RANGE SURVEY MANUAL

FOR ALBERTA RANGELANDS

VERSION ONE



Alberta
Sustainable Resource Development

Rangeland Management Branch

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1.0 INTRODUCTION

Alberta Sustainable Resource Development (ASRD) is responsible for managing numerous grazing dispositions throughout Alberta. These dispositions are managed for multiple land uses that include wildlife and domestic animals, timber, recreation, and oil and gas exploration. Reducing conflict between land users and minimizing environmental damage is achieved by practicing range management in these areas.

Range management planning depends on accurate, up-to-date range inventories and inspections that are done according to the procedures and standards that are outlined in this manual. The purpose of a range and reconnaisance surveys and disposition audits is to aid in the determination of the number of head that can be supported by a given site, for a given period of time, or the **stocking rate**. This stocking rate is the balance between the livestock's monthly forage utilization requirements, the plant production and the ecology of the site. **Ecologically sustainable stocking rates** [ESSR] are suggested for each plant community described within Range Plant Community Type Guides.[1] The ESSR reflects the maximum number of livestock [e.g. hectares (ha)/animal unit month (**AUM**)] that can be supported by the plant community given inherent biophysical constraints and the ecological goal of sustainable health and proper functioning of the plant community. When the ESSR is expressed for the area [e.g. ha] of a plant community polygon, the result is termed **carrying capacity** [CC], and is written in AUMs. Often the CC must be adjusted for **access factors** [e.g. areas that are inaccessible due to natural barriers], and **management factors** [e.g. reduced livestock distribution attributed to livestock management]. This adjusted/reduced carrying capacity is the **grazing capacity** [GC].

The various survey methods used by Rangeland managers to collect the information needed to calculate carrying and grazing capacities manage public **rangelands**[2] in Alberta is outlined in this document. It also explains the process for map development.

IN GENERAL A RANGE SURVEY CONSISTS OF:

1. A **site description** (location, elevation, aspect, slope, natural subregion, etc.),
2. A **vegetation survey** for all of the current and potential forage producing areas for livestock use. This will consist of a 30 meter transect, a site description, forage production, and a photograph,
3. A **rangeland and/ or riparian health assessment**,
4. Preliminary range typing and mapping on 1:20,000 orthophotos or ARCPAD extracts,
5. **Plant community type** (**PCT**) classification
   a) Community type descriptions and associated PLC information,
   b) Community type forage productivity and carrying capacity,
   c) A list of major species within each community type,
6. A **written summary** of the surveyor's impressions of the current range management practices and subsequent recommendations.

[1] Web page link to guides: http://www.srd.gov.ab.ca/lands/managingpublicland/rangemanagement/classifica

2.0 RANGE SURVEY METHODOLOGY

This section outlines the methodology for completing the various type of range surveys used within Rangeland Management Branch. These surveys include detailed range inventory, reconnaissance surveys, Forest Reserve disposition audits and disposition renewal audits.

2.1 DETAILED RANGE INVENTORY SURVEYS

These surveys are conducted on areas that have **never been inventoried** or for which the **information is outdated**. The surveyor will be provided with the most up-to-date digital and/ or hardcopy maps available to aid in the survey. Sources for this information may include:

1. Phase 3 maps,
2. AVI, GVI, AGRASID
3. 5m panchromatic IRS satellite imagery,
4. C5 digitized maps/ data,
5. Old disposition maps,
6. Digitized disposition boundaries,
7. Topographic, access, hydrologic, and other relevant base map data,
8. Clean, 1:20,000 black and white air photos (the most recent available),
9. IRS imagery with original AVI polygons.
10. ELC/ PLC
11. Ecosite maps

The basic mapping unit for a range survey is the ecological site. Relatively stable landscape features and the existing plant communities define the potentials for each of these sites. Identification of current and potential areas for livestock grazing is the first step in planning field sampling. Preliminary mapping of plant community types will be done by SRD personnel in order to give the contractor an idea of how many sites will have to be surveyed according to the procedures outlined below. Range map boundaries are delineated using available maps and air photos. Five acres (2 ha) is the minimum site size surveyed at a mapping scale of 1:20,000.

2.1.1 Supplies Needed

1. Whatever maps are available and appropriate for survey of the disposition,
2. Several copies of:
   - The site description form PLD 021 (Appendix 5),
   - Vegetation inventory forms and continuation sheets MF5 (Appendix 1 and 2) or Prairie version (Appendix 3) and MF6 (Appendix 4),
   - Range Health Assessment short forms,
   - Tame Pasture Assessment short forms,
   - Riparian (Lotic and Lentic) Health Assessment short forms,
   - Pre-harvest Ecological Assessment Short forms (if required),
3. Coloured pens or stabilos for marking information on the maps,
4. Electric or manual clippers for biomass production clips,
5. Paper bags for biomass clips,

6. Daubenmire frame (1/10 m^2) for species identification microplots within grassland transects,
7. A quarter-meter squared frame for species identification microplots within forested rangeland transects, and for litter collection on grassland transects,
8. A half-meter squared frame (clipped once) or a quarter meter-squared frame (clipped twice) for production clips,
9. A 35 mm camera and colour print film and/or a digital camera if available,
10. Community type and carrying Capacity guide(s) for the subregion(s) that the disposition falls within,
11. GPS (UTM) location.

2.1.2 Inventory Procedures

1. Range inventory plots will be completed for all of the sites indicated on the supplied maps as well as for any other sites that the Surveyor deems necessary. In the southeast region, Agrasid polygons and potential range sites (Appendix 7) will be determined by the surveyor prior to entering the field and entered on the field sheets in the appropriate boxes on the Prairie MF5 form (Appendix 3).

2. A transect will be placed along the most representative part of each site/or within each polygon, and indicated with a T on the map. Each transect will be 30m long with 15 microplots placed randomly along it's length. If the transect is located on a slope, it will run parallel with the contour of that slope.

