undulating areas having few or no prominent irregularities; formed by erosional or by depositional (or constructional) processes; include broad, continuous, gently sloping piedmont plains extending along and from the base of a mountain, formed by lateral coalescence of a series of separate but confluent alluvial fans; alluvial processes are mainly responsible for the sedimentation;

		coarse fragments are rounded by transport over relatively long distances; slopes generally <6%; relief generally <10 m; extent generally >5 km in one direction.
6	S	Scarp dominated. An escarpment, cliff, or steep slope of some extent along the margin of a terrace, bench, plateau, hill, or mesa; a scarp may be of any height.
7	V	Valley dominated. Terrain dominated by major spillways, drainageways, or mountain trenches separated from surrounding landforms by a significant and abrupt break in slope; the valley profile may be V- or U-shaped with an extensive valley floor and flood plain up to about 5 km wide; valley profile may also include eroded terraces and their irregular slope segments.
8	#	Not applicable (urban area, water, etc.).
9	-	Attribute does not occur.

Local surface form

The type of local surface form on which the area is located (e.g., inclined, level, dissected). In the dominant and subdominant local surface form files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	D	Dissected. A dissected (or gullied) pattern providing external drainage for an area.
2	H	Hummocky (or irregular). A very complex sequence of slopes extending from somewhat rounded concavities (or swales) or various sizes to irregular, conical knolls (or knobs) and short, discontinuous ridges; there is a general lack of concordance between knolls and swales; slopes are 4-70%; examples: hummocky moraine, hummocky fluvioglacial.
3	I	Inclined. A sloping, unidirectional surface with a generally constant slope not broken by marked irregularity or gullies; a weakly developed pattern provides external drainage for the local area; slopes are 2-70%; the form of inclined slopes is not related to the initial mode of origin of the underlying material.
4	K	Knoll and kettle. A very chaotic sequence of knolls and numerous kettles (or sloughs), that occupy 15-20% of an area and that have no external drainage; slopes are generally >3%; examples: morainal plains and hillands.
5	L	Level. A flat, very gently sloping, unidirectional surface with a generally constant slope not broken by marked elevations and depressions; slopes are generally <2% (i.e., 1%); examples: flood plain, lake plain.
6	M	Rolling. A very regular sequence of moderate slopes extending from rounded and, in some places, confined concave depressions to broad, rounded convexities producing a wavelike pattern of moderate relief; slope gradients are generally >5% but may be less; this surface form is usually controlled by the underlying bedrock.

7	R	Ridged. A long, narrow elevation of the surface, usually distinctly crested with steep sides; ridges may be parallel, subparallel, or intersecting; examples: eskers, crevasse fillings, washboard moraines, some drumlins.
8	S	Steep. Erosional slopes >70%, on both consolidated and unconsolidated materials; form of a steep erosional slope on unconsolidated materials is not related to the initial mode of origin of the underlying material; example: escarpments.
9	T	Terraced. Scarp face and the horizontal or gently inclined surface (or tread) above it; example: alluvial terrace.
10	U	Undulating. A very regular sequence of gentle slopes that extends from rounded and, in some places, confined concavities to broad, rounded convexities producing a wavelike pattern of low local relief; slope length is generally <0.8 km and the dominant gradient of slopes is usually 2-5%; it lacks an external drainage pattern; examples: some ground moraine, lacustrine material of varying texture.
11	BO4	Domed bog. A large (diameter usually >500 m) bog with a convex surface, rising several meters above the surrounding terrain; center usually drains in all directions; small crescentic pools commonly form around the highest point; if highest point is in the center, the pools form a concentric pattern, or, if the highest point is off-center, an eccentric pattern; the peat development is usually >3 m.
12	BO5	Polygonal peat plateau bog. A perennially frozen bog, rising about 1 m above the surrounding fen, the surface is relatively flat, scored by a polygonal pattern of trenches that developed over ice wedges; the permafrost and ice wedges developed in peat originally deposited in a nonpermafrost environment.
13	BO7	Peat plateau bog. A bog composed of perennially frozen peat, rising abruptly about 1 m from the surrounding unfrozen fen; the surface is relatively flat and even, and commonly covers large areas; the peat was originally deposited in a nonpermafrost environment and is associated in many paces with collapse scar bogs or fens.
14	BO9	Atlantic plateau bog. A bog with a flat-to-undulating surface raised above the surrounding terrain, with the bog edges commonly sloping steeply down toward the mineral soil terrain; large pools scattered on the bog reach a depth of 2-4 m.
15	B13	Basin bog. A bog situated in a basin that has an essentially closed drainage, receiving water from precipitation and from runoff from the immediate surroundings; the surface of the bog is flat, but the peat is generally deepest at the center.
16	B14	Flat bog. A bog having a flat, featureless surface and occurring in broad, poorly defined depressions; the depth of peat is generally uniform.
17	B15	String bog. A pattern of narrow (2-3 m wide), low (<1 m deep) ridges oriented at right angles to the direction of drainage; wet depressions or pools occur between the ridges; the water and peat are very low in nutrients because the

		water has been derived from other ombrotrophic wetlands; peat thickness >1 m.
18	B16	Blanket bog. A bog consisting of extensive peat deposits that occur more or less uniformly over gently sloping hills and valleys; the peat thickness is usually <2 m.
19	B18	Slope bog. A bog occurring in areas of high rainfall on appreciably sloping land surfaces, fed by rainwater and by water draining from other nutrient-poor wetlands; the peat may exceed 1 m in thickness.
20	B19	Veneer bog. A bog occurring on gently sloping terrain underlain by generally discontinuous permafrost; although drainage is predominantly below the surface, overland flow occurs in poorly defined drainageways during peak runoff; peat thickness is usually <1.5 m.
21	FO1	Northern ribbed fen. A fen with parallel, low peat ridges ("strings") alternating with wet hollows or shallow pools, oriented across the major slope at right angles to water movement; the depth of peat is >1 m.
22	FO7	Shore fen. A fen with an anchored surface mat that forms the shore of a pond or lake; the rooting zone is affected by the water of the lake at both normal and flood levels.
23	F11	Slope fen. A fen occurring mainly on slow-drainage, nutrient-enriched seepage slopes; pools are usually absent, but wet seepage tracks may occur; peat thickness is usually <2 m.
24	F13	Horizontal fen. A fen with a very gently sloping, featureless surface; this fen occupies broad, often ill-defined depressions and may interconnect with other fens; peat accumulation is generally uniform.
25	SO1	Stream swamp. A swamp occurring along the banks of permanent or semipermanent streams; the high-water table is maintained by the level of water in the stream; the swamp is seasonally inundated, with subsequent sediment deposition.
26	SO4	Basin swamp. A swamp developed in a topographically defined basin where water derived locally may be augmented by drainage from other parts of the watershed; accumulation of well-decomposed peat is shallow (<0.5 m) at the edge and may reach 2 m at the center.
27	MO6	Stream marsh. A marsh occupying shorelines, bars, streambeds, or islands in continuously flowing water courses; the marsh is subject to prolonged annual flooding and is commonly covered by thick layers of sediments.
28	M11	Shallow basin marsh. A marsh occurring in a uniformly shallow depression or swale, having a gradual gradient from the edge to the deepest portion; the marsh edge may be poorly defined; water levels fluctuate rapidly.
29	M14	Shore marsh. A marsh occupying the contact zone between high and low water marks bordering semipermanent or permanent lakes; the marsh is usually found along protected shorelines, in lagoons behind barrier beaches, on islands, or in embayments; the marsh is subject to flooding by rise in lake levels, wind, waves, or surface runoff.
30	#	Not applicable (urban area, water, etc.).
31	-	Attribute does not occur.

Slope gradient class

The slope category of the land surface area. In the dominant and subdominant slope gradient class files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	A	1-3% (includes slopes <1%)
2	B	4-9%
3	C	10-15%
4	D	16-30%
5	E	31-60%
6	F	>60%
7	#	Not applicable (water)
8	-	Attribute does not occur

Soil parent material mode of deposition (or origin)

The mode in which the soil parent material was deposited on the area (e.g., colluvial, eolian, bog). In the dominant and subdominant soil parent material files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	A	Alluvial. Sediment generally consisting of gravel and sand with a minor fraction of silt and clay; gravels are typically rounded and contain interstitial sand; alluvial sediments are commonly moderately to well sorted and display stratification; examples: channel deposits, overbank deposits, terraces, alluvial fans, and deltas.
2	B	Bog. Bogs consist of unspecified organic materials associated with an ombrotrophic environment because the slightly elevated nature of the bog dissociates it from nutrient-rich ground water or surrounding mineral soils; near the surface, materials are usually undecomposed (fibric), yellowish to pale brown, loose and spongy in consistency, and entire sphagnum plants are readily identified; these materials are extremely acid, with low bulk density and high fiber content; at depths they become darker, compacted, and somewhat layered; bogs are associated with slopes or depressions on topography with a water table at or near the surface in the spring and slightly below it during the rest of the year; they are usually covered with sphagnum mosses, but sedges may also grow on them; bogs may be treed or treeless, and many are characterized by a layer of ericaceous shrubs.
3	C	Colluvial. Massive to moderately well stratified, nonsorted to poorly sorted sediments with any range of particle sizes from clay to boulders that have reached their present position only by direct, gravity-induced movement (except snow avalanches); processes include slow displacements such as creep and solifluction and rapid movements such as earth flows.
4	D	Residual. Unconsolidated, weathered, or partly weathered

		soil mineral material that accumulates by disintegration of bedrock in place.
5	E	Eolian. Sediment, generally consisting of medium-to-fine sand and coarse silt particle sizes, that is well sorted, poorly compacted, and may show internal structures such as cross bedding or ripple laminae, or may be massive; individual grains may be rounded and show signs of frosting; these materials have been transported and deposited by wind action; examples: dunes, shallow deposits and sand and coarse silt, and loess but not tuffs.
6	F	Fluvioglacial. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice; deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers, and kame terraces.
7	H	Marsh. Mineral wetland or wetland that is periodically inundated by standing or slow-moving water; surface water levels may fluctuate seasonally, with declining levels exposing drawdown zones of matted vegetation or mudflats; waters are rich in nutrients, varying from fresh to highly saline; substratum usually consists of mineral material, although in some places it consists of well-decomposed peat; soils are predominantly Gleysols, with some Humisols and Mesisols; marshes characteristically show zonal or mosaic surface patterns composed of pools or channels interspersed with clumps of emergent sedges, grasses, rushes, and reeds, bordering grassy meadows, and peripheral bands of shrubs or trees; submerged and floating aquatics flourish where open-water areas occur.
8	L	Lacustrine. Sediment generally consisting of either stratified fine sand, silt, and clay deposited on the lake bed or moderately well-sorted and stratified sand and coarser materials that are beach and other nearshore sediments transported and deposited by wave action; these materials either have settled from suspension in bodies of standing freshwater or have accumulated at their margins through wave action; examples: lake sediments and beaches.
9	M	Morainal. Sediment generally consisting of well-compacted material that is nonstratified and contains a heterogeneous mixture of sand, silt, and clay particle sizes and coarse fragments in a mixture that has been transported beneath, beside, on, within, or in front of a glacier and not modified by any intermediate agent; examples: basal till (ground moraines, rubbly moraines of cirque glaciers, hummocky ice-disintegration moraines, and pre-existing, unconsolidated sediments reworked by a glacier so that their original character is largely or completely destroyed.
10	N	Fen. Fen consists of unspecified organic materials formed in a minerotrophic environment because of the close association of the material with mineral-rich waters; it is usually moderately well to well decomposed, dark brown to black, with fine- to medium-sized fibers; decomposition commonly becomes greater at lower depths; the materials are covered with a dominant component of sedges, but grasses and reeds may be associated in local pools.

