Canada - Alberta Environmentally Sustainable Agriculture Agreement (CAESA)

Soil Inventory Project Procedures Manual

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PREFACE

The Canada - Alberta Environmentally Sustainable Agriculture (CAESA) Soil Inventory Project (SIP) was a cooperative project involving the Alberta Research Council; Alberta Agriculture Food and Rural Development; Agriculture Canada - Alberta Land Resources Unit, Centre for Land and Biological Resources Research; and private industry consulting firms. Funding for the project was provided through the CAESA agreement and by the three previously mentioned Federal and Provincial agencies.

The primary purpose of the project was to generate a 1:100 000 digital soils database for the agricultural portion of the province.

This manual was initially intended for the compilation teams conducting the CAESA Soil Inventory Project - Alberta (1993 to 1998). It was a Procedures Manual that provided instructions and methodology to personnel involved in the project. The manual has been updated and revised to accompany the digital soils information compiled during the CAESA project. The manual describes the procedures used and the attribute data captured during the project.

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1.0 INTRODUCTION

The objective of the project was to compile the soil landscapes of the White Area (Figure 1.1) of Alberta at a presentation scale of 1:100 000, linked to a digital database of soil information.

The CAESA Technical Steering Committee consisting of representatives of the three contributing agencies, one from Olds College and one from PFRA oversaw the Soil Inventory Project. The Technical Steering Committee provided a terms of reference for the project and defined the overall project goals as:

1. To produce a standardized digital database of soils information for the agricultural portion of Alberta (White Area) through review and recompilation of all relevant soils and ancillary data.

2. To develop a methodology for producing standardized descriptions of Soil Landscape Models and to apply the models uniformly and consistently across the entire White Area.

3. To ensure that the digital soils data was registered to the 1:20 000 provincial digital base.

This document represents one of the steps toward realizing the goals set by the Technical Steering Committee. Since the main objective of the project was to produce a standardized soil information database for the entire White Area of Alberta (Figure 1.1), there was a clear set of specifications for the content of the soil information database and of the procedures by which this information was compiled.

1.1 Introduction to this Manual

This manual describes the procedures used for soil mapping and attribute coding for the CAESA project. It also provides users of the database some background information on the mapping systems used during the compilation of the soils database. This manual served two main functions. The primary function was to control the inventory process through the use of standard mapping procedures and attribute codes. The secondary function was to provide an understanding of the inventory approach and process, and of information produced by the CAESA Soil Inventory Project.

1.2 Introduction to the Soil Inventory Approach Being Used

A soil inventory usually involves description, sampling and classification of the soils of an area; and the production of a soil map. Soil inventory methods and philosophies have changed considerably over the 75 years that soil surveys have been conducted in Alberta. A number of key references describing soil inventory concepts and procedures are listed in Appendix A.

Several studies were completed prior to the initiation of the CAESA Soil Inventory Project. The objectives of these studies were to evaluate and compare alternative methods of soil mapping in terms of map accuracy, cartometrics, time requirements and cost (Nikiforuk, MacMillan and Fawcett 1993; Fawcett, Nikiforuk, McNeil and MacMillan 1993; Nikiforuk and Howitt 1993). These studies provided necessary background information for the CAESA SI project.

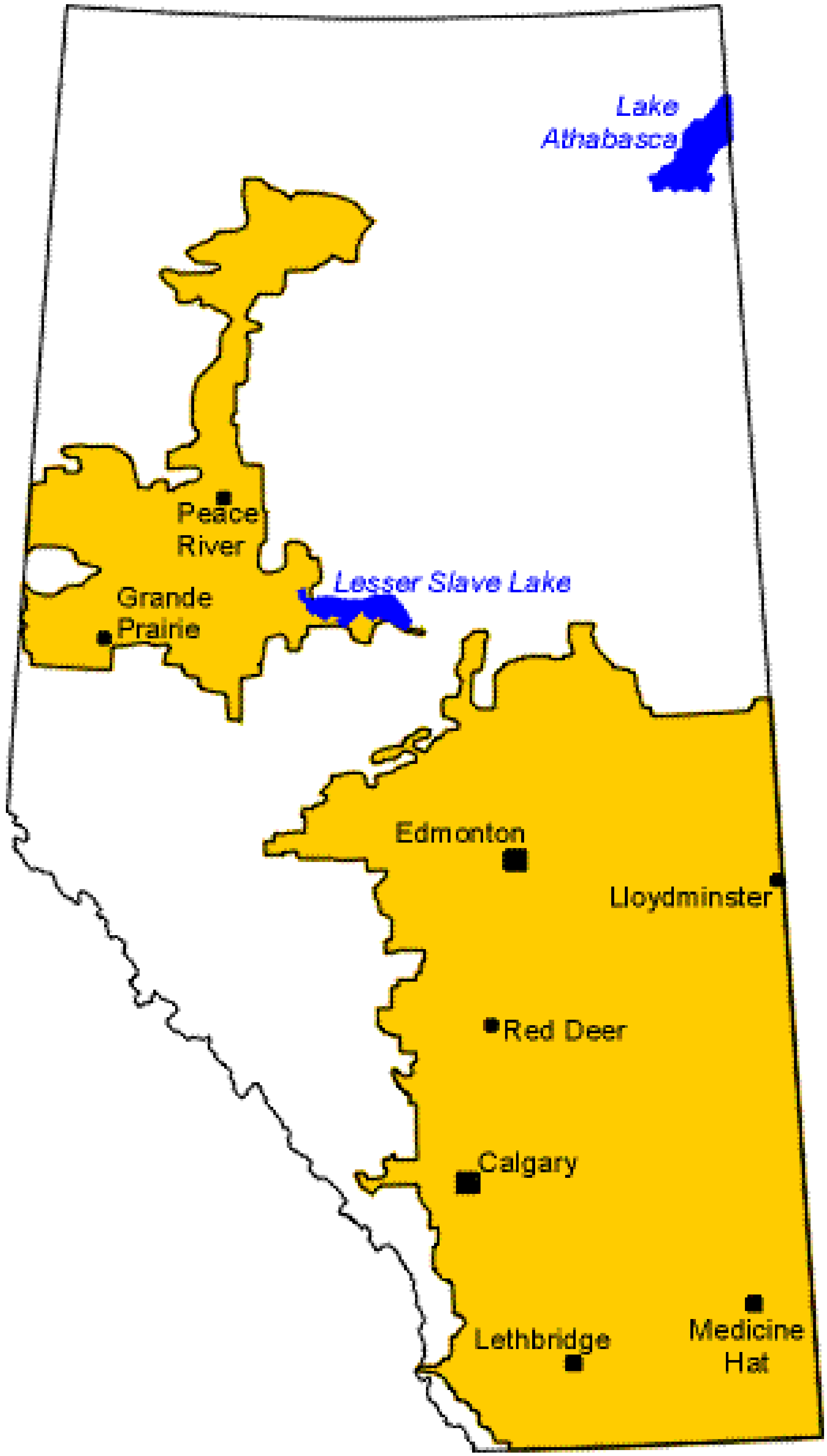

Figure 1.1 White Area (agricultural portion) of Alberta.

Soil inventories are done at several levels of detail (inventory scale), ranging from general overviews of large areas to very detailed inventories of small areas (Figure 1.2). The framework of ecological land stratification at several levels of detail is described in Section 2.1. This manual focuses on two levels of soil inventory:

- Land Systems (1:250 000 scale)
- Soil Landscapes (1:100 000 scale)

The approach described in this manual is a defined, documented and standardized approach that inventory personnel could duplicate.

The CAESA Soil Inventory Project retained many traditional concepts and procedures. Some of the differences addressed the specific information needs of potential users. The differences from traditional Alberta Soil Survey procedures and information products included:

- the products are digital;

- the user can request or produce maps with customized (user-defined) labels and map legend information;

- there are two levels of inventory - Land System inventory (1:250 000 scale), and Soil Landscapes inventory (1:100 000 scale); and

- several soil and land attributes were collected. The digital environment allowed the soil inventory analyst to attach a list of attribute codes to areas thereby permitting customized output products.

Some of the key traditions that were retained include:

- the established practice of using the soil series names as a key to a list of soil attributes. In fact, the correlation and definition of series names were improved during the project, and

- the established concept of Soil Landscape Models (called Soil Map Units in earlier reports) used by soil inventory analysts as one of the attributes of a Soil Landscape. This attribute can be used to generate a label on a soil map product (user's option) or it can be used in tabular reports.

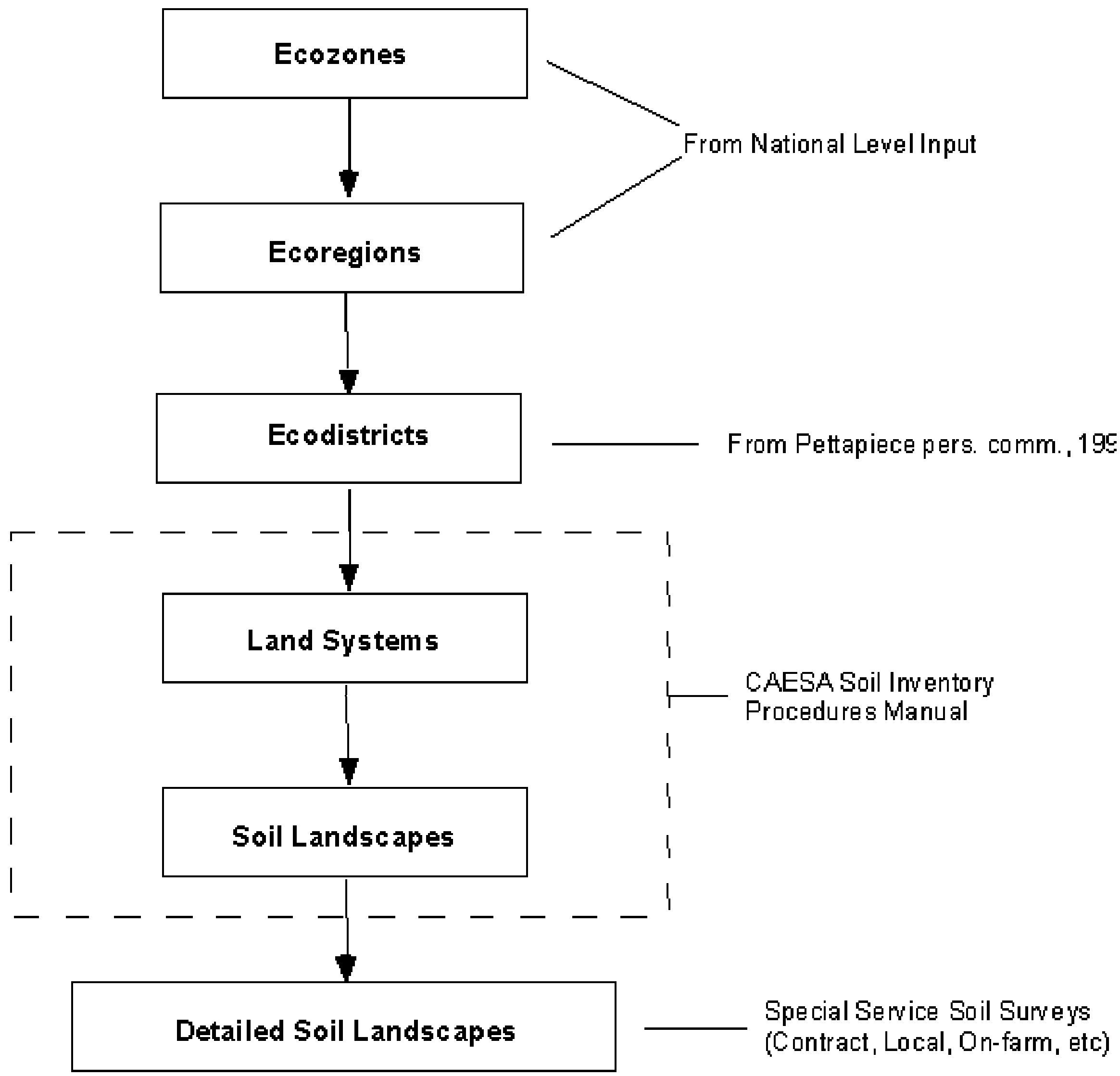

Figure 1.2 The hierarchical system of land stratification.

2.0 THE SOIL INVENTORY PROCESS

The soil inventory process can be generalized into three broad functions:

1. Compiling existing resource information or developing new resource information;
2. Mapping and coding the soil and land attributes; and
3. Developing information products (reports and maps).

The process is often iterative, and different functions may be done concurrently. The process is also hierarchical, that is, large tracts of land are subdivided into smaller pieces at each scale of inventory (Figure 1.2).

2.1 Ecological Stratification of Alberta

The CAESA Soil Inventory Project adopted principles of ecological land classification as a basis for soil inventory. Hierarchical subdivision of the earth's surface into areas of similar biological and physical characteristics is the basis for ecological stratification. Ecological units combine the characteristics of climate, physiography, soils, and vegetation into single cartographic areas (Strong and Anderson 1980). Uniformity and specificity of the area descriptions is scale dependent (larger the scale, more detail).

Ecological land classification is a hierarchical system. There are various identified levels of generalization, which comprise the classification system. The terminology used to describe the different hierarchical levels has changed with time. The different terms used to describe the similar levels of generalization within the system are illustrated (Table 2.1). Even though different names were used for labeling the different hierarchical levels, the general concepts have remained constant. The highlighted terms in Table 2.1 are the proposed standard terminology of the Ecological Land Classification System (Ecological Stratification Working Group 1995). The terminology and associated descriptions were based on the Ecoregions Map of Canada developed by the Environment Canada, State of the Environment Reporting (SOER) and Agriculture Canada, Center of Land and Biological Resources Research (CLBRR) Ecological Stratification Working Group (1995).

Soil analysts used an ecological hierarchy as an integral component in the preparation of the soil landscape database. The initial step involved the subdivision of the study area using the national ecological land classification framework. The first steps of the top down mapping approach were based on nationally correlated ecological maps to the Land Resource Area level of generalization. This framework provided a context for subsequent stratification of Land Systems and Soil Landscapes for this project.

2.1.1 Ecozone

The ecozone is an area of the earth's surface, representative of large and very generalized ecological units characterized by interactive and adjusting abiotic and biotic factors (Wiken 1986). Generally ecozones are depicted at scales <1:10M and have delineations generally ranging from 15M-150M hectares. A combination of physiographic provinces (Bostock 1964) and ecoclimatic provinces (Ecoregions Working Group 1989) define the ecozones. Five ecozones were recognized within Alberta (Wiken 1986), namely:

- Prairie (Plains)
- Boreal Plains
- Taiga Plains (restricted to outliers)
- Taiga Shield

- Montane Cordilleran

A typical description of an Ecozone is: "The Prairie Ecoprovince (Ecozone) is characterized by a severe mid to late summer drought caused by low precipitation and high evapotranspiration. It is dominated by herbaceous vegetation capable of withstanding a drought, and Chernozemic soils" (p.10 Strong and Anderson 1980).

2.1.2 Ecoregion

An ecoregion is part of an ecozone characterized by distinctive ecological responses to climate as expressed by the development of vegetation, soil, water, fauna, etc. (Wiken 1986). Ecoregions are depicted at scales of 1:1M - 1:7.5M. Within the Canadian context, delineations range from 1.5M-12M hectares. Ecoregion maps for Alberta (Figure 2.1) are depicted at scales ranging from 1:1M - 1:5M.

There are 17 ecoregions recognized in Alberta (Ecological Stratification Working Group 1995). These regions were defined on the basis of ecoclimatic regions (Ecoregions Working Group 1989), physiographic subdivisions (Bostock 1964) and ecoregions and ecodistricts (Strong 1992). For provincial scale representation, the 17 ecoregions were further subdivided into 46 sub-regions based on detailed climatic, physiographic and soil development data.

An example of a sub-ecoregion is the Cooking Lake moraine, east of Edmonton. This area was too small to depict on the national scale ecoregion map. However, on the provincial scale it is recognized as a Low Boreal sub-region within the Grassland transition / Alberta Plain ecoregion.

2.1.3 Ecodistrict (LRA)

An ecodistrict is defined as part of an ecoregion characterized by distinctive assemblages of relief, geology, landforms, soils, vegetation, water and fauna (Wiken 1986). In Alberta, the Ecological Working Group (Ecological Stratification Working Group 1995) subdivided the 17 Ecoregions (and the 46 sub-regions) into 136 Ecodistricts, with a minimum size of approximately 10 townships (93,000 ha). Ecodistricts are depicted at a map scale of 1:1M - 1:2M. Within the national context, delineations generally range from 100 000 - 500 000 hectares.

The Ecodistrict map (Section 4, Figure 4.1) represents a revision and an extension of the earlier Agroecological Resource Areas (ARA) map that only covered the White Area of the province. The Ecodistrict map recognizes ecological units across the province. Also, national ecoregion and provincial Soil Correlation Area concepts were incorporated in the delineation of ecodistrict units.

Ecodistricts are described in terms of climate, predominant soils to Great Group level, predominant texture of the materials and predominant landform. These attributes are identical to those used previously to describe ARAs (Pettapiece 1989). For example, the description for the Cooking Lake ecodistrict includes: the Low Boreal sub-ecoregion of the Grassland transition / Alberta Plain ecoregion; 3H climate; Gray Luvisolic and Dark Gray soils; loam to clay loam materials and hummocky landforms.

In order for the ecodistrict map to be as useful as possible, the ecodistrict units must be easily identifiable and reflect land use. Regional climate (as generally expressed by vegetation) is used as the first consideration for delineation of ecodistricts. Climate is usually difficult to delineate but changes in climate nearly always coincide with major physiographic breaks. Consequently, more stable and identifiable physical features are used whenever possible to define map delineations. Delineations at the ecodistrict level with minor adjustments to the ecoregion boundaries reflect local material, landforms and soils.

Boundary decisions are also aided by considerations of minimum size and land use. For example, sandy parent material in the Wainwright area was seen to have more significance for agriculture than the definition of the Dark Brown - Black soil zone boundary. Consequently, the ecodistrict boundary was adjusted to reflect the sandy soils.

In Alberta, the Ecoregion and Land Resource Area maps define the higher level strata for the present CAESA Soil Inventory Project (SIP). The CAESA SIP mandate was to compile information on the next two layers of the hierarchy, namely Land Systems (1:250 000) and Soil Landscapes (1:100 000). Application of this soil mapping approach, based on hierarchical ecological concepts assisted in the development of consistent and standardized provincial soil map products.

Table 2.1 Correlation of ecological terms used in Canada since 1969.