3. All necessary field forms (as indicated in the contract) will be filled out. Note: All surveys completed in the southeast region will use the prairie MF5 (Appendix 3)

4. A photograph will be taken at each site clearly showing the plot number and transect location.

5. A production clip (biomass) will be done at each transect as well as within any production cages that may have been established by ASRD at various sites in the area. A transect must also be completed at each production cage. The cage sites will be identified on the map supplied to the Surveyor. Clipped material will be separated into forbs, shrubs, trees, and grasses and put into the bags provided (labelled with the transect/ plot number and the vegetation type). These samples should be stored appropriately for preservation and delivered to an ASRD representative on a weekly basis for oven drying and weighing. A litter sample will also be collected at each transect by hand raking a ¼ m^2 plot at a representative site.

6. Each transect will be identified as primary, secondary or non-use on the plot sheet as well as on the maps.

7. The surveyor will identify and map any improvements and activities including: roads, trails, clearings, pipelines, salting locations, fences, buildings, corrals, and mineral licks occurring on the disposition(s). The existence and location of features that already appear as basemap features will be confirmed, and adjustments will be made as appropriate. All of these features will be saved as shape files for ArcView 3.2 and a standardized legend for all of these features will be developed on the final map as per procedures outlined in this manual.

8. Identify/ confirm and map hydrologic features such as lakes, rivers, creeks, ponds, springs, impoundments, etc. occurring on the disposition(s).

9. Rare, uncommon, and range extension sites will be delineated with a unique point or area symbol on the range map, and identified in the legend.

10. Rare plants, according to the current Alberta Natural Heritage Information Centre (ANHIC) Plant Species of Special Concern Tracking and Watch List, will be identified and documented as they are encountered. World Wide Web location: http://www.gov.ab.ca/env/parks/anhic/anhic.html. This will include completing the Rare Native Plant Report form and collecting uncommon and range extension plant specimens to be identified, verified, pressed and labelled.

11. Assessment of the disposition inventory, the overall livestock distribution and management will be done using the ASRD range inspection form. The surveyor must identify which sites should become permanent sites from which to monitor range condition trends using the rangeland, tame pasture and riparian health assessment short forms. These sites will be marked with a unique point or symbol on the range map as well as on the corresponding inventory sheets.

12. The average canopy coverage, for each species, of all 15 microplots will be entered on computer disk in the following format. **The excel format outlined below will apply to all areas of the province except the Prairie Region. In the Prairie region data will be entered into the Paradox Prairie database.** The procedure for entering data into the Prairie database is outlined in Appendix 8. Contractors will be supplied by the range managers in the SE region the template needed to enter data into the Prairie database.

EXCEL PROCEDURE FOR STORING VEGETATION TRANSECT DATA

1. All input files must be stored on a compact disk.
2. Input files will be constructed as follows in ASCII format using either EXCEL
3. The plot sheets should be divided into coniferous forest, deciduous forest, shrubland, and grassland categories. Each category should be entered **separately**.
   a) ASCII format must be established in EXCEL as follows:

Example of EXCEL data file in ASCII format (use font size 11):

Column 1	2	Column 3	4	Column 5	6	Column 7	8	Column 9	10		
7spaces	2	8	5	8	5	8	5	8	5		
ea62	6	astecil	9.9	corncan	7.4	mitenud	2	pyroasa	2.4	N	
ea62	6	arnicor	3.5	fragvir	4.7	trifhyb	0.7	rubupub	7.1	O	
ea62	6	taraoff	0.2	galibor	1.7	petapal	4.6	linnbor	6.7		
ea62	7	calacan	2.1	elyminn	4.2	oryzasp	2.5	agrotra	1.8	D	
ea62	7	schipur	1.4							A	
whsv07	1	picegla	7	popubal	10	poputre	50			T	
whsv07	2	betupap	5							A	
whsv07	4	alnucri	1.8								
whsv07	5	rosaaci	5.8	vibuedu	7.4	sympalb	0.2	loniinv	0.3		
whsv07	8	mossspp	6.3								

Column 1 contains site and plot identification **NOT** exceeding six characters in length. This column must be exactly seven spaces wide and left justified.

Column 2 represents the stratum or layer, where:

1 = Tree
2 = Understory tree
3 = Epiphyte
4 = Tall shrub (e.g. willow)
5 = Shrub
6 = Forb
7 = Grass
8 = Moss
9. = Lichen
10 = Bare soil

This column must be exactly two spaces wide and centred.

Columns 3,5,7 and 9 contain the **seven-letter code** that represents the plant species' Latin name. The first four letters represent the genus and the last three, the species (Flora of Alberta, Moss, E.H., 1994). ***Popu**lus **tre**muloides* would thus be represented as **poputre**. The species must be included to avoid confusion between similar codes (e.g. ***Agro**stis sp* and ***Agro**pyron sp* would both be represented by **agrospp** if the species were not identified). If the species is unknown it should still be marked on the plot sheet and a sample of the plant should be collected for later identification. Species should be listed on the plot sheet in the order of grasses first followed by forbs, shrubs, and trees.

These columns must be exactly eight spaces wide and left justified.

Columns 4,6,8 and 10 represent canopy cover and should be entered to one decimal place, even if the decimal is a zero (e.g. 1.2 or 1.0). These columns must be exactly five spaces wide and centred.

PROCEDURE FOR STORING VEGETATION DATA IN THE PRAIRIE PARADOX DATABASE

Detailed instructions for entering data in the Prairie database are outlined in Appendix 8.

The data must be entered in this way in order for SAS (Statistical Analysis Systems) to properly read it for analysis. Please contact Mike Willoughby at (780) 422-4598 or Barry Adams at (403) 382-4299 if you have any questions concerning data entry in the excel format or Paradox database format, respectively.

The Range Management Branch will use cluster analysis and ordination (DECORANA) to group the plots based on similarities in species composition with the purpose of finding patterns in the vegetation that were not initially apparent during the survey.

The analysis will be returned to the contractor who will determine the final grouping of the plots. These groupings will be summarized in SAS to fit pre-existing classifications by the Range Management Branch. Community type names will be based on the summarized groupings and will follow The Canadian Vegetation Classification System (Strong et. al. 1990). The community names are the responsibility of the range management branch. These names will be mapped under polygon descriptions.

13. All plant community types on the disposition (as determined from analysis of plot data) must be digitally mapped along with all other features not already on the base map. Mapping and attributing protocols for ArcView 3.2 are outlined in this manual.

2.2 RECONNAISSANCE SURVEYS

These surveys are conducted on areas that have been **previously inventoried**. The existing data will either be confirmed or updated through a reconnaissance survey.