11	O	Organic, undifferentiated. A layered sequence of more than three types of organic material (>30% organic matter by weight).
12	R	Rock. A consolidated bedrock layer that is too hard to break with the hands (>3 on Mohs' scale) or to dig with a spade when moist.
13	S	Swamp. Minerotrophic wetlands with the water table at or above the peat surface; dominant unspecified organic materials are forest and fen peat formed in a eutrophic environment because of strong water movement from the margins or other mineral sources; it is usually moderately well to well decomposed and has a dark brown to reddish brown matrix; the more decomposed materials are black; it has an amorphous or very fine-fibered structure containing a random distribution of woody fragments and trunks of coniferous tree species; the vegetation cover may consist of coniferous or deciduous trees, tall shrubs, herbs, and mosses; in some regions sphagnum mosses are abundant.
14	T	Anthropogenic. Materials modified by people, including those associated with mineral exploitation and waste disposal; they include materials deposited as a result of human activities or geological materials modified artificially so that their physical properties (structure, cohesion, compaction) have been drastically altered; examples: areas of landfill, spoil heaps, open-pit mines, leveled irrigated areas.
15	U	Undifferentiated. A sequence of more than three types of genetic mineral materials outcropping on a steep erosional escarpment; this complex class is to be used where units relating to individual genetic materials cannot be delimited separately at the scale of mapping; it may include colluvium derived from the various genetic materials and resting upon the scarp slope.
16	V	Volcanic. Volcanic pumice and ash.
17	W	Marine. Unconsolidated deposits of clay, silt, sand, or gravel that are well to moderately well sorted and well to moderately well stratified (in some places containing shells); they have settled from suspension in salt or brackish water bodies or have accumulated at their margins through shoreline processes such as wave action and longshore drift; nonfossiliferous deposits may be judged marine, if they are located in an area that might reasonably be considered to have contained saltwater at the time the deposits were formed.
18	11	Fibric Sphagnum. Sphagnum organic material in a fibric degree of decomposition in which the fibric materials are readily identifiable as to botanical origin; peat is usually undecomposed (or fibric), light yellowish brown to pale brown, and loose and spongy in consistency with the entire sphagnum plant being readily identifiable.
19	21	Mesic sedge. Sedge organic material in a mesic (or intermediate) degree of decomposition; peat composed dominantly of sedge (Carex spp.) and generally moderately decomposed and matted; the sedge leaves are readily

		identifiable to the naked eye; this material commonly contains large amounts of very fine roots of the above species.
20	22	Mesic woody sedge. Woody sedge organic material in a mesic (or intermediate) degree of decomposition; peat is composed dominantly of sedge peat (see code 21) with subdominant amounts of woody materials.
21	23	Mesic woody forest. Woody forest organic material in a mesic (or intermediate) degree of decomposition; peat is composed dominantly (>50%) of woody materials derived from both coniferous and deciduous tree species; in general, wood fragments are easily identifiable in this peat.
22	25	Mesic sphagnum. Sphagnum organic material in a mesic (or intermediate) degree of decomposition.
23	31	Humic sedge. Sedge organic material in a humic (or most advanced) degree of decomposition in which most of the material is humified, and there are few recognizable fibers.
24	#	Not applicable (urban area, water, etc.).
25	-	Attribute does not occur.

Parent material texture

The texture category to which the parent material was assigned (e.g., very fine sand, sandy loam, clay). In the dominant and subdominant soil parent material texture files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	CBS	Cobbly sand. 15-35% cobbles by volume.
2	VGS	Very gravelly sand. 35-60% gravel by volume.
3	GS	Gravelly sand. 15-35% gravel by volume.
4	S	Sand.
5	CS	Coarse sand. 25% or more very coarse and coarse sand.
6	FS	Fine sand. 50% or more fine sand.
7	VS	Very fine sand. 50% or more very fine sand.
8	LFS	Loamy fine sand. 50% or more fine sand.
9	LVFS	Loamy very fine sand. 50% or more very fine sand.
10	CBLS	Cobbly loamy sand. 15-35% cobbles by volume.
11	VGLS	Very gravelly loamy sand. 35-60% gravel by volume.
12	GLS	Gravelly loamy sand. 15-35% gravel by volume.
13	LS	Loamy sand.
14	CBSL	Cobbly sandy loam. 35-60% cobbles by volume.
15	VGSL	Very gravelly sandy loam. 35-60% gravel by volume.
16	GSL	Gravelly sandy loam. 15-35% gravel by volume.
17	SL	Sandy loam.
18	GFL	Gravelly fine sandy loam. 15-35% gravel by volume.
19	FL	Fine sandy loam. 30% or more fine sand.
20	CBL	Cobbly loam. 15-35% cobbles by volume.
21	GL	Gravelly loam. 15-35% gravel by volume.
22	L	Loam.
23	VL	Very fine sandy loam. 30% or more very fine sand.
24	GSIL	Gravelly silt loam. 15-35% gravel by volume.
25	SIL	Silt loam.

26	GSCL	Gravelly sandy clay loam. 15-35% gravel by volume.
27	SCL	Sandy clay loam.
28	VCL	Very fine sandy clay loam. 30% or more very fine sand.
29	CBCL	Cobbly clay loam. 15-35% cobbles by volume.
30	GCL	Gravelly clay loam. 15-35% gravel by volume.
31	CL	Clay loam.
32	SICL	Silty clay loam.
33	SC	Sandy clay.
34	C	Clay.
35	GSIC	Gravelly silty clay. 15-35% gravel by volume.
36	SIC	Silty clay.
37	HC	Heavy clay.
38	#	Not applicable.
39	-	Attribute does not occur.

Soil development

The category of soil development for the area (e.g., Gray Brown Luvisolic, Eutric Brunisolic). In the dominant and subdominant soil development files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	A	Brown Chernozemic. Dominantly Orthic Brown subgroup with inclusions of other subgroups within the Brown great group.
2	B	Dark Brown Chernozemic. Dominantly Orthic Dark Brown subgroup with inclusions of other subgroups within the Dark Brown great group.
3	C	Black Chernozemic. Dominantly Orthic Black subgroup with inclusions of other subgroups within the Black great group.
4	D	Dark Gray Chernozemic or Dark Gray Luvisolic. Dominantly Orthic Dark Gray Chernozemic subgroup or Dark Gray Luvisol subgroup with inclusions of other subgroups within the Dark Gray great group or of the gleyed Dark Gray Luvisol subgroup.
5	E	Gray Brown Luvisolic. Dominantly Orthic Gray Brown Luvisol subgroup with inclusions of other subgroups within the Gray Brown Luvisol great group.
6	F	Gray Luvisolic. Dominantly Orthic Gray Luvisol subgroup with inclusions of other Gray Luvisol subgroups.
7	G	Brown Solonetzic. May be dominantly Brown Solonetz or Brown Solodized Solonetz or Brown Wolod subgroup with inclusions of these subgroups, i.e., dominantly Brown Solodized Solonetz with inclusions of Brown Solod.
8	H	Dark Brown Solonetzic. May be dominantly Dark Brown Solonetz or Dark Brown Solodized Solonetz or Dark Brown Solod subgroup with inclusions of these subgroups.
9	I	Brunisolic Gray Luvisolic. Dominantly Brunisolic Gray Luvisol subgroup with inclusions of its gleyed subgroup.
10	J	Black Solonetzic. May be dominantly Black Solonetz or Black Solodized Solonetz or Black Solod subgroup with inclusions of these subgroups and their gleyed subgroups.
11	K	Gray Solonetzic. Dominantly Gray Solodized Solonetz or Gray Solod subgroups with inclusions of their gleyed subgroups.

12	L	Melanic Brunisolic. Dominantly Melanic Brunisol great group.
13	M	Eutric Brunisolic. Dominantly Eutric Brunisol great group.
14	N	Sombric Brunisolic. Dominantly Sombric Brunisol great group.
15	O	Organic Cryosolic. Dominantly Organic Cryosol great group.
16	P	Dystric Brunisolic. Dominantly Dystric Brunisol great group.
17	Q	Humic Podzolic. Dominantly Humic Podzol great group.
18	R	Regosolic. Dominantly Regosolic order.
19	S	Static Cryosolic. Dominantly Static Cryosol great group.
20	T	Turbic Cryosolic. Dominantly Turbic Cryosol great group.
21	U	Gleysolic. Dominantly Gleysolic order.
22	V	Ferro-Humic Podzolic. Dominantly Ferro-Humic Podzol great group.
23	W	Humo-Ferric Podzolic. Dominantly Humo-Ferric Podzol great group.
24	X	Fibrisol. Dominantly Fibrisol great group.
25	Y	Mesisol. Dominantly Mesisol great group
26	Z	Humisol. Dominantly Humisol great group.
27	2	Folisol. Dominantly Folisol great group.
28	3	Podzolic Gray. Podzolic Gray Luvisol subgroup; only occurs as subdominant.
29	#	Not applicable (water, rock, or ice).
30	-	Attribute does not occur.

Surface texture of mineral soil to 15 cm

The texture of the soil between the surface and a depth of 15 cm. The values and codes shown above for parent material texture also apply to the surface soil texture.