Lacate (1969)	Strong (1980)	Wiken (1986)	Kocaoglu (1990)	SOER/CLBRR Ecological Working Group (1993)
	Ecoprovince	Ecozone Ecoprovince		**Ecozone**
Land Region 1:1-3M	Ecoregion 1:1-3M	Ecoregion 1:1-3M	Region 1:3M or greater Section 1:1-3M	**Ecoregion** 1:7.5M National
Land District 1:500K-1M	Ecodistrict	Ecodistrict	District 1:500K-1M	**Ecodistrict** Land Resource Area 1:1M-1:2M
Land System 1:125-250K	Ecosection	Ecosection	Geomorphic System 1:50-250K	**Land System** 1:250K-1M
	Ecosite		Geomorphic Unit	

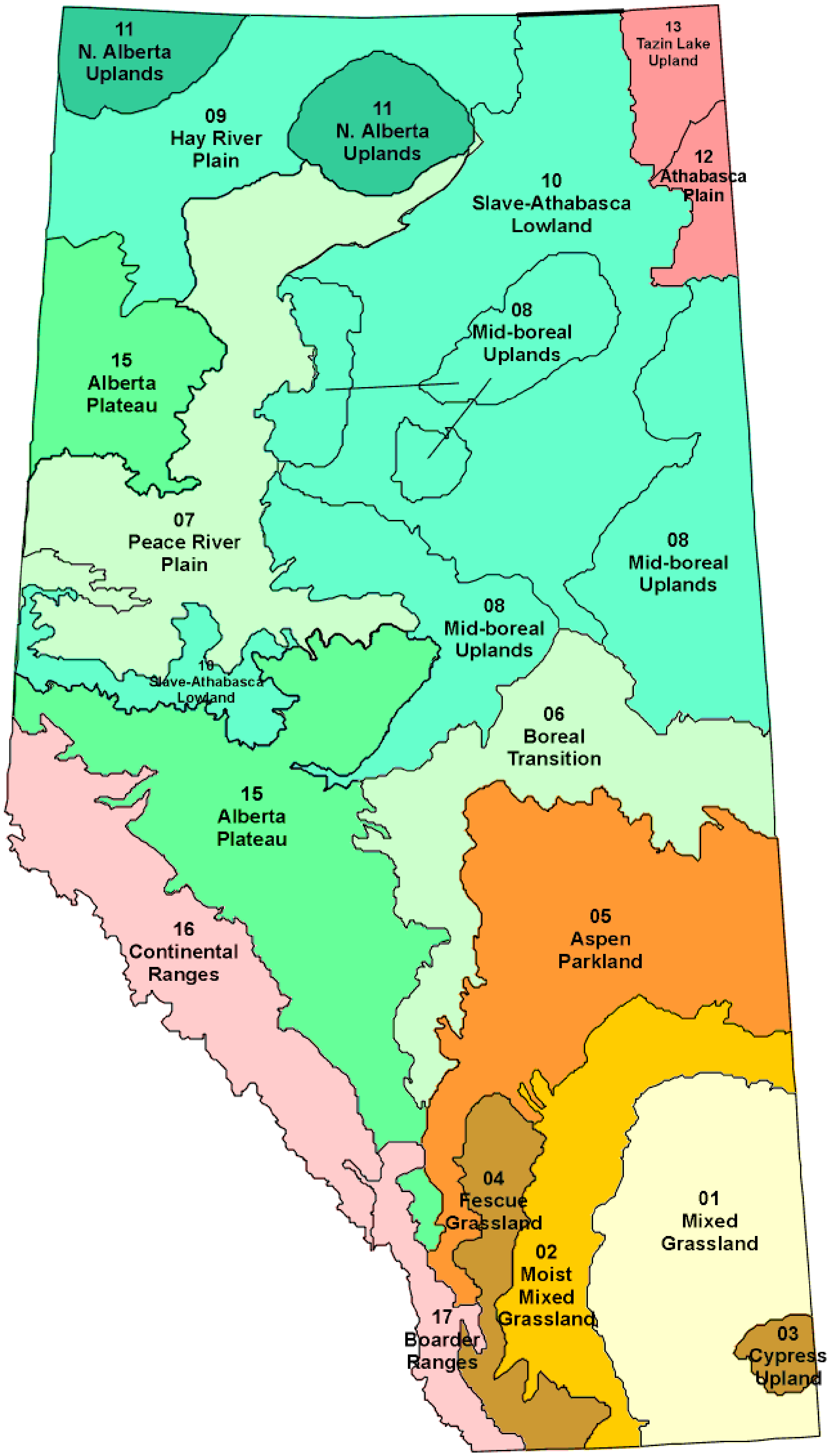

Figure 2.1 Ecoregion Map of Alberta (Pettapiece pers. comm. 1993).

2.2 Land System Inventory

A Land System is a subdivision of an ecodistrict and is a real segment of the earth's surface. Land Systems within an ecodistrict can be recognized and separated by differences in one or more of: general pattern of land surface form, surficial geological materials, amount of lakes or wetlands, or general soil pattern. All Land Systems within one ecodistrict have the same general climate for agriculture but differences in microclimate patterns can be recognized. An average-sized Land System is approximately three to four townships (32,000 hectares); the minimum sized Land System is approximately 1 township (9325 hectares) (Figure 2.2).

Some previous soil survey projects have described similar entities variously called Land Units (Pettapiece 1971; Kocaoglu 1975), Soil Groups (MacMillan 1987) and more recently, Land Systems (MacMillan, Nikiforuk and Rodvang 1988; Brierley, Andriashek and Nikiforuk 1993). Most other soil survey reports presented information on the regional distribution of the various attributes used to define Land Systems (landform, physiography, geology, climate, vegetation, generalized soils), but did not collate this information to delineate and describe Land Systems.

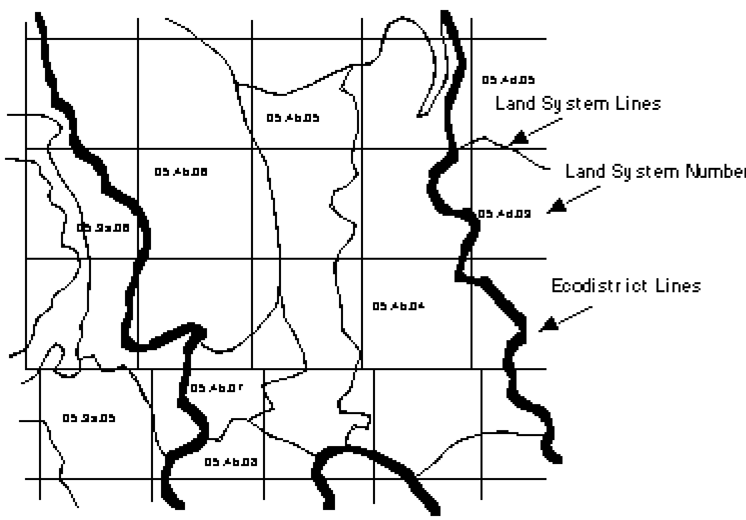

Figure 2.2 Sample block of 16 townships at 1:250 000 scale illustrating typical size of Land Systems.

2.2.1 Reasons For Doing 1:250 000 Land System Inventory

The reasons for conducting Land System Inventory included:

- It is a useful and necessary step in the process of soil inventory by a top-down mapping approach.
- Land Systems are used for municipal - level soil and water conservation planning and program delivery. Many users (researchers, agriculture fieldmen, assessors, range ecologists) stated that Land Systems are important.
- The Land Systems Inventory will be used by Agriculture Canada as a basis to modify the general Soil Landscapes of Canada - Alberta map (Agriculture Canada 1988).

2.2.2 Land System Inventory Process

The recognition and delineation of Land Systems was based on integration and interpretation of a variety of data sources. Type, texture and surface form of geological deposits were used as primary criteria in subdividing ecodistricts into Land Systems. The preferred source documents to guide this subdivision were the maps of Quaternary Geology of Southern and Central Alberta (Shetsen 1987, 1990). These were supplemented with aerial or satellite imagery, local maps of surficial geology, and existing soil maps.

Subdivision of ecodistricts into Land Systems was also influenced by differences in bedrock geology, hydrogeology and surface drainage pattern. The relative hardness or softness of underlying bedrock often affects the development of drainage systems and is reflected in the degree of integration or disruption of drainage and the depth of incision of streams or rivers. The primary source document (used to guide the subdivision of map areas according to bedrock geology) was the Geological Map of Alberta (Green 1972). Large scale topographic maps provided additional guidance, especially if bedrock geology was reflected by patterns of topography or drainage.

Natural vegetation or imposed land use, as revealed on photos and satellite imagery, provided useful clues to such attributes as depth to bedrock, degree of salinity, wetness and depth to water table. Major differences in natural vegetation or imposed land use were used to guide the subdivision of ecodistricts into Land Systems. These differences were revealed by examination of aerial photos and satellite imagery.

The process of locating Land System boundaries requires understanding of what a boundary condition might be. The list of recognized Land System boundary conditions is as follows:

- An ecodistrict boundary, which may in turn be:
    - an ecoregion boundary
    - an "inferred agro-climate change boundary" based on elevation, or cropping pattern, or other evidence
    - a bedrock-type boundary
    - a change in regional surface form (e.g. from hilly upland to plain)
    - a change in regional surficial geology (e.g. from moraine to dune field)
    - a change in the density/size of lakes and wetlands
    - a change in regional soil assemblages
    - and, within ecodistricts

- A change in regional surface forms (usually a change in pattern of forms) such as hummocky versus ridged.

- A change in regional surficial geology (usually a change in the assemblage of materials) e.g. glaciofluvial to eolian.

- A change in density or size of lakes and wetlands or a Land System may be a lake or a large wetland.

- A change in regional Soil Models *(*for example a change in dominance of Solonetzic or Gleysolic or Luvisolic).

The recommended procedure for placing Land System boundaries (i.e. mapping) and for coding attributes is described in the Land System Inventory Process and in Section 4.1 (Land System data capture). This procedure involves two groups of functions:

1. Recognizing and checking the ecodistrict boundaries, and
2. Subdividing the ecodistrict into Land Systems.

Soil analysts were encouraged to use the following steps for delineating Land Systems:

1. **Obtain base maps at 1:250 000 scale.** These maps included:
   - township grid and hydrography (derived from the 1:20 000 provincial base) on mylar
   - contours (from the 1:20 000 provincial base) on paper or mylar
   - outline of block on mylar.

2. **Gather information.** The information included resource maps, reports, point data. Scales were adjusted as required for overlays.

3. **Obtain the conversion database of soil names for the area.**

4. **Obtain existing Land Systems maps** (from existing soil survey reports or conservation plans) for the area and incorporate the information.

5. **Overlay LRA lines on satellite imagery.** Reconcile to SCA lines if necessary and move the lines if necessary at the 1:250 000 scale. Reconcile ecodistrict lines to agricultural land use (usually forage vs. annuals).

6. **Obtain bedrock boundaries** from Green (1972) and place on an overlay of satellite imagery, contours and hydrography.

7. **Identify surficial geology patterns** from Shetsen (1987; 1990) and place on overlay of satellite imagery, contours and hydrography.

8. **Identify regional soil patterns from soil maps** (changes in soil zones or materials, Chernozemic vs. Solonetzic, Chernozemic vs. Luvisolic, large wetland areas) and reconcile to surficial geology, bedrock geology and land use patterns if possible.

9. **Identify surface form patterns** from Shetsen (1987; 1990), soil maps and contours (1:50 000 contours reduced to 1:250 000 work better than 1:250 000 contours) and reconcile to 3, 4, 5 & 6 (above).

10. **Confirm agroclimate characteristics, changes and classification across the area.** Data sources to check are ecodistricts, SCAs - soil zones, Land Capability for Arable Agriculture in Alberta climate map and cropping patterns.

11. **Produce Land Systems** (by a combination of subdivision or aggregation of areas) with recurring combinations of agricultural land use, bedrock type, surficial geology, regional soils, surface form, and agroclimate. The mean size of a land system is 3 to 5 townships; minimum size is approximately one township.

12. **Code the attributes** as defined by the Land System data form (Appendix A).

13. **Edge-match to adjacent blocks.**

2.3 Soil Landscape Inventory

A Soil Landscape is a segment of the earth's surface with specific geographic location and extent. It is a subdivision of a Land System. Soil Landscapes within a Land System were recognized and separated by differences in one or more of: land surface form; surficial geological material(s); soil patterns (including amount of lakes, wetlands and wet soils). An average sized Soil Landscape is approximately 500 - 1000 hectares (2 to 4 sections); minimum size is 65 hectares (1/4 section).

Soil Landscapes are areas of land that display a consistent and recognizable pattern of distribution of soils and landscape elements. Most historical and recent soil mapping in Alberta focused on describing and delineating Soil Landscapes. The CAESA Soil Inventory Project benefits from and uses existing maps in which Soil Landscapes have been delineated at various scales (1:30 000 to 1:190 000). Soil analysts had two primary activities in the project. The first was to use existing maps and data to apply a uniform and consistent set of Landscape models to the entire White Area. The second was to capture and record basic soils evidence, so that an automated set of rules could be run to generate a Soil Landscape Model symbol for each delineated polygon.

2.3.1 Soil Landscape Inventory Process

A 9 stage process was used for soil map compilation.

Stage 1 - Background Data

- The Digital Data Processor (DDP) provided the soil analyst a hard copy of the ATS (Alberta Township Survey) township grid and the 1:20K contours and hydrography for a Working Area. The Working Area (WA) was on average 3 ranges wide by 2 townships high (working areas varied in size).

- In addition the analyst obtained additional background information. The information included:
  Base information plotted on acetate (1:20 000 contour lines and hydrography)
  ATS grid for working areas (1 copy plotted on acetate)
  - Preliminary Land System maps and descriptions for the area
  - Existing soil maps (scaled to 1:100 000)
  - Point data (pipeline reports, irrigation land classification, environmentally significant areas reports, public land reports, Alberta Soil Survey Township Plans, rural assessment sheets)
  - Surficial and bedrock geology maps and reports
  - Topography maps (1:50 000, 1:20 000)
  - Aerial photographs
  - Satellite imagery (1:250 000)
  - Soil names file (SNF)
  - Soil layer file (SLF)
  - Soil series descriptions

Stage 2 - Working Draft Maps and Data

- The analyst compiled the soils information for each Working Area, reviewed the information with the Block Leader and delivered soil lines (hand drawn, hard copy) and attribute data (digital copy) to the DDP. Analysts were encouraged to use the following process for soil map compilation:

1. **Review Land System attributes**. Identify attributes of Land Systems that were relevant to the soil landscape mapping being conducted. The Land Systems map that the analyst used was a draft copy. Some concepts, lines and numbers were in the Land Systems map changed during the course of Soil Landscape mapping.

2. **Review Soil Landscapes mapped in adjacent townships** to identify edge matching requirements.

3. **Compile soil lines.** Soil map compilation varied depending upon the scale of the existing information. For 1:50 000 maps, the process for delineating soil landscapes was to generalize existing lines. The analyst traced lines from the 1:50 000 maps and combined polygons that were smaller than minimum size (65 ha) with larger polygons. For 1:126 000 maps, the process for delineating soil landscapes was to either use existing lines as is or the analyst revised lines based upon photo interpretation of landscapes. If the analyst desired, he or she consulted other data sources to modify soil lines and increase the reliability of the soil mapping. For 1:190 000 maps, the process for delineating soil landscapes was to use aerial photography and other sources of information to derive a new set of polygons compiled at 1:100 000 scale. The analyst used existing 1:190 000 soil maps as background information only.

4. **Code Soil Landscape attributes for each delineation.** Coding of soil landscape attributes occurred as the soil polygons were compiled. Analysts recorded the evidence known about the polygon. Analysts did not provide interpretive information. The attributes that were required to be coded included:
   - Polygon identification (meridian, range, township and polygon number)
   - Land system number
   - Date compiled and analyst name
   - Soil model attributes
   - Wetness
   - Order, Great Group, Sub-Group, Soil Series (one of these)
   - Parent material
   - Extent
   - Landscape model (or surface form, relief and slope)
   - Salt affected
   - Old soil map label
   - Sources and source ID
   - Confidence level
   - Field check required

5. **Field check Soil Landscape boundaries and attributes.** The level of effort was adjusted to account for availability and quality of resource information. The level of effort varied depending upon the scale of existing mapping. There was no field checking of 1:50 000 soil maps. The rates of field checking for areas compiled using 1:126 000 soil maps was limited to 1/4 day per township. The rates of field checking for areas compiled using 1:190 000 soil maps was limited to 1/2 day per township. These rates were guidelines for field checking. Analysts were recommended to visit specific problem areas within mapping blocks and not necessarily visit every township.

6. **Correlate.** The analyst and the block leader reviewed the working area to ensure that the attributes required for each polygon were entered and that the guidelines for soil mapping listed in Section 2.3.4 were met.

7. **Revise coded attributes.** As necessary upon completion of Step 3.

Stage 3 - First Draft Hard Copy and Data

- The DDP entered the data compiled for each Working Area (the process as defined in section 3.1 of this manual).

- After entering the data, the DDP ran queries on the polygons to find errors, anomalies and omissions. The DDP provided the analyst back 4 hard copy maps; a soil map with generated map symbols plotted; a plot showing polygons that were smaller than minimum size; a plot highlighting polygons that were missing basic evidence; and a plot of the soil lines highlighting lines that separated areas with identical map symbols. The DDP also provided the analyst the attribute data (digital copy) for additions or deletion of polygons.

Stage 4 - Second Draft Hard Copy and Data

- The analyst made the required corrections and returned the corrected digital file (attributes) and corrected hard copy map (lines) to the DDP. The analyst corrected only those polygons that were identified as having problems in Stage 3.

- The analyst provided a list of the polygons that were changed in the database to the DDP. These were the only polygons that the DDP updated in the database. Failure to provide this list meant that the changes were not incorporated into the final database.

Stage 5 - Second Draft of Digital Data

- The DDP made the necessary corrections to the soil lines in each Working Area.

- The DDP joined the working areas into a Correlation Block (CB) (an area about 20 to 36 twp)

- The DDP forwarded the digital files (lines and attribute data) for a completed Correlation Block to the Block Leader.

Stage 6 - Correlation using ArcView

Block Leaders were responsible for ensuring continuity of lines and concepts between the working areas (see section 2.5, for a detailed description of the Block Leader roles and responsibilities).

- The Block Leader reviewed the soil maps and attributes for a Correlation Block (using ArcView) and made changes to the soil maps. The changes to soil lines were forwarded to the DDP for update.

- The Block Leader made changes to the attribute data in FoxPro and forwarded the changes for the Correlation Block (on disk) to the DDP.

- The Block Leader entered additional soil polygons using FoxPro.

Stage 7 - Interim Final product

- The DDP made the required changes to the soil lines and attribute data. The required changes included all edge matching of lines between Working Areas and Correlation Blocks.

- The Project Leader then delivered the completed Correlation Block to the Technical Authority.

Stage 8 - Agriculture and Agri-Food Canada Review

- Areas were reviewed by the Agriculture and Agri-Food Canada correlators on an SCA by SCA basis. Changes to the data were forwarded to the Project Leader for incorporation into the final database.

Stage 9 - Incorporation of the correlation changes

- Changes suggested by the Agriculture and Agri-Food Canada correlators were incorporated into the final database by the Project Leader.

2.3.2 Soil Landscape Models

The Soil Landscape Model is a conceptual entity that presents a summary of the principal characteristics of several areas of land that are more or less similar. The Soil Landscape Model describes a repeating pattern of soils and landscapes that can be identified on aerial photographs and in the field by an experienced soil mapper. Soil Landscape Models:

- Permit a soil mapper to describe a particular combination of soils and landscapes and apply that description to areas having similar combinations of soils and landscapes

- Help the mapper summarize concepts about where and how soils are distributed in the landscape. This information is important to some users of the information.

- Provide the Block Leader a useful correlation tool and help in maintaining consistency between analysts.

- Provide some users a convenient basis for interpreting combinations of soils and landscapes.

- A Soil Landscape Model may be thought of as an amalgamation of two models as illustrated in Figure 2.4. The basic building blocks are the Soil Model and the Landscape Model. The Soil Model is a composite of the dominant, co-dominant and significant soil series. The Landscape Model is a composite of the morphology, genesis, relief, slope class and surface form modifier attributes.

2.3.3 Defining a Soil Landscape Model

The following rules apply to the definition of a Soil Landscape Model:

1. The landscape model that most accurately describes a landscape, was selected from Table 4.11 (Section 4.0). If no existing Landscape models accurately described an area, a new Landscape model was defined based on the characteristics of the area in question. The newly defined (described) model required approval of the correlation team before it was added to the data

dictionary. The Landscape model consists of morphology, genesis, modifier, relief and slope modifiers. Slope class gradients that most accurately describe the dominant slope class in the landscape were identified.

2. The dominant soil or soils that occur within the landscape of interest were identified by series name. The primary considerations were parent material texture and dominant soil classification.

3. A Soil Model number identified the minor (significant) soils that occurred within the landscape of interest. The primary intent was to recognize the presence of significant (≥ 10 and <30%) soils.

4. An automated set of rules was applied to the evidence collected to generate the Soil Landscape Model.

2.3.4 Guidelines for Soil Landscape Mapping

The following guidelines were used for the delineation of soil landscapes:

1. The Soil Landscape map should average 10 to 20 delineations per township (excluding water bodies) (approximately 500 - 1000 ha per delineation).

2. Minimum sized soil delineations (65 ha) met at least one of the strongly contrasting criteria, that is:

   - The surface form is sufficiently contrasting that the landscape model changes

   - The parent material is sufficiently contrasting that there is a change of at least one texture group, with the classes being: 1) Very Coarse, 2) Moderately Coarse, 3) Medium, 4) Fine and Very Fine, and 5) Organic.

   - The soils are sufficiently contrasting that there is a change in the dominant or codominant soil used as basic evidence. This usually means a change in Soil Order (Chernozemic to Solonetzic or Luvisolic to Gleysolic, etc.).

   - Delineated stream channels and valleys should be more than 300 m wide, and 6 km long (i.e. polygons should be at least 3 mm wide and 6 cm long at 1:100 000 scale).

   - Water bodies (> 65 ha) were captured and automatically drawn from the base map hydrography. That is, the soil analyst was not required to trace the water body boundary. Rather the analysts tied their lines to the lake boundary. The analyst also entered the basic evidence for the water body.