2.2.1 Supplies Needed

The surveyor will be provided with a range of digital and hardcopy data that may include:

1. AVI,
2. 5m panchromatic IRS satellite imagery,
3. Old disposition maps,
4. Digitized disposition boundaries,
5. Topographic, access, hydrologic and other relevant base map data,
6. Clean 1:20,000 black and white air photos (the most recent available),
7. IRS imagery with original AVI polygons,
8. Community type and carrying capacity guides for the appropriate subregion(s),
9. AGRASID or GVI

The reconnaissance survey will concentrate on primary and secondary range polygons as indicated on the disposition maps. Corresponding polygons from current AVI coverage will form the framework for the inventory. These polygons will be confirmed in their entirety, subdivided up to three times apiece (indicating a complex of three plant community types), or merged as appropriate and attributed with plant community types from the appropriate field guides. Protocols on labelling, dividing, and merging AVI polygons are provided in this manual. If the contractor is not mapping the polygons it is preferable that he just fill in the attribute table.

Stratification, sampling, and mapping should be of appropriate detail or density for 1:20,000 scale. Units should not be smaller than 5 acres (2 ha). Error tolerances may be determined by referencing the following documents: the Alberta Vegetation Inventory Standards Manual, ASRD Public Lands and Forests Division general specifications for digital orthophoto production.

2.2.2 Inventory Procedures

1. To complete a reconnaissance survey, the contractor will follow procedures and specifications as outlined for the Preliminary (Detailed) Inventory Surveys with the following exceptions, modifications, and additions:

   a) Reconnaissance refers to a **visual** survey of an ecological site to plant community types and involves photographing the site and completing the MF5 (Appendix 2) and PLD 021 (Appendix 1) site forms. The surveyor will note all plant community types and provide information about the grazing potential, management concerns, etc. At each reconnaissance site **that is suitable for livestock grazing**, a forage production clip will be done with the exception of sites that have forage production cages; see (d) below.

   b) During a reconnaissance survey, the surveyor will reference the Community type and carrying capacity guides provided for the appropriate subregion(s); comparing dominant species and environmental characteristics to determine plant community types (**PCT**s). The PCT names and codes will be entered in the comment field on the MF5 (Appendix 2) form. Reconnaissance sites will be labelled ES on the map.

   c) Transects should only be created when the PCTs encountered in the field do not correspond with those in the guides.

d) Production cages will have been established by ASRD at various sites in the area (a map of cage sites will be provided and the department will be responsible for clipping these unless otherwise stated in the contract. At each cage, the surveyor will identify the PCT by a reconnaissance survey or, if necessary, the transect method as per c), above. Clipped material will be separated into forbs, shrubs, trees, and grasses and put into the bags provided (labelled with transect/ plot number, vegetation type and an ocular estimate of the percent utilization of each vegetation component). These samples should be stored appropriately for preservation, and delivered to a SRD representative on a weekly basis for oven drying and weighing. Production and PCT data will be forwarded to the surveyor for subsequent processing.

e) The surveyor will determine ecological site and ecological site phase for each PCT using the appropriate Community Type and Carrying Capacity Guides. These will be recorded on the MF5 (Appendix 2) form.

f) Non-use areas in the disposition, as determined from airphotos, disposition maps, AVI, and field observations will be characterized with Ecological site, phase, and PCT using the Community Type and Carrying Capacity Guides.

g) Reconnaissance and transect site positions in Latitude-Longitude will be acquired via GPS data (in NAD 83 and differentially-corrected to within 10m precision), or determined from georeferencing airphoto sites during the digital mapping process. These positions should be recorded in the Terrain Profile and Notes field of the MF5 forms and with annotated pinpricks on the clean set of airphotos.

The qualitative information recorded in the reconnaissance survey will also be recorded on the Range Management Form (RMF). The Range Management form (RMF) is essentially a summary of range health and management for a specific grazing disposition and should be completed as outlined in Section 3.0.

2.3 FOREST RESERVE DISPOSITION AUDIT

These surveys monitor **range health trends** since the last inspection and creates a record in time with respect to current management practices for forest reserve grazing allotments. A range inspection package will be created for each allotment.

2.3.1 Range Inspection Package

1. Two copies of the disposition map (on either an orthorectified aerial photo or IRS imagery background) or if available and ARCPAD extract showing boundaries, major drainages, roads, trails, and cutlines. The inspection map will also contain a number of pre-selected sites indicating appropriate locations for completing rangeland, tame pasture and riparian health assessment field sheets,
2. Several copies of the Range Health Assessment short form, Tame Pasture Health Assessment Short form and Lotic (Riparian) Health Assessment short form (also available on the IPAQ when an extract is completed),
3. A Range Inspection form (Appendix 4),
4. The contact name(s) and number(s) for disposition holders so that they can be invited to attend the inspection.

Items required for inspection that are not in the package include:

1. Plant Community Types and Carrying Capacity Guides for the appropriate subregions,
2. Coloured pens or stabilos for marking information on the map,
3. Weed Infestation reporting sheets,
4. Camera.

2.3.2 Inspection Procedure

Mission Planning: A field strategy should be established so that the inspection can be carried out effectively. This will involve a review of the disposition maps and interviewing people with knowledge of the area, particularly the disposition holders.

The rider, manager and/ or disposition holder(s) should be invited to attend the inspection. All are a valuable source of knowledge of the area and the management regime. Information is required on the inspection form that only the rider, manager and/or disposition holder can provide. If they are unavailable at the time of inspection this information can be collected over the phone.

Inspection: The inspection is composed of a quantitative component (Rangeland Health Assessment short form, Tame Pasture Assessment short form, and Lotic (Riparian) Health Assessment short form) and a qualitative component (Range Inspection form (Appendix 4)).

- **Quantitative:** The Rangeland Health Assessment short form and the Tame Pasture Health Assessment short form are intended to be a quantitative check of rangeland and tame pasture health, respectively. A number of permanent sample sites are chosen and marked on the disposition map indicating the locations at which field sheets are to be completed. These sites are expected to provide information on long-term range health trends.