Coarse fragment content of mineral soils

The categorized percent by volume of rounded, subrounded, flat, angular, or irregular rock fragment from 0.2 to 60 cm or more in size. In the dominant and subdominant coarse fragment content files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	A	<10% by volume. Rounded, subrounded, flat, angular or irregular rock fragment from 0.2 to 60 cm or more in size.
2	B	10-30%
3	C	31-65%
4	D	>65%
5	#	Not applicable.
6	-	Attribute does not occur

Rooting depth, unrestricted

The unrestricted rooting depth for vegetation that is growing in the area. In the dominant and subdominant rooting depth files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	0	<20 cm
2	50	20-75 cm
3	100	76-150 cm
4	200	>150 cm
5	#	Not applicable (e.g., rock, ice)
6	-	Attribute does not occur

Kind of compacted, consolidated, or contrasting layer

The type of compacted, consolidated, or contrasting layer that is present (e.g., Ortstein). In the dominant and subdominant compacted, consolidated, or contrasting layer files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	A	Compacted parent material. Compacted glacial till or other material.
2	B	Basal till. Compacted glacial till deposited beneath a moving glacier.
3	C	Compacted material (anthropogenic). Soil material compacted by human activities that adversely affect crop production.
4	D	Duric horizon. This strongly cemented Bc horizon does not satisfy the criteria of a podzolic B horizon; usually it has an abrupt upper boundary to an overlying podzolic B or to a Bm horizon and a diffuse lower boundary >0.5 m below; cementation is usually strongest near the upper boundary and occurs commonly at a depth of 40-80 cm from the mineral surface; the color of the duric horizon usually differs little from that of the moderately coarse textured to coarse textured parent material, and the structure is usually massive or very coarse platy; air-dry clods of duric horizons do not slake when immersed in water, and moist clods >3 cm thick usually cannot be broken in the hands.
5	E	Ortstein. Horizon of fragipan character; a fragipan is a loamy subsurface horizon of high bulk density and very low organic matter content; when dry, it has a hard consistency and seems to be cemented; when moist, it has moderate to weak brittleness; it commonly has bleached fracture planes and is overlain by a friable B horizon; air-dry clods of fragic horizons slake in water.
6	O	Ortstein. This strongly cemented Bh, Bhf, or Bf horizon, >3 cm thick, occurs in more than one-third of the exposed face of the pedon; ortstein horizons are generally reddish brown to very dark reddish brown.
7	P	Placic horizon. This layer (commonly <5 mm thick) or series of thin layers is irregular or involuted, hard, impervious, commonly vitreous, and dark reddish brown to black; placic

		horizons may be cemented by Fe, Al-organic complexes (Bhfc or Bfc), hydrated Fe oxides (Bgfc) or a mixture of Fe and Mn oxides.
8	R	Rock. Consolidated bedrock too hard either to break with the hands (>3 on Mohs' scale) or to dig when moist.
9	G	Gravel. A layer of coarse fragments with diameters of 0.2-7.5 cm.
10	L	Colluvium. See attribute number 09, code C.
11	S	Sand. Soil texture class in which the material contains >85% of sand-sized separate; the percentage of silt plus 1.5 times the percentage of clay does not exceed 15%.
12	X	Silt. Soil texture class in which the material contains >80% silt and <12% clay.
13	Y	Clay. Soil texture class in which the material contains >40% clay, <45% sand, and <40% silt-sized separates.
14	#	Not applicable.
15	-	Attribute does not occur.

Depth to compacted, consolidated, or contrasting layer

The depth class for any compacted, consolidated, or contrasting layer that exists. In the dominant and subdominant depth to compacted, consolidated, or contrasting layer files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	1	0-49 cm
2	2	50-100 cm
3	3	>100 cm
4	4	<100 cm for mineral overlays
5	5	<160 cm for shale (terric) organic
6	#	Not applicable
7	-	Attribute does not occur

Drainage class

The drainage class of the soil over the area (e.g., excessive, rapid, poor). In the dominant and subdominant drainage class files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	E	Excessive. Water is removed from the soil very rapidly in relation to supply; excess water flows downward very rapidly if underlying material is pervious; subsurface flow may be very rapid during heavy rainfall provided the gradient is steep; source of water is precipitation.
2	R	Rapid. Water is removed from the soil rapidly in relation to supply; excess water flows downward if underlying material is pervious; subsurface flow may occur on steep gradients during heavy rainfall; source of water is precipitation.
3	W	Well. Water is removed from the soil readily but not rapidly; excess water flows downward readily into underlying pervious material or laterally as subsurface flow; these

		soils commonly retain optimum amounts of moisture for plant growth after rains or addition of irrigation water.
4	M	Moderately well. Water is removed from the soil somewhat slowly in relation to supply; excess water is removed somewhat slowly because of low perviousness, shallow water table, lack of gradient, or some combination of these; precipitation is the dominant source of water in medium-to-fine textured soils; precipitation and significant additions by subsurface flow are necessary in coarse-textured soils.
5	I	Imperfect. Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season; excess water moves slowly downward if precipitation is the major supply; if subsurface water or groundwater, or both, is the main source, the flow rate may vary, but the soil remains wet for a significant part of the growing season.
6	P	Poor. Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen; excess water is evident in the soil for much of the time; subsurface flow or groundwater flow, or both, in addition to precipitation are the main sources of water; there may also be a perched water table.
7	V	Very poor. Water is removed from the soil so slowly that the water table remains at or on the surface for most of the time the soil is not frozen; groundwater flow and subsurface flow are the major sources of water; precipitation is less important except where there is a perched water table.
8	#	Not applicable.
9	-	Attribute does not occur.

Available water capacity in upper 120 cm

That portion of water in a soil that can be readily absorbed by plant roots; generally considered to be the water held in the soil between field capacity and a pressure of up to about 15 bars. In the dominant and subdominant water capacity files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	1	50 mm
2	2	100 mm
3	3	150 mm
4	4	200 mm
5	5	250 mm
6	6	Not applicable (solonetzic or saline soils)
7	7	Not applicable (high water table)
8	8	Not applicable (perennially frozen subsoils)
9	#	Not applicable (water, ice, rock)
10	-	Attribute does not occur

Average depth to water table

The average depth to the water table in the area. In the dominant and subdominant depth to water table files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	1	0-2 m (most shallow water table during growing season
2	2	2-3 m
3	3	>3 m
4	4	0-1 m
5	5	1-2 m
6	6	0-1 m (with perennially frozen subsoil)
7	#	Not applicable (water, ice, rock)
8	-	Attribute does not occur

Ice type

The type of ice found in the soil. In the dominant and subdominant ice type files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	1	Ice crystals and ice lenses
2	2	Ice wedges
3	3	Massive ground ice
4	4	Undifferentiated
5	#	Not applicable
6	-	Attribute does not occur

Ice content

The relative amount of ice contained in the soil. In the dominant and subdominant ice content files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	L	Low
2	M	Medium
3	H	High
4	#	Not applicable
5	-	Attribute does not occur

Permafrost occurrence

The relative occurrence of permafrost in the soil of the area. In the dominant and subdominant permafrost occurrence files, the following values are used to represent the various groupings.

Pixel Value	Original Code	Description
1	V	Very sporadic. Sparse patches of permafrost occurring near the southern limit of permafrost.
2	S	Sporadic. The occurrence of isolated patches or islands of permafrost near the southern boundary of discontinuous

		permafrost zone.
3	D	Discontinuous. Permafrost occurring in some areas beneath the exposed land surface throughout a geographic region where other areas are free of permafrost.
4	C	Continuous. Permafrost occurring everywhere beneath the exposed land surface throughout a geographic region with the exception of widely scattered sites, such as newly deposited unconsolidated sediments.
5	#	Not applicable.
6	-	Attribute does not occur.

Active layer depth in soils with permafrost

The depth of the top layer of ground subject to annual thawing and freezing in areas underlain by permafrost. The value in the file represents the depth of the active layer.

Kind of patterned ground in soils with permafrost

The types of geometrically shaped patterns found in soils with permafrost. In the dominant and subdominant kind of patterned ground files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	01	Sorted circle. Patterned ground having a dominantly circular mesh and a sorted appearance commonly produced by a border of stones surrounding finer material.
2	02	Sorted net. Patterned ground having a mesh neither dominantly circular nor polygonal; a sorted appearance results from borders of stones surrounding finer material.
3	03	Sorted stripe. Patterned ground with a striped pattern and sorted appearance resulting from parallel lines of stones and intervening stripes of finer material oriented down the steepest available slope.
4	04	Sorted large polygon. Patterned ground having a dominantly polygonal mesh and a sorted appearance commonly produced by border of stones surrounding finer material; polygon diameter is >1 m.
5	05	Sorted small polygon. Same for code 04 except that polygon diameter is <1 m.
6	06	Nonsorted circle. Patterned ground having a dominantly circular mesh but lacking a border of stones.
7	07	Nonsorted net. Patterned ground having neither a dominantly circular or polygonal mesh nor a border of stones.
8	08	Nonsorted large polygon. Patterned ground having a dominantly polygonal mesh but lacking a border of stones; polygon diameter is >1 m.
9	09	Nonsorted small polygon. Same for code 08 except that polygon diameter is <1 m.
10	10	Earth hummock. Hummock having a core of silty and clayey mineral soil and showing signs of cryoturbation.
11	11	Lowland (peat) polygon. Bog with flat-topped or convex peat surfaces separated by trenches over ice wedges that form a polygonal pattern at the surface.

12	12	Polygonal peat plateau. Generally flat-topped expanse of peat elevated above the general surface of a wetland and containing segregated ice that may or may not extend downward into underlying mineral soil.
13	13	No pattern. Unpatterned ground.
14	#	Not applicable.
15	-	Attribute does not occur.

pH of upper 15 cm of soil measured in $CaCl_2$

The pH of the upper 15 cm of soil as measured using $CaCl_2$. The value in the file divided by 10 represents the pH of the upper 15 cm of soil.

pH of upper 15 cm of soil measured in water

The pH of the upper 15 cm of soil as measured using water. The value in the file divided by 10 represents the pH of the upper 15 cm of soil.

Organic carbon of upper 15 cm of soil

The percent of organic carbon contained in the upper 15 cm of soil. The value in the file represents the nearest percent of carbon in the top 15 cm of soil.