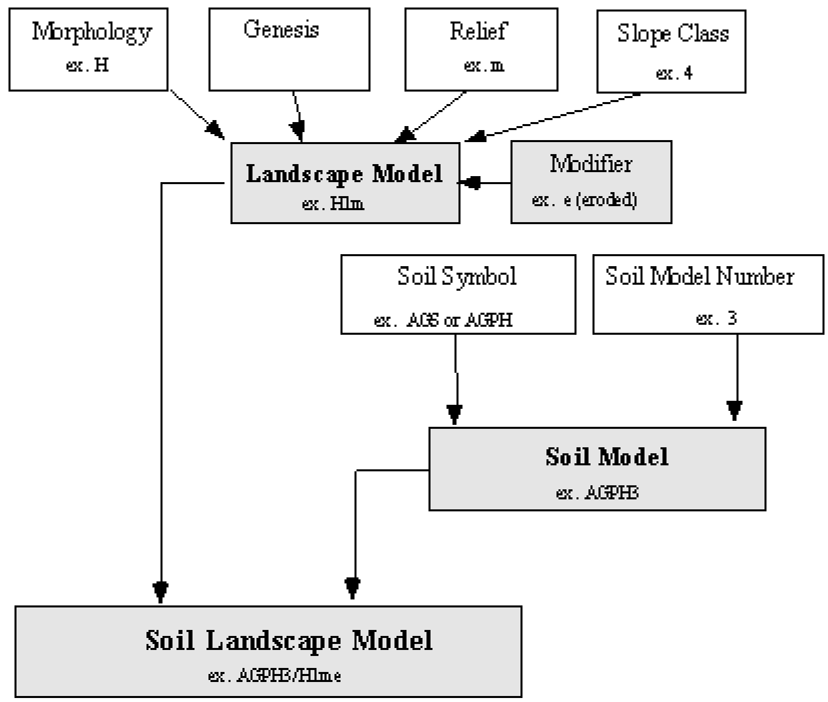

Figure 2.3 Components of a Soil Landscape Model.

2.3.5 Guidelines for Soil Landscape Map Coding

The following guidelines were used for the coding of the attributes of soil landscapes:

- The analyst entered the basic evidence for a polygon.
- The analyst had the option of importing evidence from an existing polygon.
- If an analyst was working in an SCA transition zone, the analyst chose the SCA which best described the polygon.
- The order of coding basic evidence was important because the order that soils were coded was used to generate the Soil Model.

2.3.6 Conventions for Creating Symbols for Soil Landscape Models

The following guidelines were based upon recognizing proportions of soils and associated modifiers as basic evidence for each polygon. The Landscape Model symbol obtained from Table 4.11, was added to the Soil Model symbol as an open legend factor. The combination of these 2 model symbols resulted in the formation of the Soil Landscape Model. The soil analyst was responsible only for the collection of the basic soil and landscape evidence used for delineation of polygons. The soil landscape data was entered into the data entry screens. The soil model was generated automatically based upon rules that are documented in Section 2.3.9. Some analysts used the rules to help in the derivation of soil model concepts. However it was not necessary for analysts to know the rules to record basic soil evidence.

The following guidelines outline the rules used for creating Landscape Model symbols (including surface form model modifiers) and Soil Model symbols.

I. Landscape Model Symbol
The Landscape Model consists of the Slope Gradient (1 or 2 digit numeric symbol), Surface Form (alpha + 1 digit numeric symbol), and Surface Form Modifier (1 or 2 letter alpha symbol).

- **Slope Gradient Symbol**
  The slope gradient symbol reflects classes as defined in the Canadian System of Soil Classification (Agriculture Canada Expert Committee on Soil Survey 1987a).

- **Surface Form Symbol**
  Existing conventions used for describing surface forms for soil mapping in Alberta or elsewhere in Canada were not used for this project. A unique set of surface form classes was defined for the project. Surface forms recognized during data compilation are described and documented (Table 4.11). The surface form models reflected as closely as possible the main kinds of surface expression recognized on the Surficial Geology maps of central and southern Alberta (Shetsen 1987; 1990).

- **Surface Form Model Modifiers**
  These modifiers were intended to describe unique features of a surface form model. In the past some of these descriptors were actually simple surface forms and were deemed crucial for interpretation purposes. They were included as modifiers since no surface form descriptor was included within the final soil map symbol denominator of the recent survey products.

II. Soil Model Symbol
The Soil Model Symbol consists of the Dominant or Co-dominant soil(s) (3 or 4 letter alpha symbol) and the Significant soils (1 or 2 digit number). The dominant or co-dominant soil symbol consists of the alpha codes used to represent one or two soil series. The alpha codes used to form the symbol help identify:

- Parent Materials.
  - Dominantly homogeneous textured parent materials (for example till, lacustrine, etc.) or;
  - Complex of parent materials, for example till and lacustrine veneer/till or moderately coarse and very coarse fluvial

- Classification Concepts.
  - The soil type representative of the area; for example Brown Chernozemics or Solonetz in a particular SCA.
  - Transitional concepts; for example Black / Dark Brown Chernozemics or Dark Gray / Gray Luvisols

2.3.7 Rules for Creating the Soil Symbol

Dominant and Co-dominant soils
The Soil Model symbol was kept as simple as possible. For example, an area of Orthic Blacks on till was not differentiated from an area of Orthic and Eluviated Blacks on till. The Soil Model symbol was assigned based on a single soil name (3 letter code obtained from the Soil Names File). In polygons where recognition of two co-dominant soils occurred, a 4 letter symbol based on the first two letters of each of the codes for the two co-dominant soils was used. The generated soil symbol reflected the order of coding

of the co-dominant soils.

Significant Soils

Numbers were used in conjunction with the 3 or 4 letter Soil model symbol to describe a recognizable pattern of significant soils which is characteristic of the soil landscape. These numbers allowed the mapper to describe a variety of types of soils of lesser extent which are associated with the dominant or co-dominant soils recognized by the 3 or 4 letter Soil Model symbol. These associated soils may or may not have been named (as part of the basic soil evidence) or may have been too numerous to recognize individually. These types of soils are present in proportions varying from ≥ 10 and < 30%. The list of unique soil model numbers was used to identify specific patterns of significant soils (Section 2.3.9, Table 2.2).

2.3.8 Rules for Compilation of Polygon Data

The following rules were used to generate Soil Models. The generation of Soil Models was done automatically. The soil analysts' responsibility was to ensure that the basic evidence used for delineation of soil polygons was entered correctly. The soil analyst was required to use the following soil proportions for entering basic evidence:

1. Dominant soils ≥ 60%
2. Co-Dominant soils ≥ 30% and < 60%
3. Significant soils ≥ 10% and < 30%

The following were allowable combinations of soil proportions:

1. One dominant soil; up to five significant soils (ranked order of occurrence whenever possible).
2. Two co-dominant soils; up to four significant soils (ranked order of occurrence whenever possible).
3. Three co-dominant soils (ranked order of occurrence); one significant soil

2.3.9 Rules for Soil Model Number Generation

A program was written that used basic evidence collected by analysts to generate the soil landscape model symbol. The program is documented and is available from Agriculture and Agri-Food Canada or Alberta Agriculture Food and Rural Development. The soil model number was determined by the soils found in significant proportions (or in some cases the third co-dominant soil). The following rules were used in the generation of the soil model number.

Table 2.2 Rules for Soil Model generation.

Unit	Description
1	No Significant soils are identified as basic evidence
2	When a <u>significant</u> (C3 or S*) soil has the following: ORDER = ORGA or GLEY (from GEN2 - SNF) or; SERIES = ZGW (from GEN2 - SNF) or; Basic Evidence (Wetness) = P or AP (Procedures Manual) (NOTE: Salinity takes precedence over drainage. Therefore if a soil is poorly drained but has a saline (SA) subgroup modifier (from SNF) then it becomes a '3' unit). If D, C1 or C2 soils have drainage = P or AP then ignore the rule
3	When a <u>significant</u> (C3 or S*) soil has the following: MOD or VARIANT = SA (from GEN2 - SNF) or; SERIES = ZNA (from GEN2 - SNF)
4	When a <u>significant</u> (C3 or S*) soil has the following: 1. If landscape modifier = E then ignore this rule 2. ORDER = REGO (from GEN2 - SNF) or; SUB-GR = R.* (from GEN2 - SNF) and Order [1] Gleysol or; VARIANT = ZR, CR, ER (from GEN2 - SNF)or; SERIES = ZER (from GEN2 - SNF) 3. When Dom (D, C1 or C2) soil has SUB-GR = R.* then these rules do not apply

Table 2.2 (continued)

5	When a significant (C3 or S*) soil has the following: SERIES = ZFI (from GEN2 - SNF) or; 1. All Dom (D) or Co-Dom (C1, C2) soils have Parent Material = C* and any Sig or C3 soils have Parent Materials = M* or F* or L3, L8, L10, L14, L15, L16 2. Dom or Co-Dom (C1, C2) soils have Parent Material = M* and Sig or C3 soils have Parent Materials = F* , L14, L15, L16 If D, C1 or C2 soils has parent material = F* then ignore the rule
6	When a significant (C3 or S*) soil has the following: SERIES = ZCO (from GEN2 - SNF) 1. When all Dom or Co-Dom (C1, C2) soils have Parent Material = F* Sig (S* or C3) soils have Parent Materials = M0, M1, M2, M6 or C* or L1, L2, L3, L4, L5, L7, L8, L9, L10, L17, L18, L19 2. When all Dom or Co-Dom (C1 or C2) soils have Parent Material = M* Sig (S* or C3) soils have Parent Materials = C* or L1, L2, L4, L5, L7, L9, L17, L18, L19 3. When Dom or Co-Dom (C1 or C2) soils have Parent Material = M*, F*, C2, C3, C4, C5, C6 Sig (S* or C3) soils have Parent Materials = C1, L1, L19
7	When a significant (C3 or S*) soil has the following: ORDER = SOLO (from GEN2 - SNF) SERIES = ZSZ (from GEN2 - SNF) If any Dom ORDER = SOLO then ignore
8	When a significant (C3 or S*) soils meet the criteria of: 2 and 4 units
9	When a significant (C3 or S*) soils meet the criteria of: 2 and 6 units
10	When a significant (C3 or S*) soils meet the criteria of: 2 and 7 units
11	When a significant (C3 or S*) soils meet the criteria of: 4 and 6 units

Table 2.2 (continued)

12	When a significant (C3 or S*) soils meet the criteria of: 2, 4 and 6 units
13	3 and 4 units
14	4 and 7 units
15	6 and 7 units
16	If all Dom or Co-Dom (C1, C2) has ORDER = SOLO, LUVI, BRUN, GLEY; and Significant (C3 or S*) soil ORDER = CHER
17	5 and 7 units
18	2 and 5 units
19	16 and 2 units
20	If all D, C1 or C2 have ORDER = GLEY or ORGA and significant has drainage = I or FD
21	If any D, C1 or C2 are ORDER = GLEY but none are ORDER = ORGA and if any C3, S* is ORDER = ORGA

Example 1:

Soil Name	Areal Extent	Landscape Model	Model Symbol
AG*S*	C1 (≥30% and <60%)	U1h	AGPO1/U1h
PO*K*	C2 (≥30% and <60%)		

Example 2:

Soil Name	Areal Extent	Landscape Model	Model Symbol
AG*S*	C1 (≥30% and <60%)	H11	AGPO9/H11
PO*K*	C2 (≥30% and <60%)		
PHS	S1 (≥10% and <30%)		
ZGW	S2 (≥10% and <30%)		

Example 3:

Soil Name	Areal Extent	Landscape Model	Model Symbol
AGS	D (≥60%)	H11	AGS6/H11
PHS	S1 (≥10% and <30%)		

Example 4:

Soil Name	Areal Extent	Landscape Model	Model Symbol
AGS	C1 (30%)	H11	AGPO6/H11
POK	C2 (30%)		
PHS	C3 (30%)		
ZGW	S1 (10%)		

2.3.10 Additional Guidelines for Deriving a Soil Model Symbol

Additional factors were considered in the creation of a Soil Model symbol. These factors are grouped under the following headings that are ranked in importance:

1. SCA specific rules
2. Parent material concepts

SCA Specific Rules

Some historical artifacts of SCAs were maintained for derivation of soil model symbols. These artifacts related to the distribution or the relationship of till soil series names in physiographic areas, or bedrock types within specific SCAs. For example, in SCA 3, CRD is used for describing O.DB on till, south of the Lethbridge moraine. (Refer to the Gen 2.0 SNF manual for the complete list of SCA till definitions).

Parent Material Concepts

1. The variability of parent material texture is accounted for only when there is a textural group (fine, medium, coarse, very coarse and organic) difference, not a textural class difference.

2. The basis for recognizing two or more parent materials within a landscape is contrasting texture or coarse fragment content (e.g. till versus glaciofluvial), and veneers over a contrasting texture group or parent material occupying more than 30% of a polygon.

3. In cases where there were 3 co-dominant soils, the soil model symbol created reflected the two co-dominant soils with the greatest textural difference (at least one textural group difference).

2.3.11 Rules for Undifferentiated Models and Symbols

1. All of these models are identified with a Z prefix.

2. The model symbol Z__ will be used when the Dom or Co-Dom soils are undifferentiated in terms of classification, parent material and texture.

3. The landscape model will be the unique identifier of many undifferentiated model symbols.

4. Significant soils were identified using the rules as defined for soil landscape models

5. The undifferentiated categories and associated symbols are:
    - ZUN - Undifferentiated mineral soils
    - ZER - Undifferentiated eroded mineral soils
    - ZGW - Undifferentiated gleyed soils, gleysolics and water
    - ZSZ - Undifferentiated solonetzic soils (any parent material)
    - ZNA - Undifferentiated saline soils (any parent material)
    - ZCO - Undifferentiated coarse (gravel and sand) soils
    - ZFI - Undifferentiated fine (clay and heavy clay) soils
    - ZOR - Undifferentiated organic soils
    - ZWA - Water bodies that exceed minimum size (65 ha)

Examples

RB4 map unit (narrow V-shaped river channel)

Basic Evidence: ZUN Dom
Landscape model SC3
Model symbol: ZUN1/SC3

Area of undifferentiated Gleysols containing significant amounts of salinity

Basic Evidence: ZGW Dom / ZNA Sig1
Landscape model L1
Model symbol: ZGW3/L1

Area of undifferentiated Gleysols and salinity (co-dominant)

Basic Evidence: ZGW Co-Dom1 / ZNA Co-Dom2
Landscape model L1
Model symbol: ZGZN1/L1

City, Mine Site, etc.

Basic Evidence: ZUN Dom
Landscape model DL
Model symbol: ZUN1/DL

2.4 Field Inspections

There was only limited opportunity for field inspections in this project. The amount of time allocated for field checking depended upon the scale of existing mapping being updated. Soil maps published at a map scale of 1:50 000 had no time allocated for field inspections. Field checking was limited to 1/4 day per township for those maps published at 1:126 000 and 1/2 day per township for maps published at 1:190 000 scale or smaller. Field inspections consisted of a drive through of a township, an inspection of a road cut or the digging of a soil pit.

2.5 Correlation

Correlation is the process of maintaining consistency in soil taxonomy and interpretation, and in the delineation of Soil Landscape Models. Correlation included the standardization of basic soil attributes and the development of soil landscape concepts.

The correlation process did not include items or activities that may be considered as quality control (audit) procedures, such as:

- contract supervision, work planning (Technical Leader responsibility)
- review of polygon line placement, density, and minimum size (Block Leader responsibility)
- edge matching between townships and work areas (Block Leader responsibility).

Correlation for the CAESA Soil Inventory Project was managed by a correlation team composed of the:

- Technical Leader
- Block Leaders
- Agriculture Canada Correlators

2.5.1 Context

Guidelines

Standards for soil attributes and taxonomy were developed over many decades, both nationally and internationally. The concept of Soil Landscape Models (a synonymous term with soil landscape map units) is a recent development. Similar notions for standardizing soil landscape inventory have evolved recently.

Soil correlation standards exist in: this CAESA Soil Inventory Project Procedures Manual; the Canadian System of Soil Classification (ECSS 1987a); the CanSIS Manual for describing soils in the field (ECSS 1982); the Soil Survey Handbook (ECSS 1987b), the Alberta Soil Names Generation 2 Users Handbook (Alberta Soil Series Working Group 1993); A Soil Mapping System for Canada: Revised (Mapping Systems Working Group 1981) and other manuals.

2.5.2 Role of Correlation Team and Members

The role of the correlation team was to:

- coordinate correlation procedures

- maintain consistent standards as outlined in the various manuals covering soil inventory procedures etc. (guidelines listed previously)

- review recompiled soils information (polygons and associated attributes)

- finalize soil landscape models and descriptions

- maintain the working lists of soil models, and landscape models and consolidate them to revise the Soil Landscapes of Canada map

- review documentation for new soil series and soil model concepts

Roles of the individual correlation team members

Technical Leader:

- coordinated the soil inventory activities within the White Area
- reviewed and assessed (audit) the Block Leader deliverables
- delivered project deliverables to the Technical Authority

- was responsible for edge matching and correlating the Blocks within the White Area with the cooperation of the Block Leaders and Correlators

Block Leaders:

- supervised analysts within the Block
- were responsible for proper and consistent application of Soil Names and soil landscape model concepts
- were responsible for ensuring that edge matching between Working Areas (6 twp) within a Correlation Block (approximately 25 to 36 townships) is done
- ensured that edge matching between Correlation Blocks was done
- assisted the Technical Leader with edge matching adjacent sub-blocks in conjunction with Agriculture Canada correlators and corresponding Block Leaders
- reviewed the appearance (polygon density, 'flow' of soil landscape model concepts) of the selected work areas
- reviewed and updated the polygon attribute files for Correlation Blocks
- updated (when necessary) the polygon attribute files for the Correlation Block (using FoxPro)
- provided justification for creating new soil names, landscape models, soil landscape models and block specific rules to correlators
- provided justification for modifying SCA lines and associated attributes within the block to Agriculture Canada correlators

Agriculture Canada Correlators:

- developed and maintained soils meta-data as required by the Block Leaders, including:
    - Soil Correlation Areas map and attributes
    - Soil Names, Soil Layer Files and Soil Series Descriptions
    - Master lists of Landscape Models
    - Master list of 'rules' for defining Soil Landscape models
- provided assistance in the application of the mapping guidelines to Block Leaders, on a consultative basis
- coordinated, in conjunction with the Block Leader(s) correlation tours and other activities to standardize the application of mapping guidelines, within and between Blocks
- reviewed the compiled soils database on an SCA by SCA basis and provided corrections to the database to the Project Leader
- assisted the Technical Leader with edge matching the Blocks (with the Block Leaders) for the White Area of the province, and compile the 'master' polygon data base

- ran queries on the soil landscape attribute database

- consulted the Peatland Inventory of Alberta Phase 1: 1996 database to augment the descriptions of organic soil landscapes throughout central Alberta.

3.0 DIGITAL PROCEDURES

The process described in Section 3.1 are for conversion of soil lines drawn on paper into ARC/INFO polygon coverage. Only the lines are converted in this process. A separate process, described in Section 3.2, connects the ARC/INFO polygons with the attribute data for the polygon information entered using the FoxPro data entry screens.

3.1 Conversion of soil lines from paper to ARC/INFO polygons

The following steps were used in the conversion process.

1. **Linework Preparation**

Linework to be converted was delivered to the Digital Data Processor on paper or mylar with:

- At least four Alberta Township Survey (ATS) locations indicated. In most cases, the actual township outline was included on the same sheet as the linework

- Clear, dark lines of uniform thickness

- Lines reaching the edge of the area to be converted extending past the boundary about 0.5 cm.

The linework could NOT have:

- Extraneous lines other than soil lines and ATS lines
- Polygon numbers or other annotation within the boundary of the area to be converted.

Notes:
Soil lines that were intended to be coincident with hydrography from the base map were NOT drawn. These lines were digitally overlaid during the conversion process.
A photocopy of the linework (scale is not important) was provided with soil polygon numbers clearly labeling each polygon. This sheet was used in the following step.

2. **Scanning**

Process
The linework was converted to a black and white raster representation through scanning. The scanning was done using a Microtek scanner.

Scanning was done at 200 dots per inch (dpi). This value was chosen to minimize file size and processing time while retaining all linework.

The scan was stored as a TIFF (Tagged Interchange File Format) file.