In addition to the permanent sites, inspectors should use their discretion to complete a number of Rangeland and Tame Pasture Health Assessment field sheets (10-20%) in any other areas they feel to be indicative of present management issues. The inspector can make a note if they feel that one of these discretionary plots should become a permanent sample site. Photographs must be taken of every site at which a field sheet or short form is completed, as well as, of any other area where there is an issue or concern. If there are riparian areas in the disposition, the Lotic (Riparian) Health Assessment short form should be used to quantitatively evaluate these areas.

- **Qualitative:** The Range Inspection form (Appendix 4) and the disposition map make up the qualitative portion of the inspection.

  The map is not intended solely for orientation in the field, but also as a visual management tool. Writing notes directly on the map creates a spatial record of information pertaining to; problem areas, areas that could be managed to receive more use, areas where dynamic management is currently in practice, weed infestations, existing and potential water development sites, etc.

  The Range Inspection form is essentially a summary of range condition and management for a specific grazing disposition and should be completed as follows:

Primary and Secondary Range Tables: These tables rate the current livestock utilization on primary and secondary range. Primary ranges are the preferred ranges for grazing livestock. Cattle, if not managed, will normally utilize primary range very heavily before they will significantly utilize secondary range. However, through active management, cattle can be encouraged to make significant use of secondary range without negatively impacting primary range.

Percent utilization, of both primary and secondary range should be noted for each individual management unit or plant community type, depending on disposition size. For management purposes, larger dispositions (i.e. allotments in the Forest Reserve) should have percent utilization estimates for each distribution unit, whereas it may be feasible on smaller dispositions (i.e. northern grazing leases and licenses) to estimate utilization of each plant community type. Comments specific to utilization in each management unit/ plant community type can also be included in this table.

1. **Livestock Utilization and Distribution:** this space is provided for the inspector to fully discuss general livestock utilization and distribution. Successful management should be noted along with any problems.

2. **Management**:
   a) **Riding and Herding:** Examines the disposition holder's riding and herding program (if applicable). A discussion with the manager along with information gathered during the inspection will be required to adequately assess the riding and herding program.

   b) **Salt:** This question examines whether or not salt is being used properly as a management tool. As well as having importance as a livestock distribution tool, salting is also a disturbance factor. Determine if salt is well placed in order to

minimize disturbance (visual impact). Are the rules for salt placement being followed?

The use of salt or mineral licks can be a valuable tool to control livestock distribution patterns. Salting should be done away from primary range, water sources and main trails, unless a specific management goal is trying to be achieved. Suitable sites for salting include open shallow soiled areas (such as rocky outcrops), or forested areas that are productive but are not currently receiving much utilization (secondary range). Soil substrate and moisture conditions should be considered before salt is placed to ensure that severe trampling damage does not occur. At permanent salting sites the salt should be placed in some type of container. Salting sites should not be placed in sensitive or highly visible areas. It may be necessary to move cattle to a salt lick once or twice in order to educate them or its location. When a salting site is not being used or grazing in the area is to no longer be emphasized, the salt should be removed.

c) **Fencing**: On an extensive grazing disposition, several days may be required to check fences. This may not always be feasible however, and the inspector should inspect a number of sections of fence (both internal and perimeter). The sections checked must be marked on the map and their condition noted. If fencing on the allotment is known to be an issue, a much more detailed review will be required during the inspection.

d) **Water supply and Distribution**: Water is a very important livestock distribution tool that is often the limiting factor to successful range management. Existing developments should be mapped and their condition noted. Areas where watering livestock are responsible for riparian damage should also be noted. Comment on the potential for water development (remember water must be present) and map any plausible locations.

3. **Weeds**: a short, general statement about weeds is required in the report. Weed infestations should be marked on the map and a weed infestation report filled out.

4. **Other Resource User Issues:** This section should be based on discussions with the disposition holder and on observations made during the inspection. Inspectors should focus on existing conflicts or potential future conflicts that are influencing management. Consideration should be given to resolution or follow-up on the issues where this is possible. Action items should be highlighted in yellow on the final inspection form.

5. **Predators:** Problems with predators or management activities undertaken to deal with predators should be noted. This information will be gathered primarily through interviews with the manager and/or disposition holder.

6. **Range Maintenance:** Discuss any new range maintenance projects undertaken since the last inspection. Consider the following: Are the projects performing as expected? Are there any future projects planned? Are there any new projects that should be considered?

7. **Overall Management Summary:** Intended as an area for a general discussion of the success or failure of the current management scheme. What action is required?

The qualitative information recorded with the map and the range inspection form should be recorded on the Range Management Form (RMF). The Range Management form (RMF) is essentially a summary of range health and management for a specific grazing allotment and should be completed as outlined in Section 3.0.

2.4 DISPOSITION RENEWAL AUDITS FOR SOUTHEAST REGION

These inspections monitor **range health trends and factors to assess the standing** for each dispositon that is up for renewal. The reasons for doing this procedure are outlined in staff directive "Renewal of Grazing Dispositions". An audit package will be created for each grazing disposition and will be used to complete a Range Management Form (RMF).

2.4.1 Range Renewal Package

1. Disposition map or ARCPAD extract of the disposition (Procedure for completing and ARCPAD extract is outlined in GLIMPS help under ARCPAD Disposition Management features guide).
2. Several copies of the Range Health Assessment short form, Tame Pasture Health Assessment Short form and Lotic (Riparian) Health Assessment short form (also available on the IPAQ when an extract is completed),
3. The contact name(s) and number(s) for disposition holders so that they can be invited to attend the inspection.

Items that may also be required for inspection include:

1. Plant Community Types, Carrying Capacity Guides and AGRASID polygons identifying the various range sites (Appendix 7) for the appropriate subregions,
2. Weed Infestation reporting sheets,
3. camera.
4. Blank copies of the Rangeland Management Form and Rangeland Assessement Form (Downloadable from GLIMPS under REPORTS….BLANK FORMS)

2.4.2 Inspection Procedure

Range Health Short Forms

The Rangeland Health Assessment short form and the Tame Pasture Health Assessment short form are intended to be a quantitative check of rangeland and tame pasture health, respectively. A number of sample sites are chosen and marked on the disposition map or IPAQ (for information on completing a short form on the IPAQ see GLIMPS help "ARCPAD short form user guide") indicating the locations at which the field sheets were completed. Photographs should be taken of every site at which a field sheet or short form is completed, as well as, of any other area where there is an issue or concern. If there are riparian areas in the disposition, the Lotic or

Lentic (Riparian) Health Assessment short form should be used to quantitatively evaluate these areas. The riparian short forms are also available on the IPAQ.