Nitrogen content of upper 15 cm of soil

The percent of nitrogen contained in the upper 15 cm of soil. In the dominant and subdominant nitrogen content files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	0	<0.1%
2	1	0.1-0.5%
3	2	0.6-1.5%
4	3	>1.5%
5	#	Not applicable (water, rock, ice)
6	-	Attribute does not occur

Thickness of humus layer (L, F, H)

The thickness categories for the humus layer. In the dominant and subdominant thickness of humus layer files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	0	<5 cm
2	1	5-10 cm
3	2	11-20 cm
4	3	21-40 cm
5	4	>40 cm
6	#	Not applicable (e.g., cultivated, eroded)
7	-	Attribute does not occur

Calcareous class of parent material

The calcareous class of the parent material. In the dominant and subdominant calcareous class files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	0	Noncalcareous. No $CaCO_3$ detectable with dilute HCl.
2	1	Weakly. 1-5% $CaCO_3$ equivalents (weak effervescence with dilute HCl).
3	2	Strongly. 6-40% $CaCO_3$ equivalents (moderate to strong effervescence with dilute HCl)
4	3	Extremely. >40% $CaCO_3$ equivalents (very strong effervescence with dilute HCl)
5	#	Not applicable (water, rock, ice).
6	-	Attribute does not occur

Inclusions 1

The predominant type of inclusions found in the area. Inclusions may represent a maximum of 15% of the polygon area. Although their percent occupance is relatively small, they are generally strongly contrasting to the dominant or subdominant soil landscapes. A maximum of two inclusions may be recorded for each of the dominant and subdominant soil landscapes; a maximum of four inclusions may be recorded for each polygon. Inclusions provide an opportunity to document that "little bit" of extra information about the polygon. They may be associated with the dominant or subdominant soil landscape or they may occur independently. Extreme caution is recommended when using inclusions in area calculations. In the dominant and subdominant inclusions files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	A	Acid surface soil. pH <6.0.
2	BG	Bog. See file 10, code B.
3	BL	Black Chernozemic soil. See file 12, code C.
4	BC	Brown Chernozemic soil. See file 12, code A.
5	BR	Bedrock, hard. Consolidated bedrock that is too hard either to break with the hands (>3 on Mohs' scale) or to dig with a spade when moist.
6	BS	Bedrock, soft. Bedrock that can be broken with the hands (<3 on Mohs' scale) and dug with a spade when moist.
7	C	Clay substrate. Clay material forming a lithologic discontinuity within 1 m of the soil surface.
8	CA	Calcareous surface soil. Indicated by visible effervescence when dilute HCl is added.
9	CC	Colluvium. See file 10, code C.
10	CH	Chernozemic soil. Unspecified Chernozemic soils; more than one subgroup present.
11	CY	Clay. See file 11.
12	D	Dissected surface form. See file 8, code D.
13	DB	Dark Brown Chernozemic soil. See file 12, code B.
14	DC	Deep colluvium. Colluvial material (see attribute number 09, code C) to a depth of >1 m.

15	DG	Deep gravelly fluvioglacial. Gravelly fluvioglacial material to a depth of >1 m; see file 10 (code F) and 11.
16	DU	Duric material. See file 16, code D.
17	E	Eroded knolls. Relatively light-colored knolls compared to other slope positions, occurring in hummocky or knoll-and-kettle surface forms.
18	EO	Eolian material. >50 cm of eolian material (see file 10, code E).
19	ES	Eroded slopes. Slopes eroded by water.
20	F	Fluvioglacial substrate. Substrate of fluvioglacial material (see file 10, code F).
21	FH	Ferro-Humic Podzolic soil. See attribute number 11, code V.
22	FO	Folisol. See file 12, code 2.
23	G	Sandy loam morainal material. Morainal material with a sandy loam texture (see file 11).
24	GG	Gravelly alluvium. See files 10 (code A) and 11.
25	GG	Gravelly fluvioglacial material. See files 10 (code F) and 11.
26	GL	Gleyed soil. Presence of faint to distinct mottles (or blotches) of different color interspersed within the dominant matrix color.
27	GM	Gravelly marine material. See files 10 (code W) and 11.
28	GV	Orthic Gray Luvisolic soil. See file 12, code F.
29	GY	Gleysolic soil. See file 12, code U.
30	HC	Shallow lithic colluvium. Colluvial material (see file 10, code C) overlying a lithic contact 50-100 cm from the surface.
31	HP	Humo-Ferric Podzolic soil. See file 12, code W.
32	HU	Hummocky surface form. See file 8, code H.
33	I	Brunisolic Gray Luvisolic soil. See file 12, code I.
34	IC	Ice. See file 5, code C.
35	ID	Imperfectly drained soil. See file 18, code I.
36	L	Melanic Brunisolic soil. See file 12, code L.
37	LC	Lacustrine material. See file 10, code L.
38	LF	Loamy alluvium material. See files 10 (code A) and 11.
39	LI	Lithic layer. Bedrock occurring within the normal depth of soil development, usually within 1 m of the soil surface.
40	LM	Loamy morainal till. Till (or morainal) material in which soil separates contain <35% clay and coarse fragments occupy <35% by volume.
41	LO	Loamy marine material. See files 10 (code W) and 11.
42	LS	Silty lacustrine material. See files 10 (code L) and 11.
43	LU	Luvisolic soil. See file 12, code E or F.
44	M	Eutric Brunisolic soil. See file 12, code M.
45	ML	Clay loam marine material. See files 10 (code W) and 11.
46	MP	Moss peat. Relatively undecomposed, spongy organic material.
47	N	Sombric Brunisolic soil. See file 12, code N.
48	NN	None.
49	O	Organic material. See file 10, code O.
50	OC	Organic Cryosolic soil. See file 12, code O.

51	OT	Ortstein. See file 16, code O.
52	P	Dystric Brunisolic soil. See file 12, code P.
53	PD	Poorly drained soil. See file 18, code P.
54	PP	Poorly drained, peat soil. Poorly drained soil with a peaty surface layer (<40 cm thick).
55	R1	Soft rock outcrops. See file 5, code R1.
56	R2	Hard rock outcrops, acidic. Granite rock outcrops.
57	R3	Hard rock outcrops, basic. Limestone rock outcrops.
58	R4	Hard rock outcrops, undifferentiated. See attribute number 03, code R4.
59	RD	Rapidly drained soil. See file 18, code R.
60	RG	Regosolic soil. See file 12, code R.
61	SA	Saline soil. Soil causing an obvious reduction in crop growth, may have white surface crust.
62	SC	Static Cryosolic soil. See file 12, code S.
63	SD	Sandy marine material. Marine material with a sand texture class; see files 10 (code A) and 11.
64	SF	Sandy alluvium. See attribute numbers 09 (code A) and 10.
65	SG	Sandy fluvioglacial material. Fluvioglacial material but with a sand texture class; see files 10 (code F) and 11.
66	SH	Gravelly shoreline. See file 11.
67	SL	Silty alluvium. See files 10 (code A) and 11.
68	SO	Sombric Humo-Ferric Podzolic soil. See file 12, code W.
69	SP	Steep surface form. See file 8, code S.
70	SS	Silty surface texture. See file 11.
71	ST	Stony surface. Sufficient stones to seriously handicap cultivation.
72	SY	Sandy material. See file 11.
73	T	Till substrate. Till (or morainal) material forming a lithologic discontinuity within 1 m of the soil surface.
74	TA	Talus. Sloping mass of rock fragments below a cliff or at the foot of a steep slope.
75	TC	Turbic Cryosolic soil. See file 12, code T.
76	TE	Terric layer. Unconsolidated mineral substratum occurring within the normal depth of organic soil development (40-160 cm).
77	TR	Terraced surface form. See file 8, code T.
78	TT	Anthropogenic material. See file 10, code T.
79	VA	Volcanic ash. Deposition of fine, wind-transported material of volcanic origin deposited in thin layers that persist for along time in bogs, river terraces, talus slopes, and kettle holes.
80	VS	Very shallow lithic layer. Rock material occurring at <50 cm from the surface.
81	WD	Well-drained soil. See file 18, code W.
82	WE	Wind erosion. Removal of surface soil particles caused by wind action.
83	WT	Wetlands. Lands dominated by the persistent presence of excess water indicated by Gleysolic and shallow Organic soils under a cover of hydrophytic vegetation.
84	X	Fibrisol. See file 12, code X.
85	Y	Mesisol. See file 12, code Y.
86	Z	Humisol. See file 12, code Z.

87	11	Fibric-sphagnum soil. Sphagnum organic soil in the stage of decomposition in which fibric materials are readily identifiable as to botanical origin.
88	14	Patterned ground. See file 25.
89	17	Bouldery material. Rounded or irregular coarse fragments >60 cm in diameter.
90	21	Mesic-sedge material. Sedge organic material in a mesic (or intermediate) degree of decomposition.
91	23	Mesic woody-forest material. Woody-forest organic material in a mesic degree of decomposition; the material is partly altered physically and biochemically.
92	#	Not applicable.
93	-	Attribute does not occur.
94	22	(Not in original documentation.)

Inclusions 2

The secondary type of inclusions found. In the dominant and subdominant inclusions files, the same values are used as for inclusions 1 described previously.

Vegetative cover or land use, or both

The category of vegetative cover or type of land use in the area. In the dominant and subdominant vegetative cover or land use files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	A	Agricultural crops. Annual field crops.
2	B	Bog. Bogs may be treed or treeless and are usually covered with sphagnum spp. and ericaceous shrubs.
3	C	Coniferous forest. Dominated by needle-leaved, cone-bearing species.
4	D	Deciduous forest. Dominated by broadleaf species.
5	E	Fen. Dominated by sedges, grasses, reeds, and brown mosses with some shrubs and, at times, a sparse tree layer.
6	G	Grassland. Perennial native grassland or improved pasture.
7	H	Arctic desert. Unvegetated areas in the polar desert of the high Arctic; may be caused by either climatic (too cold or too dry) or edaphic (low soil nutrients or toxic substrate) factors, or a combination of both.
8	M	Mixed deciduous and coniferous forest. See codes C and D.
9	P	Parkland. A forest-grassland transition comprising a mosaic of trembling aspen stands interspersed with patches of cropland, grassland, and meadow.
10	R	Marshland. A mosaic surface pattern composed of pools or channels interspersed with clumps of emergent sedges, grasses, rushes, and reeds, bordering grassy meadows, and peripheral bands of shrubs or trees; submerged and floating aquatics flourish in open water areas.
11	S	Shrubland. Dominated by shrub species.
12	SP	Sedge peat. Dominated by Carex spp. and generally moderately decomposed and matted; the sedge leaves are readily identifiable to the naked eye.
13	TA	Tundra, alpine. Treeless terrain found at high altitudes occurring immediately above the forest zone and the upper

		altitudinal timberline; tundra vegetation comprises lichens, mosses, sedges, grasses, forbs, and low shrubs (<20 cm) including heaths, dwarf willows, and birches.
14	TL	Tundra, low shrub. Treeless terrain found at high latitudes occurring most widely in the zone immediately north of the boreal forest including the treeless parts of the forest-tundra ecotone adjacent to the treeline; tundra vegetation comprises lichens, mosses, sedges, grasses, forbs, and low shrubs (<20 cm), including heaths, dwarf willows, and birches.
15	TM	Tundra, medium shrub. Similar to low-shrub tundra (see code TL) except for medium (>20 cm) instead of low shrubs.
16	U	Unvegetated surface.
17	#	Not applicable.
18	-	Attribute does not occur.