Output
Raster image from scanner in TIFF format:

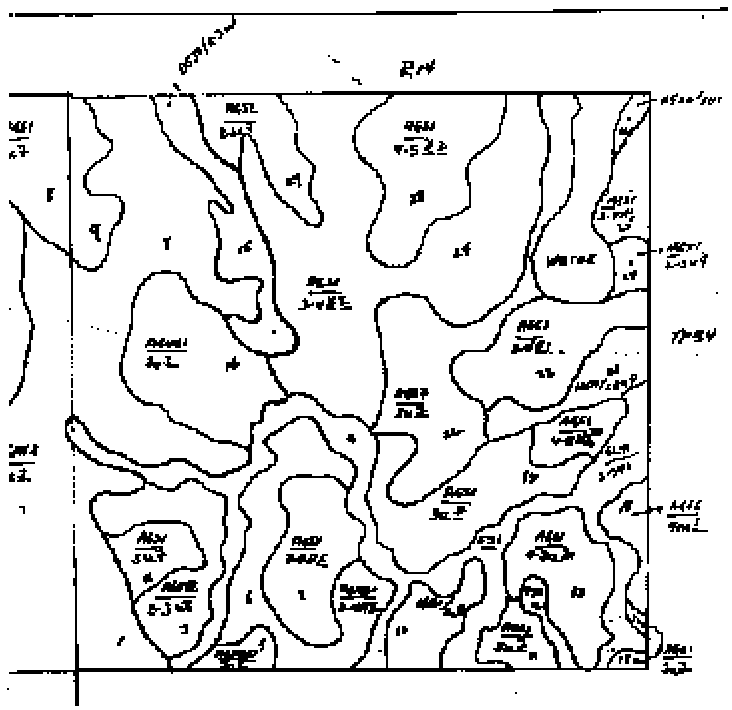

Figure 3.1 Scanned soil map output.

3. **Raster editing**

Input
Raster image from scanner in TIFF format:

Process
The raster image was edited with a bitmap editor (Canvas) to remove unnecessary lines, to fill in small gaps in the image, and to ensure that the ATS corners were easily identified. In this step:

- Unnecessary lines, especially the ATS township lines, were removed. Smudges and overlaps of lines may were also edited.
- Gaps in the image were filled in. If the gaps were too large, the image was re-scanned after touching it up, or scanned at a higher resolution.
- Four ATS corners were selected and the raster image edited to produce a clear reference point after conversion. The points chosen were as close to the extreme corners of the area to be converted as possible, but were separate and distinct from soil lines. The raster image of the corner appeared in the shape of a cross. The arms of the cross were uniform in width and as narrow as possible (length is unimportant). Opposite arms were required to line up exactly.

The editing was done using Canvas. The edited file was written on the local disk as a TIFF file using 'simple compression'. Problems were encountered when using Canvas to write directly to a file on the file server.

Once the file was written, it could be copied to the file server to be accessible for the next processing step.

Output
Clean raster image, stored as a TIFF format file:

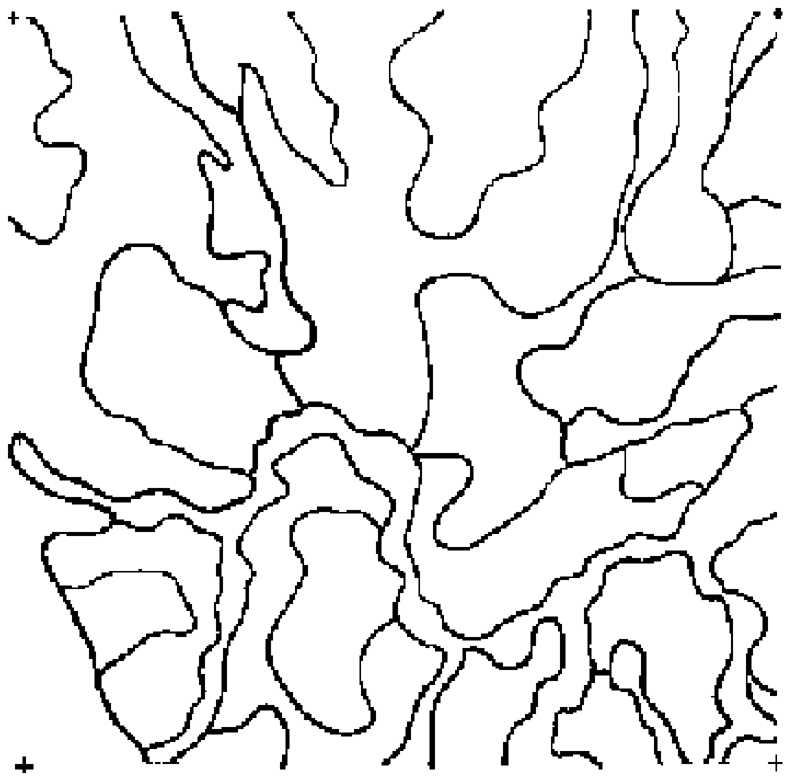

Figure 3.2 Raster edited soil map.

4. **Convert to DataPath raster format**

(The following five steps (4-8) used a software package (DataPath).

Input
Clean raster image, stored as a TIFF format file:

Process
The TIFF raster file was converted into a format acceptable by the raster-to-vector conversion program.

Output
Clean raster image, stored as a file in DataPath raster format:

5. **Convert to vectors**

Input
Clean raster image, stored as a file in DataPath raster format.

Process
The raster-to-vector conversion was done on a SPARC workstation. All conversion parameters were left at the default value supplied by the conversion software.

Output
DataPath format vector file in scanned raster coordinates, oriented with respect to the scanner:

6. **Check and edit vectors**

Input
DataPath format vector file in scanned raster coordinates, oriented with respect to the scanner.

Process
The converted vectors were checked using the vector editor alf (on the SPARCS workstation).

Output
DataPath format vector file in scanned raster coordinates, oriented with respect to the scanner.

7. **Rotate and flip vector coordinates.**

Input
DataPath format vector file in scanned raster coordinates, oriented with respect to the scanner.

Process
Scans generated on the Microtek scanner were oriented with the long axis in the Y direction. Since CAESA working blocks were oriented east west, the vector coordinates were rotated through 90 degrees.

The scanned image had its origin in the upper left corner, with X increasing to the right, and Y increasing downward. To be compatible with geographic coordinates, the Y values were converted to increase upward.

Output
DataPath format vector file in raster coordinates oriented as geographic coordinates.

8. **Convert to ARC/INFO format**

Input
DataPath format vector file in raster coordinates oriented as geographic coordinates.

Process
An empty file was created, and the lines in the DataPath-format file were converted into ARC/INFO 'Generate' format.

Output
Linework description in ARC/INFO 'Generate' format.

9. **Import into ARC/INFO**

Input
Linework description in ARC/INFO 'Generate' format.

Process
The ARC/INFO input file prepared by dsf2arc was used to create ARC/INFO line coverage of soil lines and crosses at the corners.

Output
ARC/INFO coverage of soil lines in scanner coordinates.

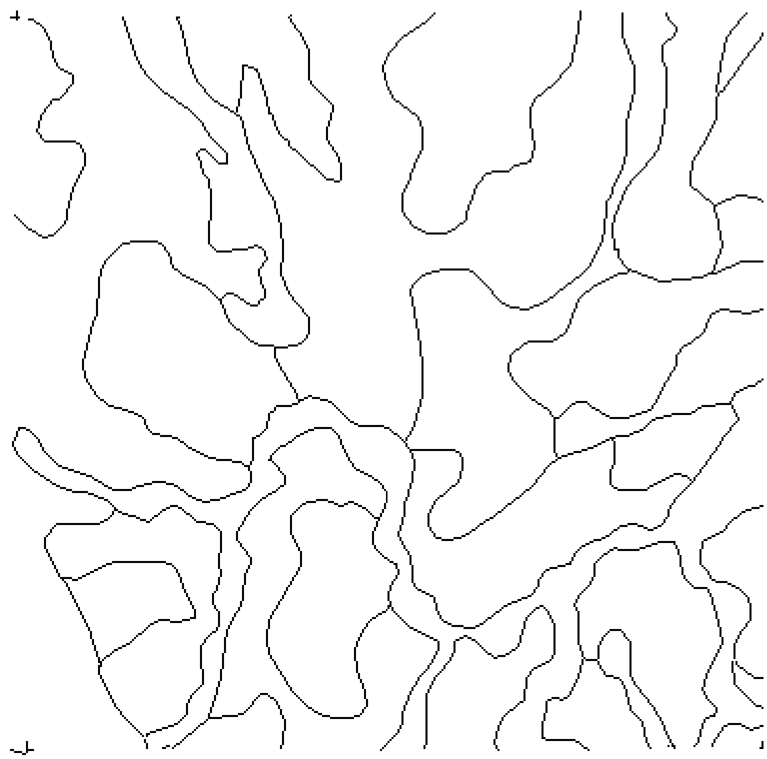

Figure 3.3 Soil lines after import to ARC/INFO.

10. **Obtain township corners**

Process
The corners of the working area were extracted from the Alberta Township Survey (ATS) file, by specifying the township corners that are to be used. The points were specified in a counter-clockwise order around the area, starting in the northeast. Whenever possible, the NE corner of a township was used as a reference.

Output
File containing latitude and longitude coordinates of township corners.

11. **Convert township corners to 10TM**

Input
File containing latitude and longitude coordinates of township corners.

Process
Use the USGS projection software to convert the latitude and longitude position of each corner into the provincial standard 10 degree Transverse Mercator projection (10TM), centered on 115 degrees West longitude.

Output
File containing 10TM coordinates of township corners.

12. **Add reference points (tics)**

Input
ARC/INFO coverage of soil lines in scanner coordinates.

Process
The linework was drawn on the screen, and a tic was added at each of the corners, centered on the crosses left from the township lines.

Output
ARC/INFO coverage of soil lines in scanner coordinates, with tics located at the corners of the coverage.

13. **Convert to geographic coordinates**

Input
ARC/INFO coverage of soil lines in scanner coordinates, with tics located at the corners of the coverage.
File containing 10TM coordinates of tics.

Process
A command file was generated, using the 10TM coordinates of the corners of the working area, which created a new ARC/INFO coverage, replaced the tics with the 10TM coordinates, and transformed the coverage.

Output
ARC/INFO coverage of soil lines with coordinates in 10TM coordinates.

14. **Overlay township grid and hydrography**

Input
ARC/INFO coverage of soil lines.

Process
Add township lines computed from the Alberta Township Survey, and lines representing perennial hydrography which were candidates for soil delineations.

Output
ARC/INFO coverage of soil lines, township lines, and hydrography.

15. **Clean up linework**

Input
ARC/INFO coverage of soil lines, township lines, and hydrography.

Process
Used the ARC/INFO editor, ARCEDIT, to be sure that the linework was reduced to polygon lines only. This step ensured that:

- The crosses in the corners used for geo-referencing were removed
- All lines reach the line they intersected (no 'dangles')
- There were no gaps in the linework
- All unnecessary hydrography lines were removed

Output
Edited ARC/INFO coverage of soil lines and township lines.

16. **Build polygon topology**

Input
Edited ARC/INFO coverage of soil lines and township lines.

Process
The clean linework was converted into complete polygons, with a unique (within a working area) graphical polygon number assigned to each polygon by ARC/INFO.

Output
ARC/INFO coverage of soil polygons, with a graphical polygon number assigned to each polygon.

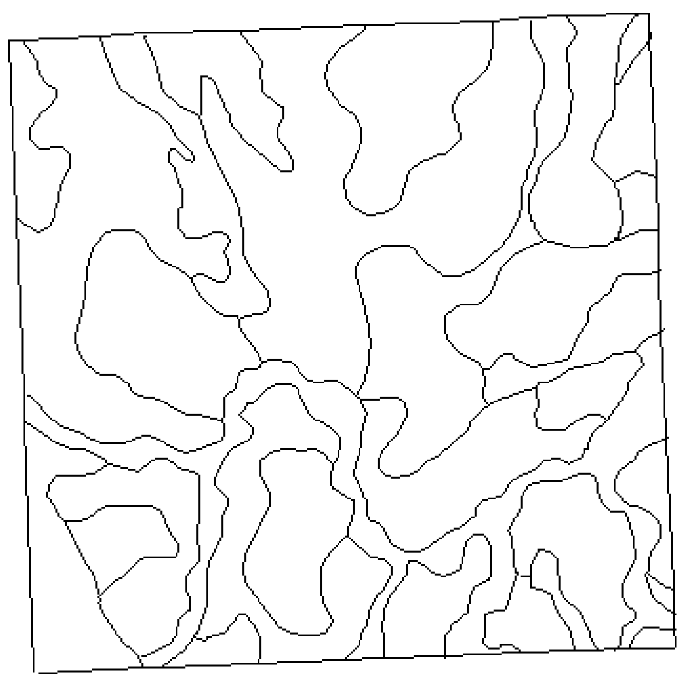

Figure 3.4 Soil lines after topology building.

17. **Get township attributes**

Input
ARC/INFO coverage of soil polygons, with a graphical polygon number assigned to each polygon.

Process
In order to ensure that each polygon in the entire database had a unique number, the township ID (according to the LRIS standard of Meridian Range Township, e.g., 401001) was appended to the attributes of every polygon.

Output
ARC/INFO coverage of soil polygons, with a graphical polygon number and township identifier assigned to each polygon, as well as other attributes.

18. Remove unnecessary attributes

Input
ARC/INFO coverage of soil polygons, with a graphical polygon number and township identifier assigned to each polygon, as well as other attributes.

Output
ARC/INFO coverage of soil polygons, with a graphical polygon number and township identifier assigned to each polygon.

3.2 Attaching Attribute Tables to ARC/INFO polygons

This process connected the ARC/INFO polygons with the attribute data for the polygon entered into the FoxPro data entry screens. Only the attributes were attached in this process. A separate process, described Section 3.1, converted soil lines drawn on paper into ARC/INFO polygon coverage.

1. **Cross reference preparation**
   A photocopy of the linework (scale is not important) was provided with soil polygon numbers clearly labeling each polygon. A plot of the linework from the previous step was generated with the graphical polygon number (GPLYNUM) from ARC/INFO displayed in each polygon.

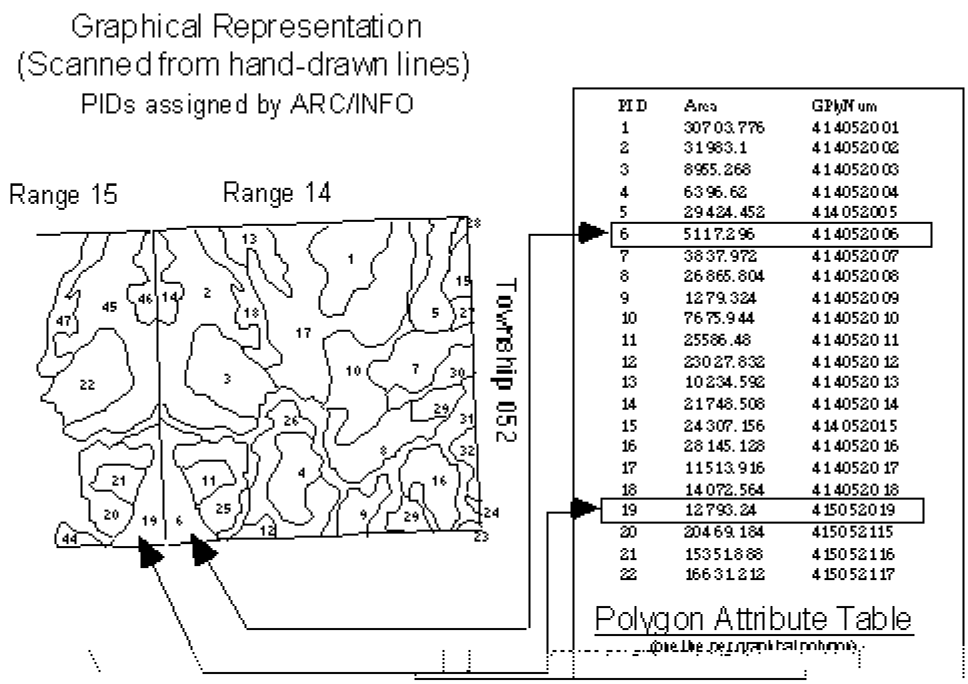

Figure 3.5 Identification of polygons crossing township boundaries.

Notes

- It was essential that each polygon number assigned to a soil polygon be unique

- A soil polygon that crossed township boundaries within a working area had one soil polygon number assigned.

2. **Load cross-reference table with graphical polygon numbers**

Process

Extract a file with one line for each graphical polygon number (GPLYNUM) in the Polygon Attribute table. The file was generated using INFO, then moved to a specific filename using a Unix shell command.

3. **Enter soil polygon numbers into cross-reference table**

Input

Paper copies of GPLYNUM plot and analyst's drawing

Notes

- There may be several graphical polygons for each soil polygon. There was only one line in the file for each graphical polygon.

- A quick test for completeness was to compare the number of polygons reported by ARC/INFO with the number of lines in the spreadsheet. There was one more polygon than lines, since ARC/INFO counts the background polygon.

4. **Prepare temporary cross-reference table**

Process
Create a new INFO table, using the Cross Reference table as a template. Load the table with the values from the Excel spreadsheet.

5. **Test for typos**

Process
Checked to see that all graphical polygon numbers (GPLYNUM) were within the acceptable range for a work area.

Counted the number of times each graphical polygon number occurred in the cross-reference table. If any occurred more than once, the table was corrected.

6. **Check for GPLYNUMs missing from cross-reference table**

Process
Identified any graphical polygon numbers (GPLYNUM) which existed in the Polygon Attribute Table, but not in the cross-reference table. This was done by searching through the cross-reference table through a relate from the polygon attribute table. Only the ARC/INFO background polygon (always record #1) should not be found.

7. **Check for GPLYNUM entries not in polygon attribute table**

Process
Identified any graphical polygon numbers (GPLYNUM) which existed in the cross-reference table, but not in the Polygon Attribute Table. This was done by searching through the Polygon Attribute Table through a relate from the cross-reference table. No polygons should have been found. Any that were found likely represented polygons that were deleted from the ARC/INFO coverage, and were deleted from the cross-reference table.

8. **Prepare plot of soil polygons smaller than guideline**

Process
Prepare a plot which highlighted soil polygons smaller than 65 ha. This was done by using the area stored in the polygon attribute table.

Output
Plot highlighting polygons with areas smaller than 65 ha.

9. **Check for soil polygon continuity**

Process
Highlighted lines that have identical soil polygons on either side. This should result in the interior township lines of the working area. Gaps in these lines indicate that soil polygons are broken across township lines. Other non-township lines indicate duplicate soil polygons. In either case, the soil polygon numbers on either side of the lines were checked.

Output
Plot of lines with identical soil polygon numbers on both sides.

10. **Import data tables**

Process
Data was loaded into info tables that were structured to match the FoxPro tables. The first step was to remove the quotation marks from the FoxPro export files. The delimiter character used was a TAB, since commas appeared in the slope field. The number of records imported was compared to the number of records exported from FoxPro to be sure no records were lost.

11. **Add items to data tables.**

Process
An item (SOILPOLY) was used in both attribute data tables to link to the cross-reference table. The value of this item was calculated from the legal description fields.

12. **Check for polygons in the attribute tables that are not in the cross-reference table**

Process
Identified any soil polygons (SOILPOLY) that existed in the attribute tables, but not in the cross-reference table. This was done by searching through the cross-reference table for legitimate GPLYNUM's found in a related attribute tables. All other soil polygons were not in the cross-reference table. No polygons should be found. Any polygons that are found likely represented polygons that were missing from the ARC/INFO coverage.

Also checked to see that there was meaningful data in the MAS table, by checking that the mandatory field MAS_EXT (extent) was not blank.

13. **Check for polygons missing from the attribute tables**

Process
Identified any graphical polygon numbers (GPLYNUM) which existed in the Polygon Attribute Table, but not in the attribute tables. This was done by searching through one of the attribute tables through a relate from the polygon attribute table. Only the ARC/INFO background polygon (always record #1) was not found.

14. **Build temporary evidence table**

Process
Build a new table (EVDDBF), with an identical structure to MASDBF, which contained both evidence entered in the MASDBF table by the analyst, as well as evidence filled in by looking up the symbol and variant in the soil names file (SNFDBF).

15. **Generate preliminary soil landscape models**

Process
Apply the rules for soil landscape model generation to the evidence in the temporary evidence table, and stored the preliminary symbol in the SLADBF table.

16. **Highlight lines, which have identical soil landscape models on both sides.**

Process
Selected lines from the graphical coverage that had identical soil landscape models on both sides. The

resulting lines should be the interior township grid for the area. Gaps in this grid indicated soil polygons split across the township line. Additional lines indicated possible redundancy in the mapping process. The analyst checked the soil data in the polygons on either side of the line to see if the line should be removed, and the two polygons united.

Output
Plot

3.3 Rules for Soil Model Number Generation

The soil model number indicates the presence of a soil characteristic that is not part of the soils in the dominant or co-dominant part of the soil symbol.