Range Management Form (RMF)

There are a number of additional items that should be noted at the time of inspection that will make completion of the RMF form easier. These include:

a. Plant community and range site polygons - Percent utilization and rangeland health, of both primary and secondary range should be noted for each individual polygon, plant community type or range site, if a health short form was not completed.

b. Management considerations

Livestock Utilization and Distribution: Successful management should be noted along with any problems.

Salt: This question examines whether or not salt is being used properly as a management tool. As well as having importance as a livestock distribution tool, salting is also a disturbance factor. Determine if salt is well placed in order to minimize disturbance (visual impact). Are the rules for salt placement being followed?

Fencing: Note condition of fencing is it satisfactory or not?

Water supply and Distribution: Existing developments should be mapped and their condition noted. Areas where watering livestock are responsible for riparian damage should also be noted. Comment on the potential for water development (remember water must be present) and map any plausible locations.

Weeds: Weed infestations should be marked on the map and a weed infestation report filled out if applicable.

Predators: Problems with predators or management activities undertaken to deal with predators should be noted.

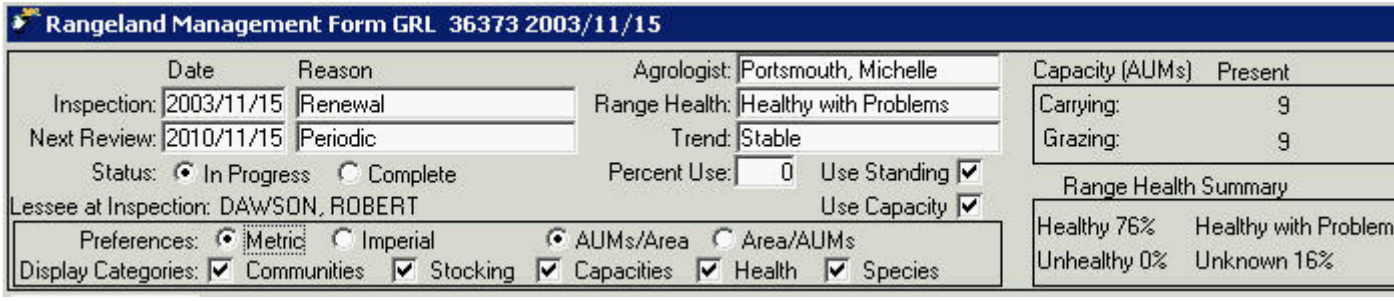
Overall management summary: This section should be based on discussions with the disposition holder and on observations made during the inspection. Inspectors should focus on existing conflicts or potential future conflicts that are influencing management. Consideration should be given to resolution or follow-up on the issues where this is possible.

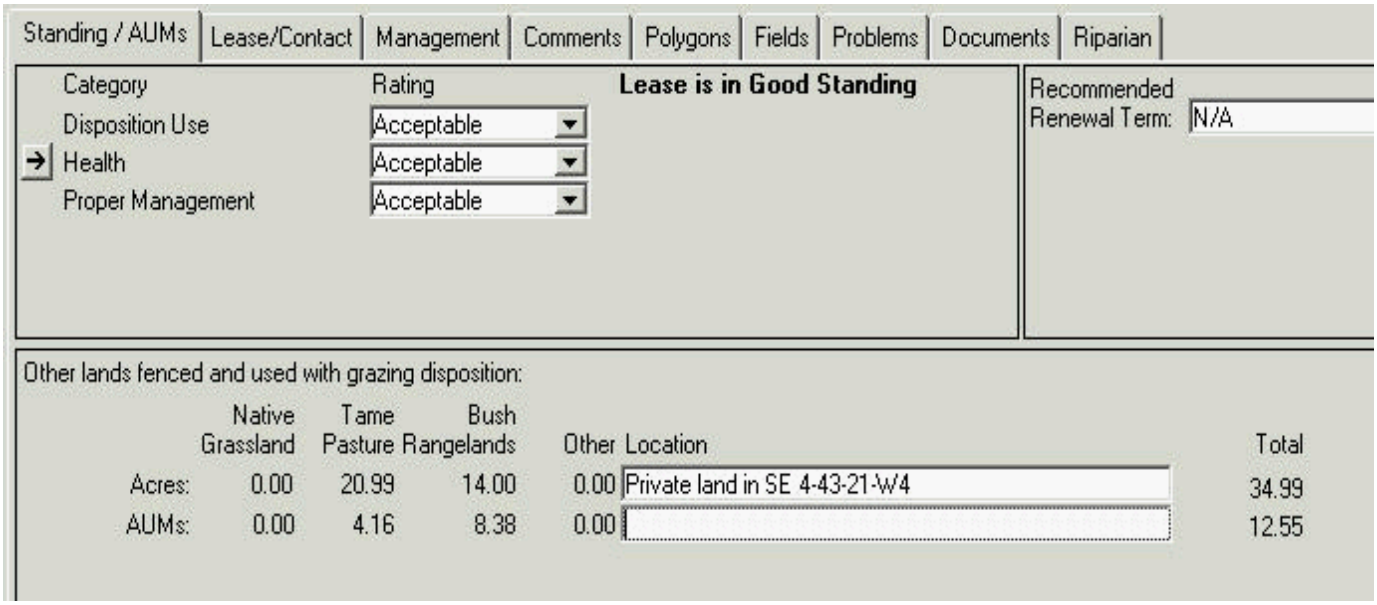
c. Mapping -The map is not intended solely for orientation in the field, but also as a visual management tool. If new polygons are outlined on the map or IPAQ in ARCPAD these should be sent to the GIS specialists in Edmonton for update and storage.

3.0 RANGE MANAGEMENT FORM (RMF)

The Range Management Form (RMF) is the format in which range health and management information for a specific grazing disposition is captured and stored by Rangeland Agrologists in a centralized database [GLIMPS (Geographic Land Information Management and Planning System)]. An RMF is required prior to issuing and generally prior to renewing a grazing disposition and should be completed as outlined in the "Guide to Completing the Range Management Form".. The minimum standard is one RMF, with at least one polygon encompassing the lease, to be completed at least every 10 years and follows the staff directive "Determining the Carrying Capacity of Grazing Dispositions for Billing Purposes". The only exception is Forest Reserve Grazing Allotments which require RMFs every 15 years.