Lake size estimated from Landsat imagery

The size category of a lake that exists over the area. In the dominant and subdominant lake size files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	S	Small <1 km^2 (not visible on 1:1,000,000-scale Landsat imagery)
2	M	Medium 1-10 km^2
3	L	Large 11-50 km^2
4	V	Very large >50 km^2
5	#	Not applicable
6	-	Attribute does not occur
7	F	(Not in original documentation)

The percent levels of the area covered by water bodies that are wholly contained within the polygon as estimated from Landsat images. In the dominant and subdominant percent water body files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	F	Few. Water bodies cover 0-10% area of polygon.
2	C	Common. Water bodies cover 11-25% area of polygon.
3	M	Many. Water bodies cover 26-50% area of polygon.
4	A	Abundant. Water bodies cover >50% area of polygon.
5	#	Not applicable.
6	-	Attribute does not occur.

Reliability class of polygon

The relative reliability of the information provided for the polygon. In the dominant and subdominant reliability class files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	V	Very low. Compiled from interpretation of Landsat data only; no ground data are collected for verification of these areas.
2	L	Low. Compiled from soil survey maps produced from field traverses at wide intervals (up to 10 km) and without the use of aerial photographs, or compiled from maps produced by inspections using fixed-wing aircraft or helicopter and aided by interpretation of Landsat imagery.
3	M	Medium. Produced from systematic traverses by helicopter and by interpretation of stereoscopic aerial photographs, or compiled from modern soil survey procedures, which include traversing existing accessible roads in wilderness areas, and aided by interpretation of stereoscopic aerial photographs.
4	H	High. Compiled from modern soil survey maps produced from field traverses at <1.6-km intervals and with the aid of stereoscopic aerial photographs.
5	#	Not applicable.
6	-	Attribute does not occur.

Complexity class of polygon (8-bit integers)

The relative complexity or variability of the soil in the area. In the dominant and subdominant complexity class files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	L	Low. Soil and landscape attributes within the polygon are uniform for most interpretations; in most cases the polygon has only a dominant component.
2	M	Medium. Soil and landscape attributes are moderately variable but predictable; there are generally dominant and subdominant components, each of which usually has been generalized from no more than two classes of parent material or soil development, or both; there may also be an inclusion in the polygon.
3	H	High. Soil and landscape attributes are highly variable and unpredictable; dominant, subdominant, and inclusion components are present, each of which has been generalized from more than two classes of parent material or soil development, or both; use this class to warn of extreme oversimplification in any interpretations from the extended legend.
4	#	Not applicable.
5	-	Attribute does not occur.

Soil name numbers (files 1 and 2)

The binary number in the dominant and subdominant soil name number raster files for Saskatchewan and Manitoba that are used to look up pertinent information in the American Standard Code for Information Interchange (ASCII) soil name files.

Parent material textural group

The texture group of the parent material. In the dominant and subdominant parent material texture files, the following values are used to represent the various groupings:

Pixel Value	Original Code	Description
1	sd	Sand. Group includes CBS, CBLS, CS, S, LS, LFS, FS, GS, VGS, LVFS, VS, GLS, VGLS
2	sl	Sandy loam. Group includes CBSL, SL, FL, GSL, VGSL, and GFL.
3	lm	Loam. Group includes GL, CBL, L, GSIL, VL, SIL.
4	cl	Clay loam. Group includes CBCL. GSCL, GCL, SCL, VCL, CL, and SICL.
5	cy	Clay. Group includes SC, GSIC, SIC, C, and HC.
6	#	Not applicable.
7	-	Attribute does not occur.

The following describes the soil names files and how to decode the various columns of data that they contain.Soil Names Supplemental Information for Saskatchewan (ASCII): The columns of this file are listed in the following order:

Image Value
Soil Code
Undocumented variable
Province
Soil Name
Modifier
Land Use
Kind of Soil
Water Table
Soil layer that restricts root growth
Type of Root Restricting Layer
Soil Drainage class
Mode of Deposition 1
Mode of Deposition 2
Mode of Deposition 3
Soil Order
Soil Sub-Group
Soil Great Group
Profile
Date
A-Thick (cm)
Soil Thickness (cm)
Soil Chemistry
Parent Material Modifier
Parent Material Complex
Parent Material Deposition 2
Parent Material Chemistry

```
Parent Material Textural Class
Texture Modifier
Family Particle Size
Physiographic
```

Soil Names Supplemental Information for Manitoba (ASCII): The columns of this file are listed in the following order:

```
Image Value
Soil Code
Province
Soil Name
Modifier
Land Use
Kind of Soil
Water Table
Soil layer that restricts root growth
Type of Root Restricting Layer
Soil Drainage class
Mode of Deposition 1
Mode of Deposition 2
Mode of Deposition 3
Soil Order
Soil Sub-Group
Soil Great Group
Profile
Date
Soil Layer File Availability
```

The following information describes the codes for the column values in the soil names files:

```
Soil Name
File Column     Description
------------    --------------------------
IMAGE VALUE     The value assigned to each pixel on the Soil Name layers.
                The soil name file for a province should be used only with
                the soil name layer for that province.  For example, the soil
                name file for Manitoba should not be used with a soil name
                layer for Saskatchewan.
SOIL_CODE       Three-character code for the soil name.
PROVINCE        BC       British Columbia
                AB       Alberta
                SK       Saskatchewan
                MB       Manitoba
                ON       Ontario
                QU       Quebec
                NF       Newfoundland
                NB       New Brunswick
                NS       Nova Scotia
                PE       Prince Edward Island
                YU       Yukon
                NW       North West Territories
SOILNAME        Assigned by correlator.
MODIFIER        Three-character code to show soil variations.  The modifier
```

	applies to the soil name and the soil code.	
LU	Land use:	
	N	Native conditions
	A	Agriculture
KIND	Kind of soil.	
	M	Mineral
	O	Organic
	N	Nonsoil
	U	Unclassified or incomplete
WATERTBL	Water table characteristics:	
	-	Not applicable
	NO	Not present at any time
	YU	Present during unspecified time
	YG	Present during growing season
	YN	Present during nongrowing season
	YB	Present during both seasons
ROOTRESTR	Soil layer that restricts root growth:	
	-	Not applicable
	0	Not present
	1-9	Restricting layer number (in SLF)
RESTR_TYPE	Type of root restricting layer:	
	-	Not applicable
	UN	Undifferentiated
	BN	Solonetzic B
	SA	EC>4dS/m
	CT	Compact (Basal) Till
	OR	Ortstein
	FP	Fragipan
	LI	Lithic
	CR	Cryic
	DU	Duric
	PL	Placic
DRAINAGE	Soil drainage class:	
	-	Not applicable
	VR	Very Rapidly
	R	Rapidly
	W	Well
	MW	Moderately Well
	I	Imperfectly
	P	Poorly
	VP	Very Poorly
MDEP	Mode of deposition (and MDEP1, MDEP2, MDEP3)	
	-	Not Applicable
	ANTH	Anthropogenic
	COLL	Colluvial
	EOLI	Eolian
	FLEO	Fluvioeolian
	FLLC	Fluviolacustrine
	FLUV	Fluvial
	FNPT	Fen Peat
	FOPT	Forest Peat
	GLFL	Glaciofluvial
	GLLC	Glaciolacustrine
	GLMA	Glaciomarine

	LACU	Lacustrine
	LATL	Lacustro-Till
	MARI	Marine
	RESD	Residual
	SAPR	Saprolite
	SEPT	Sedimentary Peat
	SPPT	Sphagnum Peat
	TILL	Till (Morainal)
	UNDM	Undifferentiated mineral
	UNDO	Undifferentiated organic
	VOLC	Volcanic
ORDER	Soil Order:	
	-	Not applicable
	BR	Brunisolic
	CH	Chernozemic
	CY	Cryosolic
	GL	Gleysolic
	LU	Luvisolic
	OR	Organic
	PZ	Podzolic
	RG	Regosolic
	SZ	Solonetzic
S_GROUP AND G_GROUP	Soil Subgroup and Great Group characters before the dot (.) go into the S_GROUP field; characters after the dot go into the G_GROUP field):	
	-.-	Not applicable
	A.SZ	Alkaline Solonetz
	B.SO	Brown Solod
	B.SS	Brown Solodized Solonetz
	B.SZ	Brown Solonetz
	BL.SO	Black Solod
	BL.SS	Black Solodized Solonetz
	BL.SZ	Black Solonetz
	BR.GBL	Brunisolic Gray Brown Luvisol
	BR.GL	Brunisolic Gray Luvisol
	BR.SC	Brunisolic Static Cryosol
	BR.TC	Brunisolic Turbic Cryosol
	CA.B	Calcareous Brown
	CA.BL	Calcareous Black
	CA.DB	Calcareous Dark Brown
	CA.DG	Calcareous Dark
	CU.F	Cumulo Fibrisol
	CU.H	Cumulo Humisol
	CU.HR	Cumulic Humic Regosol
	CU.M	Cumulo Mesisol
	CU.R	Cumulic Regosol
	D.GL	Dark Gray Luvisol
	DB.SO	Dark Brown Solod
	DB.SS	Dark Brown Solodized Solonetz
	DB.SZ	Dark Brown Solonetz
	DG.SO	Dark Gray Solod
	DG.SS	Dark Gray Solodized Solonetz
	DU.DYB	Duric Dystric Brunisol
	DU.FHP	Duric Ferro-Humic Podzol
	DU.HFP	Duric Humo-Ferric Podzol