The process used to determine the soil model number translates the measure of each soil characteristic to a severity category. One category is computed for the dominant soils (those mentioned in the soil symbol - D or C1 and C2), and a second category is computed for the significant soils. In the case of multiple dominant or significant soils, only the extreme (maximum or minimum) measure is recorded. The extreme measures of each characteristic are compared, and any that are more extreme in the significant soils than the dominant soils are included in the computation of the soil model number.

Example:
Given the following soils

Name	Extent	Wetness	Parent Material
WLN	C1	FD	M3
LTZ	C2	I	C2
AGC	C3	FD	F1
MDF	S1	P	C3

The categories for each characteristic would be assigned

Name	Extent	Wetness	Parent Material
WLN	C1	1	2
LTZ	C2	2	3
AGC	C3	1	1
MDF	S1	3	3

The extreme category of each of three characteristics (drainage-2, fineness-5, and coarseness-6) would be evaluated as

Soil	2 Wetness (Maximum)	5 Fineness (Minimum)	6 Coarseness (Maximum)
Dominant	2	2	3
Significant	3	1	3

So the individual numbers would be 2 and 5, which is represented by a soil model number of 18.

3.3.1 Soil Model Number Generation Process

The following process was followed to generate the soil model number:

1. Calculate individual numbers:

- For each soil, assign a category representing each characteristic.
- For each polygon, calculate two extreme categories, one for dominant soils, and one for significant soils.
- For each polygon, compare the extreme significant category and the extreme dominant category, to calculate all individual model numbers which apply.

Number	Characteristic to be represented	Computation	Comparison
2	Wetness	Maximum Wetness Category	Sig > Dom
3	Salt-affected	= 1 if symbol = 'ZNA' **or** modifier contains 'SA' **or** variant contains 'SA' = 0 otherwise	Sig > Dom
4	Regosolic	**Ignored if landscape modifier is 'e'** = 1 if order = 'REGO' **or** (subgroup is 'R.*' **and** order is not 'GLEY') **or** variant is 'ZR','ER',or 'CR' **or** symbol = 'ZER' = 0 otherwise	Sig > Dom
5	Fineness	Minimum Parent Material Category	Sig < Dom
6	Coarseness	Maximum Parent Material Category	Sig > Dom

7	Solonetzic	= 1 if order = 'SOLO' **or** symbol = 'ZSZ' = 0 otherwise	Sig > Dom
16	Chernozemic	= 1 if order = 'CHER' **or** subgroup = ‘D.GL’ or ‘GLD.GL’ = 0 otherwise	Sig > Dom
20	Dryness	Minimum Wetness Category	Sig < Dom
21	Organic	Sig = 1 if order = 'ORGA', = 0 otherwise. Dom = -1 if order = 'ORGA', Dom = 1 if order = 'GLEY' and no 'ORGA', Dom = 0 otherwise.	Sig = 1 AND Dom = 1

2. **Compute the soil model number**

For each soil polygon, find the first number which matches the candidate numbers, following the order in the table below:

	Individual number								
Composite (final) Number	2	3	4	5	6	7	16	20	21
19	X						X		
18	X			X					
17				X		X			
15					X	X			
14			X			X			
13		X	X						
12	X		X		X				
11			X		X				
10	X					X			
9	X				X				
8	X		X						
21									X
7						X			
3		X							
6					X				

5				X					
20								X	
16							X		
4			X						
2	X								

Polygons which do not have a number assigned are considered to be homogeneous, and are assigned soil model number 1.

Severity category tables:

2: Soil wetness

Category	MAS_WET
1	FD, I
3	P
4	AP

5 and 6: Texture

Category	Parent Material (MAS_PM)
0 (ignored)	P1, P2, P3, U0, missing
1	F*, L6, L13, L14, L15, L16
2	L3, L8, L10, M0, M1, M2, M3, M4, M5
3	C0, C2, C3, C4, C5, C6, C7, L1, L2, L4, L5, L7, L9, L11, L12, L17, L18, L19, M6
4	C1

MAS_PM	PARENT	MAS_PM	PARENT	MAS_PM	PARENT
missing	0	L1	3	M0	2
C0	3	L2	3	M1	2
C1	4	L3	2	M2	2
C2	3	L4	3	M3	2
C3	3	L5	3	M4	2

C4	3	L6	1	M5	2
C5	3	L7	3	M6	3
C6	3	L8	2	P1	0
C7	3	L9	3	P2	0
F0	1	L10	2	P3	0
F1	1	L11	3	U0	0
F2	1	L12	3		
F3	1	L13	3		
F4	1	L14	1		
F5	1	L15	1		
F6	1	L16	1		
		L17	3		
		L18	3		
		L19	3		

4.0 DATA DICTIONARY

The purpose of this section is to describe the field definitions and data capture rules in detail and to provide the data tables of allowable attribute codes. The attributes collected for Land Systems and Soil Landscape compilation is described in detail in the following sections.

4.1 Land Systems Data Capture

The Land Systems data is captured on the Land Systems Data Form.

4.1.1 Land System Number

Land Systems are numbered to show the hierarchical classification of ecoregion, ecodistrict (LRA) and land system. The LRA (Ecodistricts) map is illustrated (Figure 4.1) and the legend is presented in Table 4.1. The Land System number has the following notation:

Field Definition:

Land System Number	*16.4b.03*

- Enter the land system number as provided in the above example, where:
  16 = Ecoregion
  4b = Ecodistrict (LRA)
  03 = Land System number

Attribute Coding Rules:

- The Land System number is a concatenation of Ecoregion, Ecodistrict and the Land System Number.

- This number will start at 1 for each Ecodistrict and end at the appropriate number of Land Systems in that given Ecodistrict.

- Land System numbers are unique but a Land System can be composed of more than one polygon (Figure 4.2).

- River valleys will break at the Ecoregion but will cross Ecodistricts and will be coded with a 00 (example 16.00.1).

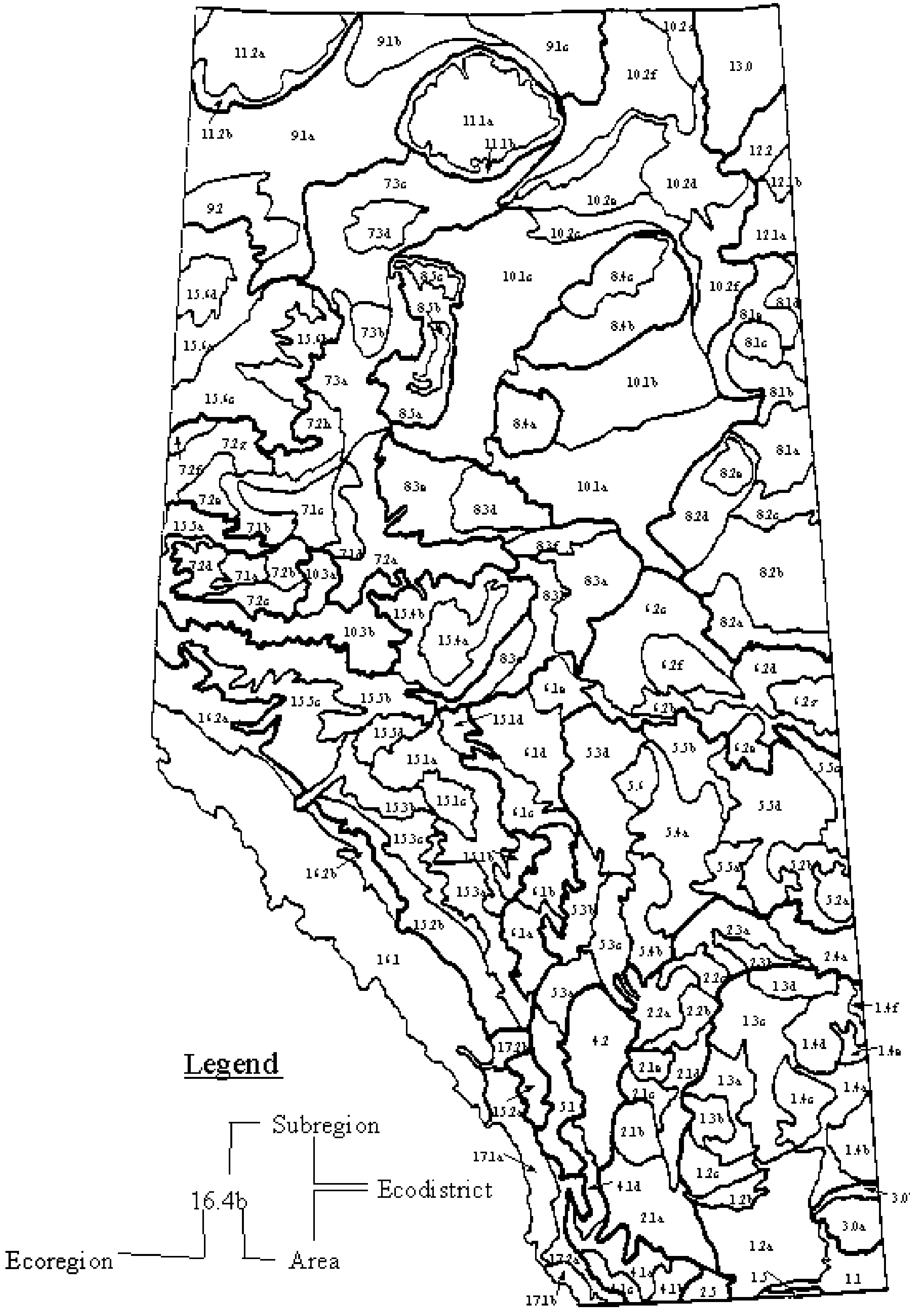

Figure 4.1 Ecodistricts of Alberta (Pettapiece pers. Comm. 1993).

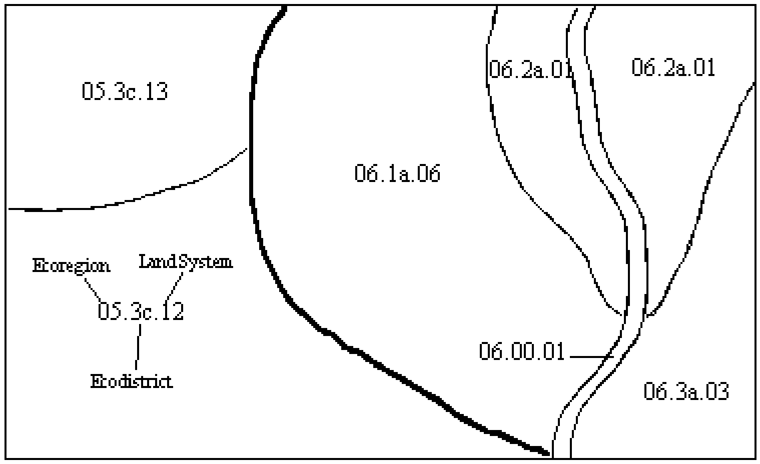

Figure 4.2 Land System map illustrating Land Systems in two Ecoregions (05 and 06), and a Land System (06.2a.01) with two polygons.

4.1.2 Analyst Name and Date

Attribute Coding Rules:

- Enter the analyst name and date (year/month/day).

Table 4.1 Ecodistrict legend (Ecological Stratification Working Group 1995).

Ecodistrict Symbol	Ecodistrict Name	Landform	Texture	Soils	Agroclimate
01.1	Wild Horse	H-U	CL-SL	BR-SS	3A
01.2a	Foremost	U(H)	L-SiL	BR	3A
01.2b	Purple Springs	U	SL(S)	BR	3A
01.2c	Vauxhall	U	L(SL)	BR	3A
01.3a	Brooks	U	SiL-SL(S)	BR(SS)	3A
01.3b	Bow City	U	L to CL	SS-BR	3A
01.3c	Berry Creek	U	L to CL	SS(BR)	3A
01.3d	Sounding Creek	U	SL-L	SS(BR,DB)?	3A
01.4a	Bindloss	U(H)	S-L	BR	3A
01.4b	Schuler	H-U	L to CL	BR	3A
01.4c	Rainy Hills	H(U)	L(SL)	BR	3A
01.4d	Oyen	H(U)	L to CL	BR(DB)	3A(2A)
01.4e	Acadia	U	C	BR	3A

Table 4.1 (continued)

01.4f	Sibbald	U	SiC-SiL	BR	3A
01.5	Sweetgrass	U-M	L-CL	DB	2AH
02.1a	Lethbridge	U(L)	SiL(SiC)	DB	2A
02.1b	Vulcan	U(M)	SiL	DB	2A
02.1c	Blackfoot	U	SL(L)	DB	2A
02.1d	Majorville	H	L to CL	DB	2A
02.1e	Standard	U(M)	SiL-SiC	DB	2A
02.2a	Drumheller	U-M	C	DB	2AH
02.2b	Wintering Hills	H(U)	L to CL	DB(BL)	2AH
02.2c	Endiang	H(U)	L to CL(SL)	DB	2AH
02.3a	Castor	U(L)	L to CL	SS(DB)	2AH
02.3b	Sullivan Lake	U	SL-L	SS(DB)	2AH
02.4a	Neutral Hills	H(S,U)	L-CL	DB	2AH
02.5	Milk River	H(U)	CL(SL)	DB	2AH
03.0a	Cypress	S(L)	L	DB-BL	2AH-3H
03.0b	Mcalpine	U-H	L to CL	DB	2A
04.1a	Cardston	U	U(H)	BL	2AH-3H
04.1b	Del Bonita	H-U	SiL-CL	BL	2AH
04.1c	Twin Butte	M-S	L to CL	BL	4H
04.1d	Willow Creek	M-S	L to CL	BL	4H
04.2	Delacour	U	SiL-CL	BL	2AH
05.1	Black Diamond	M(U)	L to CL	BL-DG	4H(3H)
05.2a	Provost	U(M)	SiL(SL)	DB	2AH
05.2b	Edgerton	H(U)	S(SL)	DB	2AH
05.3a	Olds	U(M)	L to CL	BL	3H
05.3b	Red Deer	U(H)	L to L(C,S)	BL-DG	3H
05.3c	Pine Lake	H(M,U)	L to CL	BL(DG)	3H
05.3d	Leduc	U(L,H)	L-C(S)	BL(SS)	2H

Table 4.1 (continued)

05.4a	Daysland	U	L to CL	SS-BL	2AH
05.4b	Bashaw	H(U)	L to CL	BL	2AH
05.5a	Sedgewick	U	L to CL	BL(DB)	2AH
05.5b	Andrew	U	L to CL	BL(SS)	2AH
05.5c	Lloydminster	U(H)	L to CL	BL	2AH
05.5d	Vermilion	H(U,M)	L to CL	BL	2AH
05.6	Cooking Lake	H	L to CL	GL-DG	3H
06.1a	Caroline	U(H)	L(SL)	GL	4H
06.1b	Rimbey	H-U	L to CL	GL-DG	3H
06.1c	Breton	U-H	CL(C,O)	GL(O)	4H-3H
06.1d	Lac Ste Anne	H(U)	SiL-CL	GL(DG,O)	3H
06.1e	Westlock	U	CL(C)	GL(DG,O)	3H
06.2a	Redwater	U-H	SL(S,L)	DG	3H
06.2b	Elk Point	U(H)	CL	DG(BL,GL)	3H
06.2c	Athabasca	U(L)	L to CL (S,C)	GL(DG,O)	3H(4H)
06.2d	Bonnyville	U(H)	L to CL(SL)	GL(DG)	3H
06.2e	Myrnam	H	CL(C)	GL(DG)	3H
06.2f	Whitefish	H(U)	CL(C)	GL(O)	4H
06.2g	Frog Lake	H(U)	CL	GL(O)	4H
07.1a	Grande Prairie	L(U)	C	BL-SO(DG)	2H
07.1b	Rycroft	U-L(H)	C-L	SO-DG(GL)	2H
07.1c	Dunvegan	U(H)	L(S,O)	GL(BD,O)	2H(3H)
07.1d	Falher	L	C	SO(DG,GL)	2H
07.2a	Mclennan	L(U)	CY(L)	SO(GL-DG)	3H
07.2b	Debolt	U(L)	C(L)	SO(GL,GY)	3H
07.2c	Smoky	U(H)	S(SL,O)	BD-GL(O)	3H
07.2d	Beaverlodge	U(L)	C	SO(GL-DG)	3H
07.2e	Blueberry	U	C(O)	GL(DG,O)	3H
07.2g	Worsley	L(U)	C(L)	SO(GL,DG)	3H

Table 4.1 (continued)

07.2h	Grimshaw	U(L)	CL(L,O)	GL(SO,O)	3H
07.3a	Manning	L	C	SO(GL-DG)	3H
07.3b	Cache	U	S-SL(O)	BD-GL(O)	3H
07.3c	High Level	L(U)	C-L(O)	GL(SO,O)	3H(4H)
07.3d	Boyer	U(H)	SL(S,O)	GL(BE,O)	3HA
08.1a	Garson	U(H)	SL,CL-O	GL-O(BD)	4H
08.1b	Steepbank	U(L)	O(S,L)	O(BD,CL)	4H
08.1c	Muskeg	U(H)	L-O(S)	GL-O(BD)	4H
08.1d	Firebag	H(U,M)	S(O)	BD(O)	4H
08.1e	Hart Lake	U(H)	O-S(L)	O-BD(GL)	4H
08.2a	Pinehurst	H(U)	CL(SL,O)	GL(O)	4H
08.2b	Mostoos	U(H)	S-O	BD-O	4H
08.2c	Christina	U(H)	O-S	O-BD	4H
08.2d	Stony Mtn	M-U	SL(S,O,CL)	GL(O,BD)	4H
08.2e	Crow Lake	U	O-SL	O-GL	4H
08.3a	Cross Lake	H(U)	CL(O,SL)	GL(O)	4H
08.3b	Hondo	U-L	S-O(SL)	BE-O(GL)	4H
08.3c	Freeman	H(U)	CL(O,SL)	GL(O)	4H
08.3d	Utikuma	U(H)	CL-O(SL)	GL-O	4H
08.3e	Heart River	H(U)	CL(O,SL)	GL(O)	4H
08.3f	Pelican	M(S)	CL-SL(O)	GL(O)	5H
08.4a	Peerless	H	CL(O,SL)	GL(O)	5H(4H)
08.4b	Birch	H(M,U)	CL(O)	GL(O)	5H
08.4c	North Birch	U(M)	O(CL)	O(GL)	5H
08.5a	Buffalo Head	H(M,U)	CL(O)	GL(O)	5H(4H)
08.5b	Russell	U-M	CL(O)	GL(O)	5H
08.5c	Wadlin	U-M	CL(O)	GL(O)	5H
09.1a	Hay River	L(U)	C-O(CL)	GL-O(GY)	4H
09.1b	Yates River	L	O(SiC)	O(GL)	4H

Table 4.1 (continued)

09.1c	Buffalo River	U(H)	O-CL	O-GL,BD	4H
09.2	Rainbow Lake	U	CL-O	GL-O	4H
10.1a	Wabasca	L-U	O-S(CL)	O-BE,GL	4H (3H)
10.1b	Mackay	L-U	O-CL,SL	O-GL	4H
10.1c	Loon Lake	L(U)	SiC-O(CL)	GL-O,CY	4H (3H)
10.2a	Delta	U	L	RE-GY	4H
10.2b	Salt River	L-U	CL-S	GY-BE(SAL)	4H
10.2c	Knight Creek	U(R)	S-O	BD-O	4H
10.2d	Fox Lake	U	O-S	O-BD(GL,GY)	4H
10.2e	Birch Fans	U-L	CL(C)	GY(GL,O)	4H
10.2f	Embarras	U	S(O)	BD(O)	4H
10.3a	Sturgeon	M-U(H)	CL(C,O)	GL(SO,O)	3H-4H
10.3b	Iosegun	U(M)	C(SL,O)	GL(SO,O)	4H
11.1a	Caribou	U(M)	O(CL)	O(GLBD)	5H
11.1b	Caribou Slope	H(S)	CL	GL	4H
11.2a	Cameron Hills	U(L,M)	O(CL)	O(GL,BD)	5H
11.2b	Cameron Slope	U	CL(O)	GL(O)	4H
12.0a	Richardson Hills	H	S(O)	BD(O)	5H
12.0b	Harrison River	U	O-S	O-BD	5H
13.0	Tazin River	H(U,M)	ROCK-(S)	ROCK(BD)	5H
15.1a	Edson	U(H)	SiC(L,O)	GL(O)	4H
15.1b	Winfield	H(U)	CL(O)	GL(O)	4H
15.1c	Cynthia	H(S,U)	CL(S)	GL(BD)	5H
15.1d	Blueridge	H-U	CL	GL	5H(4H)
15.2a	Bragg Creek	M-S	L(S)	DG-BE	5H
15.2b	Ram River	M-S	L	GL	5H
15.3a	O'chiese	H-U	CL-L(O)	GL(O)	4H
15.3b	Obed	H-U	CL-L(O)	GL(O)	4H
15.3c	Wolf Lake	H(S)	CL-L	GL	5H

Table 4.1 (continued)

15.4a	Swan Hills	S-M	CL	GL	5H
15.4b	Driftpile	H-M	CL(O)	GL(O)	4H
15.5a	Saddle	M(U)	CL(C,O)	GL(O)	4H
15.5b	Cutbank	M(U)	CL(O)	GL(O)	5H
15.5c	Berland	M-S	CL	GL(BD)	5H
15.5d	Mayberne	M-S	CL	GL(BD)	5H
15.6a	Chinchaga	U(H)	CL,SiC-O	GL-O	4H
15.6b	Notikewin	U(L)	C(O)	GL(O)	4H
15.6c	Clear Hills	H(S)	CL(O)	GL(O)	5H
15.6d	Milligan	H	CL(O)	GL(O)	5H
16.1a	Banff	SM	L-R	BD-R	5H
16.1b	Jasper	SM	R-L	R-BD	5H
16.1c	Icefield	SM	R(L,SNOW)	R(BD)	5H
16.2a	Willmore	M-S	L(S)	BD-BE(GL)	5H
16.2b	Luscar	M-S	L	GL-BD	5H
17.1a	Crowsnest	SM	L(R)	BE(R)	5H
17.1b	Waterton	SM	L-R	BD,GL-R	5H
17.2a	Blairmore	H-S	L(CL)	BL-GL(BElit)	5H
17.2b	Morley	L(M)	L-SL	BL-BE	4H

4.1.3 Soil Correlation Area

The Soil Correlation Area (SCA) to which the Land System belongs for naming soils is identified by the SCA number (1 to 24) as defined in Alberta Soil Names, Generation 2 Users' Handbook (Alberta Soil Series Working Group 1993).