These two figures outline the rangeland management form in GLIMPS. The methodology for completing each window (Standing/AUMs, Lease/Contact, Management, Comments, Polygons, Fields, Problems, Documents and Riparian) are outlined in the "Guide to Completing the Range Management Form" or in GLIMPS help.





4.0 SURVEY FORMS AND FORM METHODOLOGY

This section provides a description of the various forms required for completion of the various types of range surveys.

4.1 Vegetation Inventory Form MF5 (Appendix 1)

The Ecological Land Survey Site Description Manual (Land Information Services Division 1994) should be used in conjunction with the PLD 021 form. Information on the site description form MF5 that is duplicated on the PLD 021 vegetation inventory form will not be filled out on the MF5 form.

Disposition/ Allotment: Write in an appropriate eleven-character abbreviation specific to the management area being surveyed. For dispositions, the disposition number is used to identify an area rather than its local name. E.g. Grazing lease identified as GRL 000000.

Field/ Distribution Unit (DU): Write in an appropriate four-character abbreviation specific to the field or distribution unit number or name.

Site Number: This identifies the site being surveyed. It is a four-character designation using two letters from the disposition or, if applicable, the field or distribution unit, and two numbers for the range type. E.g. Upper Willow Distribution Unit, sixteenth range type surveyed: Site Number - UW16.

Polygon Number: The Contractor is not required to complete this section until the mapping has been finished. This will reference the survey form to the final map product.

Date: When the range type was surveyed? Enter as year, month, day (e.g. 98 08 03).

Examiner: Last name of the individual(s) doing the vegetation survey.

Legal Description: Information to be obtained from the site description form.

Slope: Information to be obtained from the site description form.

Aspect: Information to be obtained from the site description form.

Elevation (m): Information to be obtained from the site description form.

Airphoto Number: Information to be obtained from the site description form.

Polygon Geomorphic Description: Identify the corresponding polygon on the 1:20,000 PLC interpreted air photo and copy the information to this space. Refer to Physical Land Classification Methodology, (Kocaoglu, 1990), page 15 for further information.

Terrain Profile and Notes: Draw a diagram of the general area (e.g. valley) where the sampling occurred. Show the slope, aspect and topographical features. Indicate the distance to water and salt, shrubs, or any other features that give information about the

site. This does not necessarily have to be drawn to scale but distances to landscape features should be included. Identify location of transect in relation to terrain profile.

Site Description: This information is obtained from the site description form PLD021. This section does not need to be completed

.

Photography: A photograph should be taken at each site from the end of the transect, looking back on the transect line. Site number must be identified in the photo.

Plot Size: Check off the appropriate plot size, (1 m x 1 m) for shrubs and (20 cm x 50 cm) for forbs and grass.

Production: Clip a 50x100cm quadrat to a two-cm stubble height at each transect. The clip will be separated into trees (foliage at below 2.5 m) shrubs (below 2.5 m), forbs, and grasses. Current annual growth of trees and shrubs will be clipped (this years twigs and leaves). Litter should be raked out of the plot before clipping, and bagged for later drying and weighing. Each bag will be marked with the appropriate transect number. ASRD will provide bags and all air dried bags will be given weekly to department personnel for oven drying.

Species, Plot Number: A transect will be placed along the most representative part of each site. Each transect will be 30m long with 15 microplots placed randomly along it's length. If the transect is located on a slope, it will run **parallel** with the contour of that slope.

Each microplot ($1m^2$) will be used to record the canopy cover of shrubs (<2.5 m in height), and a nested microplot (20x50-cm) will record the canopy cover of forbs and grasses in grasslands and tame pastures. A ¼ m^2 quadrat will be used to record canopy cover of grass and forbs in forested stands. One macroplot ($20m^2$), located in the middle of the transect, will be used to estimate the canopy cover of trees and tall shrubs (> 2.5 m in height). This will be recorded to the nearest 5%, in the average % cover column. Cover estimates for all other species will be recorded to the nearest 5% and to the nearest 1% between 0 and 5%.

Canopy cover estimates will be recorded at each microplot on the MF5 (Appendix 2) form. The plant species (trees, shrubs, graminoids and forbs) will be recorded using a seven letter code (Flora of Alberta, Moss E.H., 1994).

Litter/Total Vegetation: Check off the appropriate one and give the cover rating for each microplot.

Exposed Soil: Give the cover rating for exposed mineral (organic too?) soil in each plot. This is **NOT** a measurement of rocks or decayed organic material. The cover of debris (sticks, etc.) and rocks should be recorded separately. If no exposed soil is encountered a tick should be marked in that box for that plot.

Moss and Lichen: Give the cover class rating for moss and lichen in each plot. If no moss or lichen is encountered, a tick should be marked in the box for that plot. Where there are a variety of species of moss and/ or lichen (e.g. within a Sw/ Moss community

type), the species names and cover of each should be recorded in the species field with all other plant species.

Browse Utilization Form: If browse utilization is measured rather than species composition, it is checkmarked here.

Subtotals/ Totals: Subtotals brought forward from any continuation sheets are to be written here.

Range Condition: Estimate the range condition as compared with the perceived climax composition of the site. Adjacent ungrazed sites may be especially helpful for visual comparisons and similar climax sites that have already been surveyed can serve as guidelines on which to base the estimate. Range condition classes are: healthy, healthy at risk, and unhealthy. Refer to rangeland health short form methodology (Adams et al. 2003).

Range Condition (%): This box may be filled out if a range health assessment short form has been completed. Range condition is estimated by comparing the percent composition of all decreaser species and an allowable percentage of increaser species (and possibly invaders) in a range type to the percent composition of species found in a climax community. Field staff and Contractors are not required to complete this section unless specified in the contract.

Page __ of __: Write in the total number of inventory forms used for the site (i.e. if one or more MF6 continuation forms are used).