DU.HP	Duric Humic Podzol
DU.SB	Duric Sombric Brunisol
E.B	Eluviated Brown
E.BL	Eluviated Black
E.DB	Eluviated Dark Brown
E.DYB	Eluviated Dystric Brunisol
E.EB	Eluviated Eutric Brunisol
E.LG	Fera Luvic Gleysol
E.MB	Eluviated Melanic Brunisol
E.SB	Eluviated Sombric Brunisol
FE.G	Fera Gleysol
FE.HG	Fera Humic Gleysol
FI.H	Fibric Humisol
FI.M	Fibric Mesisol
FI.OC	Fibric Organic Cryosol
FR.FHP	Fragic Ferro-Humic Podzol
FR.GL	Fragic Gray Luvisol
FR.HFP	Fragic Humo-Ferric Podzol
FR.HP	Fragic Humic Podzol
FR.LG	Fragic Luvic Gleysol
G.SO	Gray Solod
G.SS	Gray Solodized Solonetz
GC.OC	Glacic Organic Cryosol
GL.B	Gleyed Brown
GL.BL	Gleyed Black
GL.DB	Gleyed Dark Brown
GL.DG	Gleyed Dark Gray
GL.DYB	Gleyed Dystric Brunisol
GL.EB	Gleyed Eutric Brunisol
GL.FHP	Gleyed Ferro-Humic Podzol
GL.GBL	Gleyed Gray Brown Luvisol
GL.GL	Gleyed Gray Luvisol
GL.HFP	Gleyed Humo-Ferric Podzol
GL.HR	Gleyed Humic Regosol
GL.MB	Gleyed Melanic Brunisol
GL.R	Gleyed Regosol
GL.SB	Gleyed Sombric Brunisol
GL.SC	Gleysolic Static Cryosol
GL.TC	Gleysolic Turbic Cryosol
GLB.SO	Gleyed Brown Solod
GLB.SS	Gleyed Brown Solodized Solonetz
GLB.SZ	Gleyed Brown Solonetz
GLBL.SO	Gleyed Black Solod
GLBL.SS	Gleyed Black Solodized Solonetz
GLBL.SZ	Gleyed Black Solonetz
GLBR.GBL	Gleyed Brunisolic Gray Brown Luvisol
GLBR.GL	Gleyed Brunisolic Gray Luvisol
GLCA.B	Gleyed Calcareous Brown
GLCA.BL	Gleyed Calcareous Black
GLCA.DB	Gleyed Calcareous Dark Brown
GLCA.DG	Gleyed Calcareous Dark Gray
GLCU.HR	Gleyed Cumulic Humic Regosol
GLCU.R	Gleyed Cumulic Regosol
GLD.GL	Gleyed Dark Gray Luvisol

GLDB.SO	Gleyed Dark Brown Solod
GLDB.SS	Gleyed Dark Brown Solodized Solonetz
GLDB.SZ	Gleyed Dark Brown Solonetz
GLDG.SO	Gleyed Dark Gray Solod
GLDG.SS	Gleyed Dark Gray Solodized Solonetz
GLE.B	Gleyed Eluviated Brown
GLE.BL	Gleyed Eluviated Black
GLE.DB	Gleyed Eluviated Dark Brown
GLE.DYB	Gleyed Eluviated Dystric Brunisol
GLE.EB	Gleyed Eluviated Eutric Brunisol
GLE.MB	Gleyed Eluviated Melanic Brunisol
GLE.SB	Gleyed Eluviated Sombric Brunisol
GLFR.GL	Gleyed Fragic Gray Luvisol
GLG.SO	Gleyed Gray Solod
GLG.SS	Gleyed Gray Solodized Solonetz
GLOT.FHP	Gleyed Ortstein Ferro-Humic Podzol
GLOT.HFP	Gleyed Ortstein Humo-Ferric Podzol
GLPZ.GBL	Gleyed Podzolic Gray Brown Luvisol
GLPZ.GL	Gleyed Podzolic Gray Luvisol
GLR.B	Gleyed Rego Brown
GLR.BL	Gleyed Rego Black
GLR.DB	Gleyed Rego Dark Brown
GLR.DG	Gleyed Rego Dark Gray
GLSM.FHP	Gleyed Sombric Ferro-Humic Podzol
GLSM.HFP	Gleyed Sombric Humo-Ferric Podzol
GLSZ.B	Gleyed Solonetzic Brown
GLSZ.BL	Gleyed Solonetzic Black
GLSZ.DB	Gleyed Solonetzic Dark Brown
GLSZ.DG	Gleyed Solonetzic Dark Gray
GLSZ.GL	Gleyed Solonetzic Gray Luvisol
HE.FO	Hemic Folisol
HI.FO	Histic Folisol
HU.F	Humic Fibrisol
HU.FO	Humic Folisol
HU.LG	Humic Luvic Gleysol
HU.M	Humic Mesisol
HU.OC	Humic Organic Cryosol
HY.F	Hydric Fibrisol
HY.H	Hydric Humisol
HY.M	Hydric Mesisol
LI.FO	Lignic Folisol
LM.F	Limno Fibrisol
LM.H	Limno Humisol
LM.M	Limno Mesisol
LU.FHP	Luvisolic Ferro-Humic Podzol
LU.HFP	Luvisolic Humo-Ferric Podzol
ME.F	Mesic Fibrisol
ME.H	Mesic Humisol
ME.OC	Mesic Organic Cryosol
O.B	Orthic Brown
O.BL	Orthic Black
O.DB	Orthic Dark Brown
O.DG	Orthic Dark Gray
O.DYB	Orthic Dystric Brunisol

O.EB	Orthic Eutric Brunisol
O.FHP	Orthic Ferro-Humic Podzol
O.G	Orthic Gleysol
O.GBL	Orthic Gray Brown Luvisol
O.GL	Orthic Gray Luvisol
O.HFP	Orthic Humo-Ferric Podzol
O.HG	Orthic Humic Gleysol
O.HP	Orthic Humic Podzol
O.HR	Orthic Humic Regosol
O.LG	Orthic Luvic Gleysol
O.MB	Orthic Melanic Brunisolic
O.R	Orthic Regosol
O.SB	Orthic Sombric Brunisol
O.SC	Orthic Static Cryosol
O.TC	Orthic Turbic Cryosol
OT.FHP	Ortstein Ferro-Humic Podzol
OT.HFP	Ortstein Humo-Ferric Podzol
OT.HP	Ortstein Humic Podzol
P.FHP	Placic Ferro-Humic Podzol
P.HFP	Placic Humo-Ferric Podzol
P.HP	Placic Humic Podzol
PZ.GBL	Podzolic Gray Brown Luvisol
PZ.GL	Podzolic Gray Luvisol
R.B	Rego Brown
R.BL	Rego Black
R.DB	Rego Dark Brown
R.DG	Rego Dark Gray
R.G	Rego Gleysol
R.HG	Rego Humic Gleysol
R.SC	Regosolic Static Cryosol
R.TC	Rego Turbic Cryosol
SM.FHP	Sombric Ferro-Humic Podzol
SM.HFP	Sombric Humo-Ferric Podzol
SZ.B	Solonetzic Brown
SZ.BL	Solonetzic Black
SZ.DB	Solonetzic Dark Brown
SZ.DG	Solonetzic Dark Gray
SZ.G	Solonetzic Gleysol
SZ.GL	Solonetzic Gray Luvisol
SZ.HG	Solonetzic Humic Gleysol
SZ.LG	Solonetzic Luvic Gleysol
T.F	Terric Fibrisol
T.H	Terric Humisol
T.M	Terric Mesisol
TFI.H	Terric Fibric Humisol
TFI.M	Terric Fibric Mesisol
TFI.OC	Terric Fibric Organic Cryosol
THU.F	Terric Humic Fibrisol
THU.M	Terric Humic Mesisol
THU.OC	Terric Humic Organic Cryosol
TME.F	Terric Mesic Fibrisol
TME.H	Terric Mesic Humisol
TME.OC	Terric Mesic Organic Cryosol
TY.F	Typic Fibrisol

	TY.H		Typic Humisol
	TY.M		Typic Mesisol
PROFILE	Header from Detail II File, may be blank or '-'.		
DATE	YY.MM.DD Date of last revision for each record in the file.		
A-THICK	The thickness of the A-horizon:		
	L20	-	less than 20 cm
	G20	-	greater than 20 cm
	NA	-	not applicable
SOL-THICK	(cm)		
	-9	-	not applicable
SOL-CHEM	The general chemistry of the soil:		
	AN	-	medium acid to neutral
	EA	-	extremely acid
	EC	-	extremely calcareous
	WC	-	weakly calcareous
	UD	-	undifferentiated
	VC	-	very calcareous
	SA	-	saline
	NA	-	not applicable
PM-MODIFY	SHAL	-	shale
	CRET	-	cretaceous
	TERT	-	tertiary
	STON	-	stony contact
	LIME	-	limestone
	TECR	-	tertiary-cretaceous
	NA	-	not applicable
PM-COMPLEX	COM	-	complex
	NA	-	not applicable
PMDEP2	--	-	not applicable
	ANTH	-	anthropogenic
	COLL	-	colluvial
	EOLI	-	eolian
	FLEO	-	fluvioeolian
	FLLC	-	fluviolacustrine
	FLUV	-	fluvial
	FNPT	-	fen peat
	FOPT	-	forest peat
	GLFL	-	glaciofluvial
	GLLC	-	glaciolacustrine
	GLMA	-	glaciomarine
	LACU	-	lacustrine
	LATL	-	lacustro-till
	MARI	-	marine
	RESD	-	residual
	SAPR	-	saprolite
	SEPT	-	sedimentary peat
	SPPT	-	sphagnum peat
	TILL	-	till (morainal)
	UNDM	-	undifferentiated mineral
	UNDO	-	undifferentiated organic
	VOLC	-	volcanic
PM-CHEM	UD	-	undifferentiated
	EA	-	extremely acid
	AN	-	medium acid to neutral