Field Definition:

SCA	*3*

Attribute Coding Rules:

- Enter the SCA number

4.1.4 Land System Name

Land System names consist of two parts; a geographic locator and a morphological descriptor (e.g. Chin Coulee or Stettler Plain).

Field Definition:

	Geographic Locator	Morphological Descriptor
Land System Name	*Chin*	Coulee

Attribute Coding Rules:

- Enter a Land System name that reflects a local geographic location.
- Select a morphological descriptor from Table 4.2 . If a morphological descriptor did not exist, the user added a new descriptor.
    - o Names are not unique across the province.

Table 4.2 List of morphological descriptors (Bates and Jackson 1980).

Descriptor -- Definition

basin -- (a) A depressed area with no surface outlet. (b) a low area in the earth's crust where sediments have accumulated.

bench -- A long, narrow, relatively level or gently inclined strip or platform of land, earth or rock, bounded by steeper slopes above and below and formed by differential erosion of rocks of varying resistance or by a change of base level erosion; a small terrace or step like ledge breaking the continuity of a slope; an eroded bedrock surface between valley walls.

bottomland -- Low-lying, level land, usually highly fertile (the term signifies a grassy lowland formed by the deposition of alluvium along the margin of a watercourse; an alluvial plain or a flood plain; the floor of a valley.

coulee -- A dry or intermittent stream valley, gulch or wash of considerable extent; esp. a long steep-walled, trench like gorge or valley representing an abandoned overflow channel that temporarily carried meltwater from an ice sheet.

escarpment -- (a) A long, more or less continuous cliff or relatively steep slope facing in one general direction, breaking the continuity of the land by separating two level or gently sloping surfaces and produced by erosion or by faulting. (b) a steep, abrupt face of rock, often presented by the highest strata in a line of cliffs and generally marking the outcrop of a resistant layer.

delta -- The low, nearly flat, alluvial tract of land at or near the mouth of a river, commonly forming a triangle or fan shaped plain of considerable area.

Table 4.2 (continued)
dunefield -- Descriptive of an area with numerous low hills or banks of drifted (wind-borne) sand.

hill(s) -- (a) A natural elevation of the land surface, rising rather prominently above the surrounding land, usually of limited extent and having a well defined outline (rounded rather than peaked or rugged) and generally considered to be less than 300m from base to summit; the distinction between hill and mountain is arbitrary and dependent upon local usage. (b) Any slightly elevated ground or other conspicuous elevation in an area of rugged relief. (c) An eminence of inferior elevation in an area of rugged relief. (d) A range or group of hills, or a region.

lowland -- (a) A general term for low-lying land or an extensive region of low land. (b) the low and relatively level ground of a region, in contrast with the adjacent higher country. (c) a low or level tract of land along a watercourse.
pediment -- Gently inclined plannate erosional surface generally veneered with fluvial gravels.

plain -- Any flat area, large or small, at a low elevation; specif. an extensive region of comparatively smooth and level or gently undulating land, having few or no prominent surface irregularities but sometimes having a considerable slope, and usually at a low elevation with reference to surrounding areas. A plain may be forested or bare of trees, and may be formed by deposition or by erosion.

plateau -- Any comparatively flat area of great extent and elevation; specif. an extensive land region elevated (more than 150-300m) above the adjacent country; it is commonly limited on at least one side by an abrupt descent, has a flat or nearly smooth surface but is often dissected by deep valleys and surmounted by high hills or mountains, and has a large part of its total surface at or near the summit level. A plateau is usually higher and has more noticeable relief than a plain.

upland -- (a) A general term for high land or an extensive region of high land. (b) the higher ground of a region, in contrast with a valley, plain, or other low lying land; a plateau. (c) the elevated land above the low areas along a stream or between hills; any elevated region from which rivers gather drainage.

valley -- (a) Any low-lying land bordered by higher ground. (b) a broad area of generalized flat land extending inland for a considerable distance, drained or watered by a large river and its tributaries (example Mississippi Valley).

4.1.5 Surficial Geology

The surficial geology of the Land System is identified using the legend modified from Shetsen (1987; 1990) (Table 4.3) which identifies age, mode of deposition, materials and surface form, and relief.

Field Definition:

Surficial Geology	1	*2a*	2	*4*	3

Attribute Coding Rules:

- Enter up to 3 allowable codes as described in Table 4.3.
- List codes in order of dominance.

Table 4.3. Surficial geology legend (Shetsen 1987;1990).

[Allowable Codes] **Legend**

PLEISTOCENE AND HOLOCENE, UNDIVIDED

[0] ORGANIC DEPOSIT: woody, fibrous and mucky peat; up to 7 m thick; present in bogs, fens, swamps and marshes; generally flat topography.

[1] EOLIAN DEPOSIT: fine and medium-grained sand and silt; up to 7 m thick; longitudinal and parabolic dunes scoured by blowouts; undulating to rolling topography.

LACUSTRINE DEPOSIT: sand, silt and clay, with local ice-rafted stones; up to 80 m thick; deposited mainly in proglacial lakes, but includes also undifferentiated recent lake sediment; flat to gently undulating topography.

[2a] Coarse sediment; sand and silt; undulating surface in places modified by wind.

[2b] Fine sediment; silt and clay; flat to gently undulating surface.

FLUVIAL DEPOSIT: gravel, sand, silt and clay, includes local till and bedrock exposures; up to 20 m thick; present on floors and terraces of river valleys and meltwater channels, and in deltas; flat to undulating topography.

[3a] Coarse sediment; gravel, gravel and sand, fine to coarse-grained sand, minor silt beds.

[3b] Fine sediment; fine sand, silt and clay, minor gravel beds.

[4] STREAM AND SLOPEWASH ERODED DEPOSIT: exposed till and bedrock, local slump material; slopes of river valleys and meltwater channels, in places badland type terrain.

PLEISTOCENE

[5] CRYOTURBATED EOLIAN (LOESS) AND FLUVIAL DEPOSIT: mixed fine sand, silt and gravel, local clay; up to 3 m thick; overlies preglacial gravel and sand on the unglaciated Cypress Hills and Del Bonita uplands; flat to gently undulating topography.

ICE-CONTACT LACUSTRINE DEPOSIT: sand, silt and clay, local till; up to 20 m thick; deposited in supraglacial and ice-walled lakes or in proglacial lakes floored by ice; undulating to hummocky topography.

[6a] Coarse sediment: sand and silt.

[6b] Fine sediment: silt and clay.

ICE-CONTACT FLUVIAL DEPOSIT: gravel, sand, silt and clay, local till; up to 25 m thick; deposited in ice-walled and supraglacial streams, or in ice-front fans and deltas; undulating to hummocky topography.

[7a] Coarse sediment: gravel, gravel and sand, fine to coarse-grained sand.

Table 4.3 (continued)
[7b] Fine sediment: fine sand, silt and clay.

[8] ICE-CONTACT LACUSTRINE AND FLUVIAL DEPOSITS, UNDIVIDED: gravel, sand, silt and clay, local till; up to 25 m thick; deposited in intermittent supraglacial lakes and streams; or at margins of ice-floored proglacial lakes; undulating to hummocky topography.

GLACIAL DEPOSIT (Units 9 through 12a): till consisting of unsorted mixture of clay, silt and gravel, with local water-sorted material and bedrock; the thickness is generally less than 25 m on uplands, but may reach as much as 100 m in buried valleys; flat, undulating, hummocky or ridged topography.

[9] DRAPED MORAINE: till of even thickness, with minor amounts of water-sorted material and local bedrock exposures; up to 10 m thick; includes local areas of undifferentiated subglacially molded deposit with streamlined features; flat to undulating surface reflecting topography of underlying bedrock and other deposits.

STAGNATION MORAINE: till of uneven thickness, local water-sorted material; up to 30 m thick; undulating to hummocky topography reflecting variations in till thickness.

[10a] Undulating topography, with local relief generally less than 3 m.

[10b] Hummocky topography moderately to weakly developed, with irregularly shaped and poorly defined knobs and kettles; local relief 3 to 10 m.

[10c] Hummocky topography strongly developed, with generally round, well defined knobs, dimpled knobs, doughnut-shaped hills and kettles; local relief 5 to 20 m.

[10d] Mixed hummocky and moraine plateau topography: flat-topped irregularly shaped hills with a cover of stratified sand, silt, and clay, interspersed with mounds composed of till, local relief 5 to 20 m.

[11] RIDGED END MORAINE: till, gravel and silt; deposited in ridges at or near a glacier margin; up to 15 m thick; typically forms a series of subparallel ridges.

[12] ICE-THRUST MORAINE: mixed and contorted bedrock, till and water-sorted material that have been translocated by ice in a more-or-less intact state as thrust blocks, or deformed into thrust slabs and folds; up to 100 m thick topography consists of ridges, irregularly shaped hills and depressions.

[12a] ICE-THRUST AND STAGNATION MORAINE, UNDIVIDED: bedrock, till, local water-sorted material; up to 50 m thick rolling to hummocky topography.

GLACIAL AND FLUVIAL DEPOSITS: mixed till, sand, silt and gravel, local bedrock exposures; flat to hummocky topography.

[13a] Draped moraine interspersed with fluvial deposit; up to 5 m thick; flat to undulating topography.

[13b] Stagnation moraine interspersed with fluvial deposit; the thickness unknown; rolling to hummocky topography locally strongly modified by stream erosion.

CRETACEOUS, TERTIARY AND PLEISTOCENE, UNDIVIDED

Table 4.3 (continued)
BEDROCK AND GLACIAL DEPOSIT, UNDIVIDED: bedrock, discontinuous till, slump material, minor sand and gravel; flat, undulating, hummocky and ridged topography.
[14a] Draped moraine on bedrock uplands and plains: discontinuous till over bedrock surface slightly modified by ice and stream erosion; till is generally less than 3 m thick; flat to undulating topography.

[14b] Stagnation moraine on bedrock uplands: discontinuous till over bedrock surface strongly modified by ice and stream erosion, till is up to 10 m thick; hummocky to ridged topography.

LATE TERTIARY AND EARLY PLEISTOCENE

[15] FLUVIAL DEPOSIT: gravel and sand, minor silt beds; found overlying bedrock in upland areas, but generally covered by loess or till, and exposed only along crests of the upland slopes.

CRETACEOUS AND TERTIARY, UNDIVIDED

[16] BEDROCK: sandstone, siltstone, mudstone, and shale, minor ironstone, limestone and coal beds; includes slump material;

[16a] unglaciated bedrock exposed by erosion.

[16b] bedrock exposed by erosion or human activities

Surface modified by lake and stream erosion and deposition.

Stagnation moraine under a cover of lacustrine sediment.

4.1.6 Regional Surface Form Models

Information collected for Land System mapping described regional surface forms in general terms (Table 4.4). Soil mappers could record up to three surface forms that described an area.

Table 4.4 Surface Form Models used for Land System mapping

Surface Form Model	Symbol
Undulating	U
Level	L
Rolling	M
Ridged	R
Duned	D
Inclined and Undulating	IU
Hummocky	H
Hummocky and Plateau	HP

Table 4.4 (continued)

Hummocky and Ridged	HR
Inclined	I
Floodplains	FP
Stream Channels	SC
Peatlands	O
Water-Dominated Wetlands	W
Disturbed Land	DL

4.1.7 Regional Bedrock

The regional bedrock type is identified from the Bedrock Map of Alberta (Green 1972)

Field Definition:

Code:
Kbr

Attribute Coding Rules:

- Enter one or two codes in order of aerial extent

4.1.8 Lakes and Wetlands

The type and abundance of lakes and various kinds of wetlands are coded using a simple classification which was adapted from Miller, 1976.

Field Definition:

Type	Mineral Wetlands				Organic Wetlands				Lakes/Ponds			
Abundance	0	5	25	>>	0	5	25	>>	0	5	25	>>

Attribute Coding Rules:

- Determine <u>type</u> of wetlands present where:
  - Mineral Wetlands = gleysols and non permanent sloughs
  - Organic Wetlands = bogs and fens. Areas composed mainly of peat or sedge and organic materials
  - Lakes/Ponds = permanent water bodies

- Select only <u>one</u> abundance class <u>for each</u> applicable type, where:
  - 0 = none
  - 5 = <5%

- o 25 = 5 to 25%
- o >> = >25%

4.1.9 Regional Soil Models

This is a listing of the soils with the greatest aerial extent in the Land System. The soils can be identified by drainage, soil sub group, parent material texture and the till name.

Field Definition:

Drainage	Soils	Parent Material Texture	Till Name
(choose from table 4.5)	*(choose from table 4.6)*	*(choose from table 4.8)*	*(depending on the selection under Parent Material Texture, a list of possible till names will appear. Choose a till name according to Soil Names File Gen 2)*
eg. poorly drained	*e.g.. Solonetz*	*e.g.. F4*	*e.g.. Edmonton*

Attribute Coding Rules:

- Enter attributes that make up the regional soil model (as many as required) from Table 4.5, 4.6 and 4.7.

Table 4.5 Drainage Categories

Freely drained (FD)
Imperfectly drained (I)
Poorly drained (P)
Area Ponding (AP)

Table 4.6 Regional Soils

Soils		
Brown Chernozemic	Gray Luvisol	Luvic Gleysol
Dark Brown Chernozemic	Dark Gray Luvisol	Solonetzic Gleysol
Thin Black Chernozemic	Solonetzic Luvisol	Undifferentiated Gleysols
Thick Black Chernozemic	Gleyed Luvisol	Organics
Dark Gray Chernozemic	Solonetzic	Regosols
Solonetzic Chernozemic	Gleyed Solonetz	Brunisols
Gleyed Chernozemic	Humic Gleysol	Luvic Gleysol

Table 4.7 Parent material texture.

Codes - Description

Coarse textured materials
C0 - Coarse textured (S, LS, SL) material (undifferentiated)
C1 - Gravels or gravely (cobbly/stony) coarse textured material
C2 - Very coarse (S, LS) sediments deposited by wind or water
C3 - Moderately coarse (SL, FSL) sediments deposited by wind or water
C4 - Very coarse textured till (Till name)
C5 - Moderately coarse textured tills (Till name)
C6 - Coarse textured (S, LS, SL) softrock
C7 - Coarse grained bedrock

Medium textured materials
M0 - Medium textured (VFSL, L, SiL, SiCL, CL, SCL) materials (undifferentiated)
M1 - Gravelly medium textured sediments deposited by water (includes cobbly and stony variations
M2 - Medium textured (L, VFSL) sediments deposited by wind and water
M3 - Moderately fine textured (CL, SCL, SiCL) sediments deposited by water
M4 - Medium textured (L to CL) till (Till name)
M5 - Medium textured (L to CL) softrock
M6 - Gravelly and stony medium textured till

Fine textured materials
F0 - Fine textured (C, SiC, HC) materials (undifferentiated)
F1 - Fine textured (C, SiC) water-laid sediments
F2 - Very fine textured (HC) water-laid sediments
F3 - Fine textured (C) water-laid sediments with till-like features
F4 - Fine textured (C) till (Till name)
F5 - Fine textured (C, SiC) softrock

Layered materials (change occurs between 30 and 100 cm)
L1 - Gravel or gravelly coarse over medium or fine textured till (includes cobbly and stony variations)
L2 - Coarse textured (S, LS, SL) over medium or fine textured till
L3 - Medium textured (VFSL, L, SiCL, CL) over medium or fine textured till
L4 - Coarse textured over gravel or gravelly coarse (includes cobbly and stony variations)
L5 - Medium textured over gravel or gravelly coarse (includes cobbly and stony variations)
L6 - Till (Till name) over softrock
L7 - Coarse (not till) over softrock L8 - Medium (not till) over softrock
L9 - Coarse (not till) textured over fine or very fine (not till)
L10 - Medium (not till) textured over fine or very fine (not till)
L11 - Peat (any) over coarse textured
L12 - Peat (any) over medium textured
L13 - Peat (any) over fine textured
L14 - Fine textured (not till) over medium to moderately fine textured till
L15 - Very fine textured (not till) over medium to moderately fine textured till
L16 - Fine to very fine textured (not till) over softrock
L17 - Gravelly (includes stony variations) medium textured material over medium or fine textured till
L18 - Medium textured material over coarse textured material
L19 - Gravelly medium textured material over softrock

Table 4.7 (continued)

L20 Coarse textured over medium or moderately fine (not till)
L21 Gravelly coarse textured over medium or moderately fine (not till)
L22 Fine (not till) over medium (not till)

Peat Material
P1 - Sphagnum Peat
P2 - Fen Peat
P3 - Forest Peat

Undifferentiated Material
U0 - Undifferentiated

4.2 Soil Landscape Data Capture

The following points were some general guidelines for coding attributes for Soil Landscapes.

General

- the system was designed to provide decision assist tools when coding attributes.
- there were mandatory fields that were required to be coded as well as optional fields.
- unique polygon identification was required.
- the analyst entered the basic evidence for a polygon and was able to edit the data as required
- the analyst had the option of importing data from an existing polygon and editing the data.

Soil Model

- the order of coding the basic evidence was important. The order in which soils are coded was used to generate a Soil Model.

Landscape Model

- the analyst entered an existing Landscape model or entered the data necessary to describe a landscape if a model did not exist.

Soil Landscape Models

- the analyst entered basic evidence for the polygon. Based on the evidence and a set of rules a Soil Landscape Model was automatically generated for that polygon.

4.2.1 Polygon Identification

Field Definition and Examples:

4	*16*	*29*	*5*
MER	RNG	TWP	POLY#

Attribute Coding Rules

- Mandatory entry
- Analysts ensured that the polygon identification numbers were unique.
- Analysts coded the meridian, range, township and polygon number. Polygon numbers could not excede 99.

4.2.2 Ecological Setting

Field Definition and Examples:

05	5d	10	11
Ecoregion	Ecodistrict (LRA)	Land System Number	SCA

Attribute Coding Rules:

- Mandatory entry for ecoregion, ecodistrict, Land System number and SCA (Table 4.1).

4.2.3 Analyst and Correlator

Attribute Coding Rules:

- Analyst name was a mandatory entry (automatically done).
- For every Soil Landscape polygon coded, a record of the date and name of analyst was stored.

4.2.4 Soil Model Attributes

Attributes of the Soil Model were captured as basic evidence. The analyst captured only those pieces of evidence that were known. A set of rules were applied to the basic evidence to generate a soil model.

Field Definition and Examples

Drainage	Order	Great Group	Subgroup	Sub-group Modifier	Parent Material	Till Name	Proportion
table 4.5	*table 4.10*	*table 4.10*	*table 4.10*	*table 4.8*	*table 4.7*		
M	M*	M*	M*	O	M**	O	M

Soil Series		Variant
Gen 2		*table 4.9*
M*		O

M: mandatory entry
M*: at least one of the four attributes must be coded
M**: mandatory if soil series is not identified
O: optional entry

Attribute Coding Rules:

- the basic evidence could be recorded to any level of detail to which the soil analyst was confident.