BACK OF MF5 FORM (APPENDIX 2)

Range Use Category: Indicate whether the range is primary, secondary or non-use. Primary ranges are areas that livestock prefer to use when management is limited. Secondary ranges are lightly used or unused by livestock under minimal management and will not, ordinarily, be fully used until the primary range has been overused. Non-use areas are not used by the livestock for grazing due to a lack of forage (e.g. coniferous forest) or inaccessibility (e.g. bogs).

Grazing Intensity: Check off the appropriate box: unused (U), low (L), medium (M) and high (H) as an estimate of the level of past utilization. Past utilization can be estimated by the amount of litter, quantity of cattle droppings and seed heads remaining from the previous year.

Current Utilization: Give an estimate of the proportion of the current year's growth grazed by livestock. The proportion of new growth that has been utilized determines this. The number of livestock in the area and amount of cattle droppings can be used as well.

Vigour: This box is not to be filled out by the Contractor.

Description of Woody Species: Describe woody species in areas that have predominant shrub cover (deciduous forest, shrublands or wetland ranges) or tree re-growth (range improvement or timber harvest sites). This part of the form should be filled out when the shrub or tree re-growth cover is greater than 30%. The 20x20 m macroplot located at the centre of the transect will be used to measure the cover and density distribution of these species.

Woody Species: List the eight most dominant brush species, in order of dominance. Use the seven-letter species code.

Density Distribution Class: Choose the density distribution class which best describes the spatial pattern of each brush species from the adjacent table on the form. The density distribution classes (Walmsley et al., 1980) were developed to measure spatial patterns of individual species. They are useful in describing brushland/ grassland complexes.

Median Height (m): Record the average height of each brush species to the nearest one-tenth metre.
Height Range (m): List the height range (highest to lowest) of each brush species to the nearest one-tenth metre.

Percent Area Cover: Give a visual estimate of the per cent cover of each species. Total coverage of brush species can be greater than 100% because of the different strata of vegetation.

Basal Diameter (cm): Estimate the average basal diameter of each species (choose one stem/ species which appears representative).

Total Shrub Cover: Record the **height class** and **density distribution class** of the dominant and subdominant strata (all species).

Forest Cover: Use available cover specifications (Phase III Forest Cover Type or Alberta Vegetation Inventory Type maps) or assess forest cover according to the Alberta Vegetation Inventory specifications. Dominant/ subdominant applies only where there is an overstory/ understory designation.

Comments: Comments should refer to patterns of livestock use, relative vigour of key species, barriers to grazing from litter or shrubs and site limitations.

Poisonous Plants/ Weeds: a brief summary on some commonly encountered poisonous plants and noxious weeds.

1. i. SPECIES: List the plant codes of the three most common species.
   ii. LOCATION: Mark location of poisonous or noxious weeds on airphoto and field map and notify forest service personnel. If a GPS unit is available, record location (lat./long.) using GPS.
   iii. %AREA COVER, DENSITY DISTRIBUTION CLASS - Record the percentage of area covered and the spatial distribution based on the density distribution classes listed above.

Range Improvement/ Site Potential: Changes in use patterns and/or physical changes are recommended here.

Use patterns: Indicate any changes to salting, livestock distribution, class of livestock (mature, breeding cow, bull, yearling), or fencing. An explanation of their intent should also be given.

Water Source: Mark the appropriate box and locate on the airphoto and map.

Water Quality/ Access: Specify the quality of the water and of the access. For example, comments may indicate that the water is stagnant and that access to water is down a steep, eroding bank.

Salt Source: Mark the appropriate box and give location on the airphoto and map. These sites will be marked using an "S".

Access (Cattle): Designate the quality of the access to the site being surveyed (good, fair, poor) and the type of access (truck trail, road, etc.).

Comments: Discuss conflicts that may arise with other users of the area, their impact on the range and make recommendations on integrating them with cattle grazing. Other users would include equestrian, off-highway vehicles, hikers, wildlife, fisheries, riparian areas, timber harvesting, reforestation and oil and gas activities. Any other comments specific to the management of the area are to be included here.

4.1.1 Prairie Version of the MF5 Form (Appendix 3)

Fill out this form if you are working in the Dry Mixedgrass, Mixedgrass, Foothills Fescue, or Fescue Parkland subregions of the southeast region. Description of the components are the same as above, with the following additions :

Vegetation Type: Forested, Shrubland, Grassland, Riparian, (Lentic or Lotic)

GPS Unit #: Identification number on GPS unit

Waypoint #: The number of the waypoint as recorded on the map and within the GPS Unit.

Start: GPS location of the beginning point of the transect (decimal degrees)

End: GPS location of the end point of the transect (decimal degrees)

Litter Production: lbs/ac or kg/ha of litter as hand raked from a ¼ m^2 plot

Range Health Estimate: The range health of the entire polygon as depicted by the transect.

SCA: Soil Correlation Area

AGRASID: Manual in Appendix 7.

Allowable Cover Percentages: Cover recorded in the table must be to the exact percentage from 1-10% and to the closest 5% from 10-100%.

4.2 Vegetation Inventory Form MF6 (Continuation Sheet) (Appendix 4)

MF6 (Appendix 4). To be used when additional space is needed to record extra plant species.

4.3 Site Description Form PLD 021 (Appendix 5)

In order to make range inventory data compatible with Alberta's Ecological Site Information System (ESIS) ORACLE database, completing detailed site descriptions becomes necessary. Location information, particularly latitude and longitude, is important and site data collection must include elements of vegetation and soil that are not described on the vegetation form MF5.