	WC	-	weakly calcareous
	VC	-	very calcareous
	EC	-	extremely calcareous
	SA	-	saline
	NA	-	not applicable
PMTEXCLASS	VCS	-	very coarse sand
	CS	-	coarse sand
	LCS	-	loamy coarse sand
	S	-	sand
	FS	-	fine sand
	LS	-	loamy sand
	LFS	-	loamy fine sand
	VFS	-	very fine sand
	LVFS	-	loamy very fine sand
	CSL	-	coarse sandy loam
	SL	-	sandy loam
	FSL	-	fine sandy loam
	VFSL	-	very fine sandy loam
	L	-	loam
	SIL	-	silt loam
	SCL	-	sandy clay loam
	SICL	-	silty clay loam
	CL	-	clay loam
	C	-	clay
	HC	-	heavy clay
	O	-	organic
	F	-	fibric
	M	-	mesic
	H	-	humic
	NA	-	not applicable
TEXMODIFY	GR	-	gravelly
	VG	-	very gravelly
	WY	-	woody
	NA	-	not applicable
FAMPARTS12	UD	-	undifferentiated
	FR	-	fragmental
	SK	-	skeletal
	SY	-	sandy
	CL	-	coarse loamy
	FL	-	fine loamy
	LY	-	loamy
	CY	-	clayey
	SM	-	stratified mineral
	SU	-	stratified mineral and organic
	SO	-	stratified organic
	OG	-	organic
	WY	-	woody
	FI	-	fibric
	ME	-	mesic
	HU	-	humic
	RU	-	bedrock undifferentiated
	RA	-	bedrock acid
	RB	-	bedrock basic
	RS	-	bedrock soft

```
                NA          -    not applicable
PHYSIOG         PHY         -    physiographic
                NA          -    not applicable
```

7.3.3 Unit of Measurement

- Provincial Code - Unitless but coded value.
- Polygon Number - Unitless but coded value.
- Surface material - Unitless but coded value.
- Percentage distribution of dominant and subdominant soil landscapes - Percent.
- Regional landform - Unitless but coded value.
- Local surface form - Unitless but coded value.
- Slope gradient class - Unitless but coded value.
- Soil parent material mode of deposition (or origin) - Unitless but coded value.
- Parent material texture - Unitless but coded value.
- Soil development - Unitless but coded value.
- Surface texture of mineral soil to 15 cm - Unitless but coded value.
- Coarse fragment content of mineral soils - Unitless but coded value.
- Rooting depth, unrestricted - Unitless but coded value.
- Kind of compacted, consolidated, or contrasting layer - None.
- Depth to compacted, consolidated, or contrasting layer - None.
- Drainage class - Unitless but coded value.
- Available water capacity in upper 120 cm - Unitless but coded value.
- Average depth to water table - Unitless but coded value.
- Ice type - Unitless but coded value.
- Ice content - Unitless but coded value.
- Permafrost occurrence - Unitless but coded value.
- Active layer depth in soils with permafrost - centimeters.
- Kind of patterned ground in soils with permafrost - Unitless but coded value.
- pH of upper 15 cm of soil measured in $CaCl_2$ - Tenths of pH units. Divide by 10.
- pH of upper 15 cm of soil measured in water - Tenths of pH units. Divide by 10.
- Organic carbon of upper 15 cm of soil - Percent.
- Nitrogen content of upper 15 cm of soil - Unitless but coded value.
- Thickness of humus layer (L, F, H) - Unitless but coded value.
- Calcareous class of parent material - Unitless but coded value.
- Inclusions 1 - Unitless but coded value.
- Inclusions 2 - Unitless but coded value.
- Vegetative cover or land use, or both - Unitless but coded value.
- Lake size estimated from Landsat imagery - Unitless but coded value.
- Reliability class of polygon - Unitless but coded value.
- Complexity class of polygon - Unitless but coded value.
- Soil name 1 - Unitless but coded value.
- Soil name 2 - Unitless but coded value.
- Parent material textural group - Unitless but coded value.
- Soil Names Supplemental Information for Saskatchewan - See the end of Section 7.3.2 for descriptions of the columns in the file.
- Soil Names Supplemental Information for Manitoba - See the end of Section 7.3.2 for descriptions of the columns in the file.

7.3.4 Data Source

The original vector data set was produced by Agriculture Canada and was acquired from:

CanSIS Project Leader
Land Resource Research Centre
Research Branch, Agriculture Canada

Central Experiment Farm
K.W. Neatby Building
Ottawa, Ontario K1A 0C6

7.3.5 Data Range

The various data layers have different data ranges. Some of the potential values are listed under the variable descriptions provided in Section 7.3.2.

7.4 Sample Data Record

Not applicable for raster data files.

8. Data Organization

8.1 Data Granularity

The smallest amount of obtainable data is the entire data set containing all of the raster layers and their supporting files.

8.2 Data Format(s)

8.2.1 Uncompressed Data Files

The regional soils product contains 83 total files, of which some contain ASCII information and others contain binary numbers. The first file is a descriptive ASCII header file that describes the content of the other files. The next three binary files (files 2 to 4) contain information about the data for the respective provinces. Files 5 to 43 (39 files) contain binary values for the dominant soil landscape features. The last 39 files (files 44 to 81) contain binary values for the subdominant soil landscape features. Files 82 and 83 contain the soil name files for Saskatchewan and Manitoba, respectively.

Separate binary files exist for each of the various parameters and contain a mixture of 8-bit and 16-bit values. The bytes in the 16-bit (2-byte) values are ordered as low-order byte first. The following two blocks of information describe the various files and give needed size and storage information.

File	Description
File 1	ASCII header file with file descriptions
File 2	Provincial Code
File 3	Polygon Number for Saskatchewan data
File 4	Polygon Number for Manitoba data
File 5	Surface material for dominant soil landscape
File 6	Percentage distribution of dominant soil landscape
File 7	Regional landform for dominant soil landscape
File 8	Local surface form for dominant soil landscape
File 9	Slope gradient class for dominant soil landscape
File 10	Soil parent material mode of deposition for dominant soil landscape
File 11	Parent material texture for dominant soil landscape
File 12	Soil development for dominant soil landscape
File 13	Surface texture of soil for dominant soil landscape
File 14	Coarse fragment content for dominant soil landscape
File 15	Rooting depth for dominant soil landscape
File 16	Kind of compacted, consolidated, or contrasting layer for dominant soil landscape
File 17	Depth to compacted, consolidated, or contrasting layer for dominant soil landscape
File 18	Drainage class for dominant soil landscape
File 19	Available water capacity for dominant soil landscape

File 20 Average depth to water table for dominant soil landscape
File 21 Ice type for dominant soil landscape
File 22 Ice content for dominant soil landscape
File 23 Permafrost occurrence for dominant soil landscape
File 24 Active layer depth for dominant soil landscape
File 25 Kind of patterned ground for dominant soil landscape
File 26 pH of upper 15 cm measured with $CaCl_2$ for dominant soil landscape
File 27 pH of upper 15 cm measured with water for dominant soil landscape
File 28 Organic carbon content of upper 15 cm for dominant soil landscape
File 29 Nitrogen content of upper 15 cm for dominant soil landscape
File 30 Thickness of humus layer for dominant soil landscape
File 31 Calcareous class of parent material for dominant soil landscape
File 32 Inclusions 1 for dominant soil landscape
File 33 Inclusions 2 for dominant soil landscape
File 34 Vegetative cover or land use for dominant soil landscape
File 35 Lake size estimate from Landsat images for dominant soil landscape
File 36 Percent of area covered by water bodies for dominant soil landscape
File 37 Reliability class for dominant soil landscape
File 38 Complexity class for dominant soil landscape
File 39 Soil name numbers for first dominant soil landscape in Saskatchewan
File 40 Soil name numbers for first dominant soil landscape in Manitoba
File 41 Soil name numbers for second dominant soil landscape in Saskatchewan
File 42 Soil name numbers for second dominant soil landscape in Manitoba
File 43 Parent material texture group for dominant soil landscape
File 44 Surface material for subdominant soil landscape
File 45 Percentage distribution of subdominant soil landscape
File 46 Regional landform for subdominant soil landscape
File 47 Local surface form for subdominant soil landscape
File 48 Slope gradient class for subdominant soil landscape
File 49 Soil parent material mode of deposition for subdominant soil landscape
File 50 Parent material texture for subdominant soil landscape
File 51 Soil development for subdominant soil landscape
File 52 Surface texture of soil for subdominant soil landscape
File 53 Coarse fragment content for subdominant soil landscape
File 54 Rooting depth for subdominant soil landscape
File 55 Kind of compacted, consolidated, or contrasting layer for subdominant soil landscape
File 56 Depth to compacted, consolidated, or contrasting layer for subdominant soil landscape
File 57 Drainage class for subdominant soil landscape
File 58 Available water capacity for subdominant soil landscape
File 59 Average depth to water table for subdominant soil landscape
File 60 Ice type for subdominant soil landscape
File 61 Ice content for subdominant soil landscape
File 62 Permafrost occurrence for subdominant soil landscape
File 63 Active layer depth for subdominant soil landscape
File 64 Kind of patterned ground for subdominant soil landscape
File 65 pH of upper 15 cm measured with $CaCl_2$ for subdominant soil landscape
File 66 pH of upper 15 cm measured with water for subdominant soil landscape
File 67 Organic carbon content of upper 15 cm for subdominant soil landscape
File 68 Nitrogen content of upper 15 cm for subdominant soil landscape
File 69 Thickness of humus layer for subdominant soil landscape
File 70 Calcareous class of parent material for subdominant soil landscape

File 71 Inclusions 1 for subdominant soil landscape
File 72 Inclusions 2 for subdominant soil landscape
File 73 Vegetative cover or land use for subdominant soil landscape
File 74 Lake size estimate from Landsat images for subdominant soil landscape
File 75 Percent of area covered by water bodies for subdominant soil landscape
File 76 Reliability class for subdominant soil landscape
File 77 Complexity class for subdominant soil landscape
File 78 Soil name numbers for first subdominant soil landscape in Saskatchewan
File 79 Soil name numbers for first subdominant soil landscape in Manitoba
File 80 Soil name numbers for second subdominant soil landscape in Saskatchewan
File 81 Soil name numbers for second subdominant soil landscape in Manitoba
File 82 ASCII Soil Names Supplemental Information for Saskatchewan
File 83 ASCII Soil Names Supplemental Information for Manitoba