- the soil model symbol was generated automatically

- Attributes:
  The analyst coded at least one of the following four attributes:
  - **Soil Series**: from Generation 2 Soil Names File
  - **Order**: According to the CSSC, table 4.10
  - **Great Group**: According to the CSSC, from table 4.10
  - **Sub Group**: According to the CSSC, from table 4.10

  The analyst coded:
  - **Wetness**: table 4.5
  - **Parent Material**: from table 4.7
  - **Proportion:**
    a) Dominant (Dom) > 60%
    b) Co-Dominant (Co-Dom) > 30 and < 60%
    c) Significant (Sig) > 10 and < 30%

    Allowable combination of proportions:
    a) One dominant soil; up to five significant soils
    b) Two co-dominant soils; up to four significant soils
    c) Three co-dominant soils (ranked in order of occurrence; one significant soil

  The analyst had the option of coding:
  - **Modifier**: A modifier of the subgroup, from table 4.8
  - **Variant**: from table 4.9

Table 4.8 Soil Subgroup Modifiers

Code	**Description**	**Code**	**Description**
NA	Not applicable	GM	Grumic
AC	Acid	PT	Peaty
CA	Calcareous	SA	Saline Profile
CR	Carbonated	XL	Lithic
DA	Dark Ap or Ah >5 cm	ZT	Solonetzic B horizon
EL	Eluviated - has an Ae horizon		

Table 4.9 Variants.

Code	Description	Code	Description
AA	Not modal SCA	XL	Lithic at 30 - 99
AC	Acid	XP	Paralithic at 30 - 99
CA	Calcareous	XS	Sand at 30 - 99
CB	Cobbly	XT	Till at 30 - 99
CO	Coarse	XU	Undifferentiated material at 30 - 99
CR	Carbonated	XZ	Permafrost at 30 - 99
CY	Cryic	YC	Clay at 100 - 200
DA	Dark Ap (cult)	YG	Gravel at 100 - 200
DL	Disturbed	YL	Lithic at 100 - 200
ER	Eroded	YP	Paralithic at 100 - 200
FI	Fine	YS	Sand at 100 - 200
GL	Gleyed	YT	Till at 100 - 200
GM	Grumic	YZ	Permafrost at 100 - 200
GR	Gravelly (entire profile)	ZE	Eluviated
OB	Overblown	ZF	Fibric
OW	Overwashed	ZG	Gleyed Rego
PT	Peaty	ZH	Humic
SA	Saline	ZL	Luvisolic
SC	Saline Subsoil	ZM	Mesic
ST	Stony	ZR	Rego
TA	Thin A	ZS	Solodic
TK	Thick A	ZT	Solonetzic
XC	Clay at 30 - 99	ZZ	Atypical subgroup
XG	Gravel at 30 - 99	ZB	Brunisolic

Table 4.10 Order, Great Group and Subgroup codes for White Area of Alberta.

BRUNISOLIC (Brun)

Eutric

- O.EB - Orthic Eutric Brunisol
- E.EB - Eluviated Eutric Brunisol
- GL.EB - Gleyed Eutric Brunisol
- GLE.EB - Gleyed Eluviated Eutric Brunisol

Dystric

- O.DYB - Orthic Dystric Brunisol
- E.DYB - Eluviated Dystric Brunisol
- GL.DYB - Gleyed Dystric Brunisol
- GLE.DYB - Gleyed Eluviated Dystric Brunisol

CHERNOZEMIC (Cher)

Brown

- O.BC - Orthic Brown
- R.BC - Rego Brown
- CA.BC - Calcareous Brown
- E.BC - Eluviated Brown
- SZ.BC - Solonetzic Brown
- GL.BC - Gleyed Brown
- GLR.BC - Gleyed Rego Brown
- GLCA.BC - Gleyed Calcareous Brown
- GLE.BC - Gleyed Eluviated Brown
- GLSZ.BC - Gleyed Solonetzic Brown

Dark Brown

- O.DBC - Orthic Dark Brown
- R.DBC - Rego Dark Brown
- CA.DBC - Calcareous Dark Brown
- SZ.DBC Solonetzic Dark Brown
- GL.DBC - Gleyed Dark Brown
- GLR.DBC - Gleyed Rego Dark Brown
- GLCA.DBC - Gleyed Calcareous Dark Brown
- GLSZ.DBC - Gleyed Solonetzic Dark Brown

Black

- O.BLC - Orthic Black
- R.BLC - Rego Black
- CA.BLC - Calcareous Black
- E.BLC - Eluviated Black
- SZ.BLC - Solonetzic Black
- GL.BLC - Gleyed Black
- GLR.BLC - Gleyed Rego Black
- GLCA.BLC - Gleyed Calcareous Black
- GLE.BLC - Gleyed Eluviated Black
- GLSZ.BLC - Gleyed Solonetzic Black

Table 4.10 (continued)

Dark Gray
- O.DGC - Orthic Dark Gray
- R.DGC - Rego Dark Gray
- CA.DGC - Calcareous Dark Gray
- SZ.DGC- Solonetzic Dark Gray
- GL.DGC - Gleyed Dark Gray
- GLR.DGC - Gleyed Rego Dark Gray
- GLCA.DGC - Gleyed Calcareous Dark Gray
- GLE.DGC - Gleyed Eluviated Dark Gray
- GLSZ.DGC - Gleyed Solonetzic Dark Gray

GLEYSOLIC (Gley)

Luvic
- SZ.LG - Solonetzic Luvic Gleysol
- FR.LG - Fragic Luvic Gleysol
- HU.LG - Humic Luvic Gleysol
- FE.LG - Fera Luvic Gleysol
- O.LG - Orthic Luvic Gleysol

Humic
- SZ.HG - Solonetzic Humic Gleysol
- FE.HG - Fera Humic Gleysol
- O.HG - Orthic Humic Gleysol
- R.HG - Rego Humic Gleysol

Gleysol
- SZ.G - Solonetzic Gleysol
- FE.G - Fera Gleysol
- O.G - Orthic Gleysol
- R.G - Rego Gleysol

LUVISOLIC (Luvi)

Gray
- O.GL - Orthic Gray Luvisol
- D.GL - Dark Gray Luvisol
- BR.GL - Brunisolic Gray Luvisol
- PZ.GL - Podzolic Gray Luvisol
- SZ.GL - Solonetzic Gray Luvisol
- FR.GL - Fragic Gray Luvisol
- GL.GL - Gleyed Gray Luvisol
- GLD.GL - Gleyed Dark Gray Luvisol
- GLBR.GL - Gleyed Brunisolic Gray Luvisol
- GLPZ.GL - Gleyed Podozolic Gray Luvisol
- GLSZ.GL - Gleyed Solonetzic Gray Luvisol
- GLFR.GL - Gleyed Fragic Gray Luvisol

Table 4.10 (continued)

ORGANIC (Orga)

Fibrisol

- TY.F - Typic Fibrisol
- ME.F - Mesic Fibrisol
- HU.F - Humic Fibrisol
- LM.F - Limno Fibrisol
- CU.F - Cumulo Fibrisol
- T.F - Terric Fibrisol
- TME.F - Terric Mesic Fibrisol
- THU.F - Terric Humic Fibrisol
- HY.F - Hydric Fibrisol

Mesisol

- TY.M - Typic Mesisol
- FI.M - Fibric Mesisol
- HU.M - Humic Mesisol
- LM.M - Limno Mesisol
- CU.M - Cumulo Mesisol
- T.M - Terric Mesisol
- TFI.M - Terric Fibric Mesisol
- THU.M - Terric Humic Mesisol
- HY.M - Hydric Mesisol

Humisol

- TY.H - Typic Humisol
- ME.H - Mesic Humisol
- FI.H - Fibric Humisol
- LM.H - Limno Humisol
- CU.H - Cumulo Humisol
- T.H - Terric Humisol
- TFI.H - Terric Fibric Humisol
- TME.H - Terric Mesic Humisol
- HY.H - Hydric Humisol

Folisol

- HE.FO - Humic Folisol
- HU.FO - Humic Folisol
- LI.FO - Lignic Folisol
- HI.FO - Histic Folisol

REGOSOLIC (Rego)

Regosol

- O.R - Orthic Regosol
- CU.R - Cumulic Regosol
- GL.R - Gleyed Regosol
- GLCU.R - Gleyed Cumulic Regosol

Table 4.10 (continued)

Humic Regosol
- O.HR - Orthic Humic Regosol
- CU.HR - Cumulic Humic Regosol
- GL.HR - Gleyed Humic Regosol
- GLCU.HR - Gleyed Cumulic Humic Regosol

SOLONETZIC (Solo)

Solonetz
- B.SZ - Brown Solonetz
- DB.SZ - Dark Brown Solonetz
- BL.SZ - Black Solonetz
- A.SZ - Alkaline Solonetz
- GLB.SZ - Gleyed Brown Solonetz
- GLDB.SZ - Gleyed Dark Brown Solonetz
- GLBL.SZ - Gleyed Black Solonetz

Solodized Solonetz
- B.SS - Brown Solodized Solonetz
- DB.SS - Dark Brown Solodized Solonetz
- BL.SS - Black Solodized Solonetz
- DG.SS - Dark Gray Solodized Solonetz
- G.SS - Gray Solodized Solonetz
- GLB.SS - Gleyed Brown Solodized Solonetz
- GLDB.SS - Gleyed Dark Brown Solodized Solonetz
- GLBL.SS - Gleyed Black Solodized Solonetz
- GLDG.SS - Gleyed Dark Gray Solodized Solonetz
- GLG.SS - Gleyed Gray Solodized Solonetz

Solod
- B.SO - Brown Solod
- DB.SO - Dark Brown Solod
- BL.SO - Black Solod
- DG.SO - Dark Gray Solod
- G.SO - Gray Solod
- GLB.SO - Gleyed Brown Solod
- GLDB.SO - Gleyed Dark Brown Solod
- GLBL.SO - Gleyed Black Solod
- GLDG.SO - Gleyed Dark Gray Solod
- GLG.SO - Gleyed Gray Solod

4.2.5 Landscape Model Attributes

Landscape models are a conceptual description of a recognizably distinct landscape. The models are used to identify the following characteristics of a landscape:

- surface form (inclined, undulating, hummocky, rolling, etc.).
- slope gradients
- slope lengths

- landform elements
- relief

Surface form can be described and classified by various methods. The most common methods are surface shape (or expression) and geologic landform (which implies method of origin). Table 4.11 illustrates the current list of Landscape Models described by surface form and landform.

Definition:

Landscape Model:	*R2m*

Attribute Coding Rules:

- Choose one model for Soil Landscape mapping by entering the appropriate code as defined in Table 4.11.

Table 4.11 Landscape Models (adapted from Shetsen 1987; 1990).

Code	Description	Slope Class(es)
Undulating		
U1	undulating l. low relief h. high relief	 2 (1) 2 to 3, 3
Level		
L1	level plain	1, 1 to 2
L2	level and closed basin (depression with raised edges)	1 to 2
L3	level and terraced, not within modern stream channels	2, 2 to 3 with risers
Rolling		
M1	rolling (inclined slopes > 400 m, multi-directional) m. moderate relief h. high relief	 4, 4 to 5 5, 5 to 6
Ridged		
R2	Ridged (includes fluted terrain) l. low relief m. moderate relief h. high relief	 3 4 to 5 5 to 6, 6+
Duned		

Table 4.11 (continued)

D1	longitudinal dunes l. low relief m. mod. relief h. high relief	 3 to 4, 4 4 to 5, 5 5 to 6, 6+
D2	parabolic or u-shaped dunes l. low relief m. mod. relief h. high relief	 3 to 4, 4 4 to 5, 5 5 to 6, 6+
Inclined and Undulating		
IU	inclined and undulating l. low relief h. high relief	 < 5% > 5%
Hummocky		
H1	hummocky l. low relief m. mod. relief h. high relief	 3 to 4, 4 (3) 4 to 5, 5 5 to 6, 6+
H5	hummocky draped moraine over softrock l. low relief m. moderate relief h. high relief	 3, 3 to 4 4 to 5 5 to 6
Hummocky and Plateau		
HP1	hummocky stagnation moraine with nearly-level lacustrine plateaus (morainal lake scenarios) m. moderate relief h. high relief	 4 to 5, with 2-3 5 to 6, with 2-3
Hummocky and Ridged		
HR2	hummocky and ridged m. moderate relief h. high relief	 4 to 5 5 to 6, 6+
Inclined		
I1	inclined plain (slope length > 400 m) l. low relief	 2 to 3 (2)
I3	inclined to steep, single slope landforms with (includes old RB1 unit, fans, aprons) l. low relief m. mod. relief h. high relief	 3 to 4, 4 4 to 5, 5 5 to 6, 6+

Table 4.11 (continued)

I4	inclined to steep, single slope landforms with >10% exposed bedrock (includes old RB2 unit) l. low relief m. mod. relief h. high relief	3 to 4, 4 (3) 4 to 5, 5 5 to 6, 6+
I5	inclined, steep, with extensive failure slumps (RB5 and ZCV units)	5 to 6, 6 +
Floodplains		
FP1	meander floodplain	1 to 2, 2, 2 to 3
FP2	unconfined braided channel	1 to 2, 2, 2 to 3
FP3	confined floodplain, possibly terraced	2, 2 to 3 (1)
Stream Channels		
SC1	valley with confined floodplain l. low relief h. high relief (steep sides)	 <9% side slopes >9% slopes
SC2	wide valley with one or more terraces (coulees included)	
SC3	v-shaped valley with no terraces or floodplain (RB4)	
SC4	sub-glacial channel (intermittently incised)	
Peatlands		
O1	Level, flat, horizontal or plateau	
O2	Basin (bowl)	
O3	Channelled, ribbed or net	
O4	Sloping	
O5	Level organic with hummocky mineral soils	2, 3-6
Water-Dominated Wetlands (land surface dominated by water)		
W1	channel sloughs and ponds in linear arrangement, no channel banks. Often old ice-walled channel feature.	
W2	Non-aligned aggregation of sloughs/ponds with little inter-slough area. Can have significant inter-water area.	

Table 4.11 (continued)

W3	A single water body basin which may be filled or partly filled with water (greater than 65 ha area).	
Disturbed Land		
RR	reclaimed or reconstructed land	
DL	any disturbed land (urban, gravel pits, areas not suitable for arable crops)	
GZ	Green Zone area (not mapped in the CAESA Project)	

Field Definition:

Morphology	Genesis	Relief	*Slope*
(Table 4.11)	*(Table 4.3)*		

(Table 4.11)		*(Table 4.12)*
Landscape Model		Modifier

Table 4.12 Soil Landscape modifiers.

Code	Description
d	Dissected (> 50 cm, gully, same position year after year)
r	shallow to bedrock (within 5 metres)
e	eroded pits (specific to solonetzic landscapes)
n	concavities
c	Channeled (< 50 cm, rill, re-occur at the same position year after year)

4.2.6 Salt Affected

Define presence or absence of salinity (true if salinity is present or false if salinity is absent)

4.2.7 Confidence Level

The analyst records the level of confidence that they have in the basic evidence (low = 1, medium = 2 or high = 3)

4.2.8 Field Check Required

The analyst records if a field inspection was made in the polygon (true or false). If a field visit was made then the analyst records 'done' (entry screens only).

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6.0 GLOSSARY OF TERMS

Agroclimate: Compilation of the average and extreme weather of an area as it affects agricultural cropping in that area. Agroclimatic classification in Alberta is based on limitations of available heat and/or moisture.

Apron: A relatively gentle slope extending along the foot of a steeper slope and formed of re deposited materials derived from the steeper, upper slope.

Basin: 1) The drainage or catchment area of a stream or lake. 2) An extensive depressed area into which the adjacent land drains, and having no surface outlet.

Bedrock: Geological materials so hard and consolidated they cannot be dug with a shovel (i.e. by hand). Indurated layers created by soil-forming processes are excluded.

Bench: An elongate, narrow, horizontal or near-horizontal platform formed by differential erosion. Most Canadian Quaternary researchers apply the term only to features formed in bedrock; those formed by erosion of unconsolidated sediments are termed terraces.

Block: One of the 5 White area regions (Peace, SE, SW, NE, NW).

Block Leader: The individual responsible for ensuring mapping consistency for a Block.

Bog: Sphagnum or forest peat materials occurring in an ombrotrophic (nutrient poor) wetland environment, often slightly elevated and disassociated from underlying nutrient-rich groundwater and mineral soils. Bog peat is usually extremely acid (pH <5.4) and undecomposed (fibric).

Calcareous: Descriptive of materials containing calcium carbonate.

Channel: (1) An extremely linear three-dimensional object, usually bounded only on the bottom and sides. (2) The trough-like form which contains a river and is shaped by the force of water flowing along it. Its shape is capable of accurate measurement.

Clay: 1) A mineral particle less than 0.002 mm in equivalent diameter. Clay particles are often distinct clay minerals, but amorphous free oxides and primary minerals can also be clay sized. 2) A soil texture class. See soil texture.

Coarse Fragments: Rock or mineral particles greater than 2.0 mm in diameter.

Coarse Textured: A broad textural grouping that refers to soils or materials dominated by sand, loamy sand, and sandy loam textural classes.

Colluvial: Materials that have reached their present position by direct, gravity induced movement.

Conglomerate: Sedimentary rock composed of rounded coarse fragments cemented together, the predominant grade of the coarse fragments being the gravel and/or cobble size fractions.

Correlation Block: A subdivision of a 'sub-block' occupying about 15 to 40 townships. The Correlation Block was the area used by the correlation team to check for data quality and integrity.

Correlation Team: A group of individuals (Scientific Leader, Block Leaders, Agriculture Canada Correlators and Field Assistants) responsible for maintaining consistency in soil taxonomy and interpretation. The correlation team also ensure the standardization of basic soil attributes and the development of soil landscape model concepts.

Coulee: A deep stream valley, often rectangular or parabolic in cross-section. Coulees frequently represent glacial meltwater channels in western Canada.

Crevasse Fill: An elongate ridge formed by the infilling of crevasses in glacial ice. Crevasse fills often are characterized by angular bends and wide, level tops. The infill material may be sand, gravel, diamicton, or a combination of all three. Crevasse fills commonly occur in groups.

Delta: A fan-shaped area at the mouth of a river formed by deposition of successive layers of sediments brought down from the land and spread out on the bottom of a basin. Where the stream current reaches quiet water, the bulk of the coarser load is dropped and the finer material is carried farther out. Deltas are recognized by nearly horizontal beds, termed bottomset beds, overlain by more steeply inclined and coarser-textured beds called foreset beds.

Deposition: The leaving of material in a new position following its transport by a natural agent such as water, wind, ice, or gravity, its growth and death in the case of organic matter, or by the activity of man.

Digital Data Processor (DDP): The person responsible for converting hard copy soil lines into geographically referenced (digital) soil lines.

Discharge Area: Expanse over which water becomes free to be removed from the zone of saturation, especially by coming to or near to the ground surface.

Double-sided Channel: A stream channel delineated on a map as a channel bank, the flood-plain, and a channel bank.

Drainage: The removal of water from an area by (a) surface flow (stream and sheet flow) (b) by downward and/or lateral flow through soils.

Duned: Descriptive of an area with numerous low hills or banks of drifted sand.

Ecodistrict: Subdivision of Ecoregion in the Ecological Land Classification hierarchy.

Ecoregion: Part of an ecozone characterized by distinctive ecological responses to climate as expressed by the development of vegetation, soil, water, fauna, etc.

Ecozone: An area of the earth's surface, representative of large and very generalized ecological units characterized by interactive and adjusting abiotic and biotic factors.

Eolian (adj.): Descriptive of materials transported and deposited by air (wind).

Esker: An elongated sinuous ridge or series of mounds, composed internally of stratified or semi-stratified sand and gravel (may have minor amounts of diamicton, silt, or clay), produced by subglacial, englacial, or supraglacial streams. Eskers are commonly associated with other stream features (deltas, tributaries, etc.) Eskers may be single ridges, or may be aligned in a braided or reticulate pattern.

Farmland Assessment Records: The record of a parcel of land which details soils, topography, agroclimate, stones, vegetation and access. The farmland assessment record is used to determine the fair actual value of the parcel for taxation purposes.

Fen: Brown moss and sedge peat materials occurring in an eutrophic (nutrient rich) wetland environment, the wetness coming from nutrient-rich groundwater communicating with mineral soils. Fen peat is usually medium acid to neutral (pH 5.5-7.5) and moderately well to well decomposed.

Fine Textured Group: A broad textural grouping that refers to soils or materials dominated by clay, sandy clay, silty clay, and heavy clay textural classes.

Floodplain: The land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

Fluted Moraine: Plain of glacial till having long, smooth, gutter like depressions and/or low, elongated drumlins moulded beneath moving ice and oriented parallel to the direction of ice flow.

Fluvial (adj.): Descriptive of materials transported and deposited by flowing water.

Fluvioeolian (adj.): Descriptive of materials transported and deposited by the combined action of streams and wind.

Fluviolacustrine (adj.): Descriptive of materials pertaining to sedimentation partly in lake water and partly in streams, or to sediments deposited under alternating or overlapping lacustrine and fluvial conditions.

Glacial (adj.): Pertaining to, characteristic of, produced or deposited by, or derived from a glacier.

Glaciofluvial (adj.): Descriptive of material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine (adj.): Pertaining to, derived from, or deposited in glacial lakes; especially said of the deposits and landforms composed of suspended material brought by meltwater streams flowing into lakes bordering the glacier, such as deltas, kame deltas, and varved sediments.

Gleysolic Soils: An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas, or prominent mottling, or both, in some horizons. The great groups Gleysol, Humic Gleysol, and Luvic Gleysol are included in the order.

Gradient: See slope.

Gravelly (adj.): 1) Containing an appreciable amount of gravel (i.e. rock fragments 2 mm to 7.5 cm in diameter). 2) Textural modifier descriptive of materials with 20 to 50% gravel (i.e. the particle size distribution is noticeably bimodal) or rock fragments make up 15 to 35% by volume of the soil and the predominant rock fragments are gravels. 3) Material modifier descriptive of an accumulation of rounded to subrounded particles ranging in size from pebbles to boulders (2 mm to greater than 60 cm).

Gullying: Removal of soil by running water, with formation of channels that cannot be smoothed out (and often cannot be crossed) during normal tilling by wheeled vehicles.

Hierarchical: Higher levels in the hierarchy provide broader information as compared to lower levels in the hierarchy.

Hills: Areas rising above the surrounding country and culminating in distinctive crests or summits. Abrupt elevation differences are usually less than 300 m, altitude differences exceeding this being more typical of mountains.

Hummocky (adj.): Descriptive of land surfaces with a complex sequence of slopes that merge from somewhat rounded depressions or kettles of various sizes to irregular to conical knolls or knobs. There is a general lack of concordance between knolls or depressions. Slopes are generally 5 to 70%.

Ice-contact (adj.): Stratified material deposited directly adjacent to glacial ice, or within channels and hollows in ice. Eskers, kames, and glaciolacustrine deltas are composed of ice-contact sediments.

Ice-thrust (adj.): Descriptive of materials with deformation structures, including folds and faults, and landforms, including moraines and arcuate ridges of sediment and/or bedrock, created by glacial thrusting at or near the termini of glaciers.

Ice-thrust Moraine: Broadly arcuate, subparallel ridges, commonly high (up to 200 feet, or 60m), large and long (up to several miles, or km), resembling moraines but composed mostly of detached blocks of unconsolidated bedrock, and/or Quaternary deposits that have been folded and thrusted by glacial pressure. Ice-thrust moraine is intimately associated with lodgement till and in many places it is covered by ablation till, forming hummocky knobs and knolls on the surface of large areas of subparallel arcuate ridges.

Inclined (adj.): Descriptive of sloping, unidirectional surfaces. Gradients range from 2 to 70%, but any individual inclined area has a generally constant slope not broken by marked irregularities.

Kettle: A steep-sided, bowl or basin-shaped hole or depression in glacial drift deposits, especially outwash or kame, and believed to have formed by the melting of a large, detached block of stagnant ice, (left behind by a retreating glacier) that had been wholly or partly buried in the glacial drift. Kettles commonly lack surface drainage and some may contain a lake or swamp.

Lacustrine (adj.): Descriptive of materials that either have settled from suspension in bodies of standing fresh water or have accumulated at their margins through wave action.

Lake: Any standing body of inland water, generally of considerable size.

Land System: Subdivision of Ecodistrict (LRA) in the Ecological Land Classification hierarchy.

Land System Database: An electronic spatial database (the map) linked to an attribute database created by the CAESA-SIP. The main attributes of the database are: Land System Name, Land System Number, Surficial Geology, Regional Surface Form, Groundwater Discharge, Stream Courses, Regional Bedrock, Lakes and Wetlands, Regional Soil Models.

Land System Inventory: An inventory compiled at the 1:250 000 scale. Land Systems within one ecodistrict are recognized and separated by differences in one or more of: general pattern of land surface form, surficial geological materials, amount of lakes or wetlands, or general soil pattern. All Land Systems within one ecodistrict have the same general climate for agriculture but differences in microclimate patterns can be recognized. An average-sized Land System is approximately three to four townships (32,000 hectares).

Land System Name: Consists of a geographic locator and a morphological descriptor (e.g.. Neutral Hills).

Land System Number: The concatenation of the Ecoregion number, the Ecodistrict number, and the Land System number. Land System numbers are unique (one to one relationship of Land System number to Land System name.

Landform: The shape of the land surface resulting from a variety of actions such as deposition or sedimentation (eskers, lacustrine basins), erosion (gullies, canyons), and earth crust movements (mountains).

Landscape: All the natural features such as fields, hills, forests, and water that distinguish one part of the earth's surface from another part. Usually it is the portion of land or territory that the eye can see in single view, including all its natural characteristics.

Landscape Model: A sub-model used in building a soil landscape model. The Landscape Model includes slope class, surface form, a surface form modifier and many other attributes of a landscape.

Legend: A brief explanatory list of the symbols, cartographic units, patterns (shading and color hues), and other cartographic conventions appearing on a map, chart, or diagram.

Level: Descriptive of flat land surfaces with slopes less than 2 percent.

Limestone: Sedimentary rock consisting chiefly of calcium carbonate.

Lithic (adj.): Descriptive for the condition when bedrock (too hard to dig with a shovel) immediately underlies a soil.

Loess: Unconsolidated windblown deposit (eolian) of silt and very fine sand.

Lowland: Any extensive hollow or low-lying land bounded by diverse hills and uplands. Though it may be traversed by a major stream, it does not have distinctive directionality related to that stream. Drainage from the surrounding uplands tends to meander across it before joining the major stream.

Map (electronic): A collection of geographically referenced data stored in a file and capable of being displayed on a graphics screen or plotted in hard copy form.

Map units: Measurement units used to define quantities depicted on a map, such as offset distances, pattern and shade spacing, and text and symbol size.

Marine (adj.): Descriptive of materials that have settled from suspension in salt or brackish waters, or have accumulated at their margins through shoreline processes such as wave action and longshore drift.

Marl: A soft, unconsolidated earthy deposit consisting of calcium carbonate or magnesium carbonate, or both, and often shells, usually mixed with varying amounts of clay or other impurities.

Medium Textured Group: A broad textural grouping that refers to soils or materials dominated by loam, silt loam, silt, silty clay loam, clay loam, and sandy clay loam textural classes.

Moraine: An accumulation of heterogeneous rubbly material, including angular blocks of rock, boulders, pebbles and clay, that has been transported and deposited by a glacier or ice-sheet.

Morainal (adj.): Descriptive of materials transported and deposited by glacial ice.

Mudstone: 1) Non-fissile sedimentary rock composed mainly of clay. 2) Term used for any fine grained, clastic sedimentary rock where doubt exists about the proportions of sand, silt, and clay, or where the proportions vary in such a way that more precise terms cannot meaningfully be used.

Nonsoil: Nonsoil is the collection of soil-like material that does not meet the definition of soil. It includes soil displaced by unnatural processes and unconsolidated material beyond the influence of soil-forming processes, except for the material that occurs within 25 cm below soil as defined. Nonsoil also includes unconsolidated mineral or organic material thinner than 10 cm overlying bedrock; organic material thinner than 40 cm overlying water; and soil covered by more than 60 cm of water in the driest part of the year.

Organic Deposit: Materials that have accumulated by growth and death of plants, and that contain more than 17% organic carbon.

Organic Soils: Soils that have developed dominantly from organic deposits. The majority of Organic soils are saturated for most of the year, unless artificially drained, but some of them are not usually saturated for more than a few days. They contain 17% or more organic carbon, and: 1) if the surface layer consists of fibric organic material and the bulk density is less than 0.1 (with or without a cultivated horizon less than 15 cm thick), the organic material must extend to a depth of at least 60 cm; or 2) if the surface layer consists of organic material with a bulk density of 0.1 or more, the organic material must extend to a depth of at least 40 cm; or 3) if bedrock occurs at a depth shallower than stated in 1) or 2) above, the organic material must extend to a depth of at least 10 cm.

Paralithic (lithic-like) (adj.): Refers to weathered bedrock (softrock) which is permeable and penetrable by plant roots. The material is "diggable" and has a hardness on the Mho's scale. Coarse fragment content of this boundary layer between soil and solid bedrock increases with depth until consolidated rock is encountered.

Parent Material: The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil has developed by pedogenic processes.

Peat: Unconsolidated soil material consisting largely of undecomposed, or only slightly decomposed, organic matter.

Pediment: a plannate erosion surface abutting a mountain front or set of high hills.

Pedon: The smallest three-dimensional unit at the surface of the earth that is considered as a soil. Its lateral and vertical dimensions can vary with circumstances, but commonly it measures 1 m square by 1 m deep.

Phase, (Soil): A functional unit outside the system of soil taxonomy designed and defined according to the purposes of a soil survey.

Plain: A region of generally uniform slope that is comparatively level, of considerable extent, and not broken by marked elevations and depressions.

Plateau: An extensive, relatively elevated area of comparatively flat land, commonly limited on at least one side by an abrupt descent to lower land.

Point Data: Refers to a detailed site description, or detailed map. Examples of point date include: assessment records, detailed soil survey site investigations, pipeline soil survey, salinity survey, irrigation land classification (level 2).

Recharge Area: Expanse of ground over which water is absorbed and added to the zone of saturation.

Regional Soil: Soil specified at the subgroup and genetic material(s) levels in the soil and landform classification systems respectively, and identified within a Land System (1:250 000).

Regional Soil Models: A conceptual description of the Soil Model with the greatest aerial extent in the Land System (1:250 000).

Regional Surface Form: A conceptual description of a recognizably distinct landscape.

Relief: Inequalities or differences in elevation of a land surface occurring within some area under consideration. Level land with no unevenness or differences of elevation has no relief; undulating land has low relief; rolling and hummocky lands have moderate relief; and hilly land has high relief.

Ridged (adj.): Descriptive of land with long, narrow elevations of the surface, usually sharp crested with steep sides. The ridges may be parallel, subparallel, or intersecting.

Rill: A narrow, very shallow, intermittent water course having steep sides. It presents no obstacle to tilling.

Rolling (adj.): Descriptive of land surfaces with a very regular sequence of moderate slopes merging from rounded, sometimes confined concave depressions to broad, rounded convexities producing a wavelike pattern of moderate relief. Slope length is often 1.5 km or greater and gradients are greater than 5%.

Rough Broken: Descriptive of an area having steep slopes and many intermittent drainage channels, but usually covered with vegetation. A miscellaneous land type used in soil mapping.

Saline Soil: A non-sodic soil that contains enough soluble salts to interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 mS/cm, the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5.

Sand: 1) A mineral particle between 0.05 and 2.0 mm in diameter. 2) Any one of five soil separates. The names and size limits of sand separates recognized by pedologists in Canada and the United States are: very coarse sand (2.0-1.0 mm); coarse sand (1.0-0.5 mm); medium sand (0.5-0.25 mm); fine sand (0.25-0.10 mm); and very fine sand (0.10-0.05 mm). 3) A soil texture class. See Texture Class.

Sandstone: Rock composed of sedimentary grains cemented together, the predominant grade of the grains being the sand size fraction.

Shale: Laminar (fissile) rock composed of sedimentary grains cemented together, the predominant grade of the grains being the silt and clay size fractions.

Silt: 1) A mineral particle between 0.05 and 0.002 mm in equivalent diameter. 2) A soil texture class. See Texture Class.

Siltstone: Rock composed of sedimentary grains cemented together, the predominant grade of the grains being the silt size fraction.

Simple Channels: A stream channel mapped as a single element. The channel banks and floodplain portions are not separated.

Slope (Gradient): Amount by which the surface of the earth deviates from horizontal, sometimes expressed in degrees, but more often as percent.

Slope (Gradient) Class: The description of an area or region in terms of the steepness of slopes. The slope classes and class limits and descriptive terminology area:

	Slope Class	Percent Slope	Approximate Degrees	Terminology
a	1	0-0.5	0	level
b	2	0.5-2.5	0.3-1.5	nearly level
c	3	2-5	1-3	very gentle slopes
d	4	6-9	3.5-5	gentle slopes
e	5	10-15	6-8.5	moderate slopes
f	6	16-30	9-17	strong slopes
g	7	31-45	17-24	very strong slopes
h	8	46-70	25-35	extreme slopes
i	9	71-100	35-45	steep slopes
j	10	>100	>45	very steep slopes

Slopewash: Unconsolidated material moved downslope by running water not confined to channels.

Softrock: A colloquial term used by geologists and soil scientists to designate soft (para-lithic) sedimentary rocks and to distinguish them from igneous and metamorphic rocks (hard rock).

Soil:

1. The unconsolidated material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.
2. TThe naturally occurring unconsolidated material on the surface of the earth that has been influenced by parent material, climate (including the effects of moisture and temperature), macro- and micro-organisms, and relief, all acting over a period of time to produce soil that usually differs from the material from which it was derived in many physical, chemical, mineralogical, biological, and morphological properties.
3. For the purpose of the Canadian taxonomic system, the earth's surface (the material to be classified) is divided into soil and nonsoil. Soil is the naturally occurring, unconsolidated, mineral or organic material at the earth's surface that is capable of supporting plant growth. It extends from the surface to 25 cm below the depth at which properties produced by soil-forming processes can be detected. These properties differ from those found in any underlying unconsolidated material. The soil-forming processes are defined as an interaction between climate, living organisms, and relief acting on soil and soil parent material. Unconsolidated

material includes material cemented or compacted by soil-forming processes. Soil may have water covering as its surface to a depth of 60 cm or less in the driest part of the year.

Soil Analyst: A soil mapper responsible for soil mapping and coding of soil attribute data.

Soil Classification: The systemic arrangement of soils into categories and classes on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties.

Soil Correlation Area (SCA): An area with similar agroclimate and landscape ecology such that it defines the geographic limits for usage of soil series names.

Soil Horizon: A layer of soil material approximately parallel to the land surface; it differs from adjacent layers in properties such as colour, structure, texture, consistence, and chemical, biological, and mineralogical composition that usually reflect differences in soil genesis and/or deposition.

Soil Inventory Meta Data: Data that explains soil inventory data structures, terminology, classification systems, models and procedures.

Soil Landscape: (1) A subdivision of a Land System in the Ecological Land Classification hierarchy. (2) An actual piece of land identified in a Soil Landscape inventory as an entity for which attributes are described.

Soil Landscape Inventory: Subdivision of a Land System into Soil Landscapes based on recognition of differences in patterns of surface form, surficial geological materials, lakes and wetlands, and soils, and descriptions of associated attributes.

Soil Landscape Model: A conceptual description of recurring soil and land patterns appropriate for the Soil Landscape level of the Ecological Land Classification hierarchy. It is an amalgamation of the Soil Model and the Landscape Model. Referred to as 'soil map units' in previous soil survey reports.

Soil Landscape Model Symbol: The Soil Landscape Model symbol used to describe the Soil Model and the Landscape Model on an output report.

Soil Layer File: A CanSIS database; part of Soil Inventory Meta Data; lists properties by soil horizon for one typical profile per soil name.

Soil Map Delineation: Area delineated on a map to represent a definite tract of land (a Soil Landscape) about which information is to be communicated. For a tract to be definite, distinct from its neighbors the tract must have discernible consistency in attributes i) that are important, and ii) that (individually or collectively) can be conceptualized, defined, and named. Assigned to the delineation, usually through symbols, the names and definitions impart the meaning of the tract it represents. Since difference in important attributes is what justifies differentiation of adjacent tracts, therefore one or more polygon symbols (and attribute names and concepts they denote) must differ between adjacent polygons. Lines on the map (polygon boundaries) represent the places on Earth's surface where, for practical purposes, changeover in attributes can be said to occur.

Soil Map Unit: (See Soil Landscape Model) A combination of kinds of soil, or miscellaneous land types that can be shown at the scale of mapping for the defined purpose and objectives of a particular soil survey.

Soil Name (series) Symbol: A code which identifies a Soil Name (e.g. CMO for Camrose).

Soil Names File (Generation 2): The current (1993) list of Alberta Soil Names and selected descriptions.

Soil Map Unit File: A CanSIS created database. Refer to Soil Landscape Model database.

Soil Model: Consists of a dominant or co-dominant soil series and any significant soils.

Soil Series: A category in the Canadian System of Soil Classification. This is the basic unit of soil classification, and consists of soils that are essentially alike in all major profile characteristics except the texture of the surface.

Soil Texture: The relative proportions of the sand, silt, and clay size fractions within the fine earth (<2 mm) fraction of a soil. Soil textures are usually expressed in terms of the texture class to which they belong.

Soil Texture Class: The soil texture classes and their limits are:

sand: fine earth containing 85% or more of the sand size fraction; % silt plus 1.5 times % clay does not exceed 15.

loamy sand: fine earth containing at the upper limit 85 to 90% sand, and % silt plus 1.5 times % clay is not less than 15; at the lower limit loamy sand contains not less than 70 to 85% sand, and % silt plus twice the % clay does not exceed 30.

sandy loam: fine earth containing either 20% or less clay, with a % silt plus twice the % clay exceeding 30, and 52% or more sand; or less than 7% clay, less than 50% silt, and between 43% and 52% sand.

loam: fine earth containing 7 to 27% clay, 28 to 50% silt, and less than 52% sand.

silt loam: fine earth containing 50% or more silt and 12 to 27% clay, or 50 to 80% silt and less than 12% clay.

silt: fine earth containing 80% or more silt and less than 12% clay.

sandy clay loam: fine earth containing 20 to 35% clay, less than 28% silt and 45% or more sand.

clay loam: soil material that contains 27 to 40% clay and 20 to 45% sand.

silty clay loam: fine earth containing 27 to 40% clay and less than 20% sand.

sandy clay: fine earth containing 35% or more clay and 45% or more sand.

silty clay: fine earth containing 40% or more clay, less than 45% sand, and less than 40% silt.

clay: fine earth containing 40% or more clay, less than 45% sand, and less than 40% silt.

heavy clay: fine earth containing more than 60% clay.

Names of soil texture classes can be modified by adding suitable adjectives when coarse fragments (particles >2 mm) are present in substantial amounts; for example, "stony sandy loam". Also, the sand, loamy sand, and sandy loam texture classes can be split into subclasses based on the proportions of the various sand separates present.

Sub-block: A subdivision of a Block. For example the NE Block was divided into NE1, NE2, NE3, NE4 and NE5 sub-block.

Surface Form: The assemblage and pattern of slopes within a landscape

Technical Authority: The person to whom the final digital soils database was delivered to.

Terraced: Descriptive of land surfaces with a nearly level, usually narrow plain (tread) plus a short scarp face (riser), usually adjacent to a river, lake, or sea. Rivers sometimes are bordered by a number of terraces at different levels.

Till: Material transported and deposited by glacial ice.

Undulating: Descriptive of land surfaces with a regular sequence of gentle slopes that merge from rounded concavities into broad, rounded convexities producing a wavelike pattern of low local relief. Slopes are generally less than 0.8 km long and have gradients of 2 to 5 %.

Upland: Areas that rise above the surrounding country, but that do not culminate in distinctive crests or summits. Abrupt elevation differences are rare, and if present they are usually small.

Valley: Any hollow or low-lying land bounded by hill or mountain ranges. A valley is usually traversed by and has general directionality related to a stream that receives the drainage from the surrounding heights.

Vector-based polygon: A homogeneous area associated with a particular set of attributes and delineated by a boundary composed of linear features that form a closed loop. Vector-based polygons do not overlap and are created as an integral part of an area theme.

Wetland: Permanently or intermittently wet land, including shallow water and land-water margins. For an area to be considered a wetland water must remain in it long enough for distinctly aquatic processes to occur. Wetlands are recognized by the□

White Area: An administrative boundary considered the "settled area" of Alberta. The White Area as of March 1992 was 63,248,640 acres (approx. 2745 townships).

Working Area: An area ranging from 1 to 6 townships (mostly 6 townships) used by soil analysts to compile soils information.

APPENDIX A: KEY SOIL INVENTORY REFERENCES

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