File Number	Original Attribute Name	Record size (bytes)	Number of pixels	Number of lines	Bytes per pixel
1	Header File	80	N/A	N/A	N/A
2	PROVINCE	1000	1000	1000	1
3	POLYNUM (SK)	2000	1000	1000	2
4	POLYNUM (MN)	2000	1000	1000	2
5	DOMKDMAT	1000	1000	1000	1
6	DOMDISTR	1000	1000	1000	1
7	DOMREGFM	1000	1000	1000	1
8	DOMLOCSF	1000	1000	1000	1
9	DOMSLOPE	1000	1000	1000	1
10	DOMPMDEP	1000	1000	1000	1
11	DOMPMTEX	1000	1000	1000	1
12	DOMDEVEL	1000	1000	1000	1
13	DOMSRFTX	1000	1000	1000	1
14	DOMCFRAG	1000	1000	1000	1
15	DOMROOT	1000	1000	1000	1
16	DOMCMPLR	1000	1000	1000	1
17	DOMCMPDP	1000	1000	1000	1
18	DOMDRAIN	1000	1000	1000	1
19	DOMAVWAT	1000	1000	1000	1
20	DOMWATAB	1000	1000	1000	1
21	DOMICETY	1000	1000	1000	1
22	DOMICECT	1000	1000	1000	1
23	DOMPERMA	1000	1000	1000	1
24	DOMACTLR	1000	1000	1000	1
25	DOMPATGD	1000	1000	1000	1
26	DOMPHCAL	1000	1000	1000	1
27	DOMPHWAT	1000	1000	1000	1
28	DOMORGAN	1000	1000	1000	1
29	DOMNITRO	1000	1000	1000	1
30	DOMHUMLR	1000	1000	1000	1
31	DOMCALCA	1000	1000	1000	1
32	DINCLUS1	1000	1000	1000	1
33	DINCLUS2	1000	1000	1000	1

34	DOMVEGET	1000	1000	1000	1
35	DOMLAKE	1000	1000	1000	1
36	DOMWATBD	1000	1000	1000	1
37	DOMRELIA	1000	1000	1000	1
38	DOMCOMPL	1000	1000	1000	1
39	DOMNAME1 (SK)	2000	1000	1000	2
40	DOMNAME1 (MN)	2000	1000	1000	2
41	DOMNAME2 (SK)	2000	1000	1000	2
42	DOMNAME2 (MN)	2000	1000	1000	2
43	DOMTEXGP	1000	1000	1000	1
44	SUBKDMAT	1000	1000	1000	1
45	SUBDISTR	1000	1000	1000	1
46	SUBREGFM	1000	1000	1000	1
47	SUBLOCSF	1000	1000	1000	1
48	SUBSLOPE	1000	1000	1000	1
49	SUBPMDEP	1000	1000	1000	1
50	SUBPMTEX	1000	1000	1000	1
51	SUBDEVEL	1000	1000	1000	1
52	SUBSRFTX	1000	1000	1000	1
53	SUBCFRAG	1000	1000	1000	1
54	SUBROOT	1000	1000	1000	1
55	SUBCMPLR	1000	1000	1000	1
56	SUBCMPDP	1000	1000	1000	1
57	SUBDRAIN	1000	1000	1000	1
58	SUBAVWAT	1000	1000	1000	1
59	SUBWATAB	1000	1000	1000	1
60	SUBICETY	1000	1000	1000	1
61	SUBICECT	1000	1000	1000	1
62	SUBPERMA	1000	1000	1000	1
63	SUBACTLR	1000	1000	1000	1
64	SUBPATGD	1000	1000	1000	1
65	SUBPHCAL	1000	1000	1000	1
66	SUBPHWAT	1000	1000	1000	1
67	SUBORGAN	1000	1000	1000	1
68	SUBNITRO	1000	1000	1000	1
69	SUBHUMLR	1000	1000	1000	1
70	SUBCALCA	1000	1000	1000	1
71	SINCLUS1	1000	1000	1000	1
72	SINCLUS2	1000	1000	1000	1
73	SUBVEGET	1000	1000	1000	1
74	SUBLAKE	1000	1000	1000	1
75	SUBWATBD	1000	1000	1000	1
76	SUBRELIA	1000	1000	1000	1
77	SUBCOMPL	1000	1000	1000	1
78	SUBNAME1 (SK)	2000	1000	1000	2
79	SUBNAME1 (MN)	2000	1000	1000	2
80	SUBNAME2 (SK)	2000	1000	1000	2
81	SUBNAME2 (MN)	2000	1000	1000	2
82	Sask Soil Names	150	N/A	N/A	N/A
83	Mani Soil Names	110	N/A	N/A	N/A

8.2.2 Compressed CD-ROM Files

On the BOREAS CD-ROMs, files 1, 82, and 83 listed above are stored as ASCII text files; however, files 2 through 81 have been compressed with the Gzip compression program (file name *.gz). These data have been compressed using gzip version 1.2.4 and the high compression (-9) option (Copyright (C) 1992-1993 Jean-loup Gailly). Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP programs. The compressed files may be uncompressed using gzip (-d option) or gunzip. Gzip is available from many Web sites (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

9. Data Manipulations

9.1 Formulae

None.

9.1.1 Derivation Techniques and Algorithms

None.

9.2 Data Processing Sequence

9.2.1 Processing Steps

BORIS staff gridded each attribute for the provinces of Saskatchewan and Manitoba and combined the layers for these two provinces into one layer for each attribute, except for the polygon number and soil name layers.

BORIS staff processed the regional soils data by following these steps for each attribute:

- Reproject the vector data for the provinces of Saskatchewan and Manitoba to the BOREAS grid projection.
- Rasterize the vector files.
- Combine the Saskatchewan and Manitoba layers to produce one gridded layer.
- Write the gridded layer to tape.
- Copy the ASCII and compress the binary files for release on CD-ROM.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None.

9.3.2 Calculated Variables

None.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

Potential sources of error in the original data set include interpretation or digitizing error as well as coding and keying errors in the attributes. There is also the possibility that the data could have been gridded incorrectly, although visual inspection of the data was done to prevent this.

10.2 Quality Assessment

10.2.1 Data Validation by Source

Each gridded file/layer was spot checked to make sure that the gridding procedure assigned a digital number (DN) to each attribute value.

10.2.2 Confidence Level/Accuracy Judgment

The accuracy of the gridding procedure is high, although some consideration should be given to the scale of the data and what will be inferred from it in order to understand the accuracy of the original data.

The source in Canada from whom these data were received has strong caveats about the use of the data. These data are constantly being updated as new data are collected and become available. These data represent broad generalizations about the soil characteristics of this area. Caution should be used when inferring information from these data.

10.2.3 Measurement Error for Parameters

Unknown.

10.2.4 Additional Quality Assessments

Unknown.

10.2.5 Data Verification by Data Center

As noted previously, BORIS personnel reviewed the data layers visually as vector plots and raster data layers. Direct quantitative checking of the data was not performed.

11. Notes

11.1 Limitations of the Data

The original data were received in two parts: Saskatchewan and Manitoba. The gridded data represent a merging of these two data sets. Unfortunately, many of the attributes along the border have different values. Therefore, a sharp discontinuity exists along the border in many of the files caused by different interpretations by those who created the maps for the different provinces. CanSIS has plans to resolve these problem areas along the provincial boundaries.

11.2 Known Problems with the Data

The discontinuity of polygons along the provincial boundary can be a potential problem for some users. See Section 11.1 for more information on this problem.

11.3 Usage Guidance

Before uncompressing the Gzip files on CD-ROM, be sure that you have enough disk space to hold the uncompressed data files. Then use the appropriate decompression program provided on the CD-ROM for your specific system.

11.4 Other Relevant Information

None.

12. Application of the Data Set

The documentation for the original data listed the following uses for which these data were intended:

- Assess the productivity of the land nationally or over large regions.
- Find areas that have actual or potential problems affecting land use, such as salinity or susceptibility to erosion, and assess the severity.
- Locate general areas that may be suitable for particular types of land use, which can be selected for more detailed investigations.
- Apply general research findings and agrotechnology procedures that are successful in one part of the country to other areas that have similar attributes.
- Link soil and land information with other data bases, such as information on climate, economics, or census, for assessing land use on a regional, national, or even an international scale.
- Educate geography students at colleges or universities.

13. Future Modifications and Plans

CanSIS has plans to resolve the problem areas along the provincial boundaries.

14. Software

14.1 Software Description

BORIS staff used the ARC/INFO (Version 7) software and related tools to process the original vector data to this raster form. The ARC/INFO software is a proprietary package developed and distributed by:

Environmental Systems Research Institute, Inc. (ESRI)
380 New York St.
Redlands, CA 92373-8100

Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP commands.

14.2 Software Access

ARC/INFO is a commercial package; contact ESRI for details. Gzip is available from many Web sites across the Internet (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

15. Data Access

The BOREAS regional soils data in raster format and AEAC projection are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

These data can be made available on 8-mm, Digital Archive Tape (DAT), or 9-track tapes at 1600 or 6250 Bytes Per Inch (BPI).

16.2 Film Products

None available from BORIS; see Section 11.4, Other Relevant Information.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

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17.2 Journal Articles and Study Reports

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Padbury, G.A. and J.A. Shields. 1991. Soil Landscapes of Canada-Saskatchewan Soil Landscapes Polygon Attribute Digital Data. CanSIS No. SK018200, Version 90.11.30; CLBRR Archive, Agriculture Canada, Research Branch, Ottawa, Canada (CLBRR Contribution No. 91-108D).

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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

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AEAC    - Albers Equal-Area Conic
ASCII   - American Standard Code for Information Interchange
BOREAS  - BOReal Ecosystem-Atmosphere Study
BORIS   - BOREAS Information System
BPI     - Bytes Per Inch
CanSIS  - Canadian Soil Information System
CCRS    - Canadian Centre for Remote Sensing
CCT     - Computer Compatible Tape
CD-ROM  - Compact Disk-Read-Only Memory
DAAC    - Distributed Active Archive Center
DAT     - Digital Archive Tape
DN      - Digital Number
EOS     - Earth Observing System
EOSDIS  - EOS Data and Information System
ESRI    - Environmental Systems Research Institute, Inc.
GIS     - Geographic Information System
GSFC    - Goddard Space Flight Center
LRRC    - Land Resource Research Branch
MSS     - Multispectral Scanner
NAD83   - North American Datum of 1983
NASA    - National Aeronautics and Space Administration
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NSA     - Northern Study Area
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
SSA     - Southern Study Area
TM      - Thematic Mapper
URL     - Uniform Resource Locator
UTM     - Universal Transverse Mercator
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This data set was gridded by BORIS Staff from a vector data set received from the Canadian Soil Information System (CanSIS). The original data came in two parts that covered Saskatchewan and Manitoba. The data were gridded and merged into one data set of 84 files covering the BOREAS region. The data were gridded into the AEAC projection. Because the mapping of the two provinces was done separately in the original vector data, there may be discontinuities in some of the soil layers because of different interpretations of certain soil properties. The data are stored in binary, image format files.

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