The standard site description form that will be used is PLD 021. This form includes the following categories that are described in the Ecological Land Survey Site Manual (Land Information Services Division, 1994):

Factor	Description	Factor	Description
Exposure type	1. Not applicable 2. Wind 3. Insulation 4. Frost 5. Cold air drainage 6. Atmospheric toxicity	Site microtopography	1. Straight 2. Hummocky 3. Tussocky 4. Pitted 5. Irregular
Flood hazard	1. No hazard 2. Rare 3. May be expected 4. Frequent	Site surface shape	1. Straight 2. Concave 3. Convex
Soil drainage	1. Very rapidly 2. Rapidly 3. Well 4. Moderately well 5. Imperfectly 6. Poorly 7. Very poorly	Ecological moisture regime	1. Very xeric (very dry) 2. Xeric (dry) 3. Subxeric (moderately dry) 4. Submesic (moderately fresh) 5. Mesic (fresh) 6. Subhygric (moderately moist) 7. Hygric (moist) 8. Subhydric (moderately wet) 9. Hydric (wet)
Perviousness	1. Rapidly 2. Moderately 3. Slowly	Nutrient regime	1. Oligotrophic (very poor) 2. Submesotrophic (poor) 3. Mesotrophic (medium) 4. Permesotrophic (rich) 5. Eutrophic (very rich) 6. Hypereutrophic (e.g. saline)
Site position (Macro)	1. Apex 2. Face 3. Upper slope 4. Middle slope 5. Lower slope 6. Valley floor 7. Plain 8. Plateau	Successional status	1. Pioneer seral 2. Young seral 3. Mature seral 4. Old seral 5. Young edaphic climax 6. Mature edaphic climax 7. Young climatic climax 8. Mature climatic climax 9. Disclimax 10. Non vegetated
Site position (Meso)	1. Crest 2. Face 3. Upper slope 4. Middle slope	Disturbance Factors	1. Atmospheric 2. Cutting and soil disturbance 3. Dumping, disposal and spills 4. Fire

	5. Toe 6. Valley floor 7. Plain 8. Plateau		5. Plant/ animal effects 6. Terrain related 7. Site improvement 8. Water related

4.4 Ecological Land Survey Site Description Manual

Section one of the Ecological Land Survey Site Description Manual (1994) will provide information on the completion of the PLD 021 form. For surveyors not familiar with this form please contact your local Range Management Specialists for a copy.

4.5 Rangeland Health Assessment Short Form

The background and methodology for filling out the Rangeland Health Assessment short form (Adams et al. 2005).

4.6 Tame Pasture Health Assessment Short Form

The background and methodology for filling out the Tame Pasture Assessment short form (Adams et al. 2005)

4.7 Riparian (Lotic and Lentic) Health Assessment Short Form

For a current version of these forms and directions for its use, see the Cows and Fish website World Wide Web location: http://www3.gov.ab.ca/srd/land/m_landinfo.html

4.8 Pre-Harvest Ecological Assessment Short Form

In this day and age of shared information, it is very important that data collection in the field be standardized. The Pre-Harvest Ecological Assessment Handbook was developed for foresters and now that a great deal of timber harvesting is occurring on grazing dispositions, it becomes critical that accurate, standardized information is gathered. The more universal the information is, the easier it will be for the resource managers to make appropriate management decisions.

Some of the information on the Pre-Harvest Assessment short form is a duplication of what is found on the Site Description Form (PLD 021) and will not need to be filled out. However, the soils information may be required. Additional information regarding soil classification may be obtained from The Canadian System of Soil Classification, second edition.

5.0 DIGITAL MAPPING METHODOLOGY

Mapping of plant community types allows the range manager to determine the area [ha or ac] of a polygon attributed with a particular ESSR [AUMs/area]. Polygon area, multiplied by the ESSR [expressed as AUMs/area], equals the polygon CC. There are several steps to the mapping process, each step subdividing the previous division. The mapping process begins with the boundary of the area of interest [e.g. lease]. Next, the boundary is subdivided into management units. These are delineated based on fencelines [i.e. pastures] or natural barriers. Management goals and decisions for these units have the potential to have varying effects on plant community succession, rangeland health and therefore productivity. Additionally, management options [e.g. livestock rotations, stocking rates, water development, etc.] are applied on a pasture basis. To maximize resource management effectiveness, management units must be delineated. [Management units of associated private lands used by the livestock operation may also be mapped, but have no impact on the CC of the grazing disposition.]

Next, the lowest known ecological unit [e.g. ecological site phase or plant community] is delineated and mapped in order to determine the area associated with each community type within management units. Spatial data such as soil landscape information [e.g. Physical Land Classification (**PLC**) or AGRASID], vegetation information [e.g. Alberta Vegetation Inventory (AVI)], or aerial photo interpretation are utilized to assist in the identification of relatively contiguous ecological units or 'polygons'.

Once the area of interest is delineated to the most practical level of ecological unit, the boundaries, management units and polygons are digitized to produce a map in ArcView. Data [obtained from a detailed inventory or a health assessment] is associated with each polygon and is used to populate the ArcView attribute table [e.g. Table 1]. Additional spatial data such as AVI or AGRASID can also be linked to each polygon. Once data is associated with a particular polygon, it is mapped in a geographic information system [e.g. ArcView].

Often it will not be possible or desirable to separate out all the plant community types that exist within a mappable unit [minimum size ~ 0.7 cm X 0.7 cm at 1:20,000 or 2 ha]. For example, in the Parkland Subregions, open grassland, shrublands and aspen forest communities can all co-exist within one acre. To allow for this complexity in landform and therefore, plant community types, the ArcView attribute table can accommodate up to three plant community types as mosaics, per polygon. The convention used by RMB to map these plant community mosaics as one polygon employs the use of deciles [portions of 100% recorded as whole numbers from 1 to 10, 10 representing 100%]. A decile is used to describe the relative area occupied by each of the 3 dominant plant community types within the mapped unit. Table 1 shows a format that can be used to record the information. The fields named with "_1" are associated with the first decile, while "_2" and "_3" [not shown in the table] would be the second and third deciles. Continuing with the Parkland example, a delineated polygon might be comprised of 50% rough fescue community [in decile_1 enter 5]; 30% buckbrush community [in decile_2 enter 3]; and 20% aspen-rose community [in decile_3 enter 2]. The CC for each polygon is determined by dividing area [e.g. ha or ac] by stocking rate [ha/AUM or ac/AUM] for each decile, then summing the AUMs of all the deciles within the polygon.

These mapping procedures and calculations can be done by hand, within GLIMPS [mapping function under development] or ArcView.

Table 1: Example **rangeland unit** attribute table for mapping and calculation of CC and GC

FIELD_NAME	VALUES
Polygon_no	**Polygon Number**: Unique identifying number or character for the delineated polygon.
Decil_1	**Decil**: Use 1,2,3…10 indicating the percentage of the polygon the decile occupies i.e. 3 = 30%.
Ecosite_1 or Range Site_1	**Ecological site**: One character as per the plant community guides [e.g. c]. **Range Site:** Two or three characters as per plant community guides [e.g. Bdl]
Eco_phas_1 or Ecological Range Site_1	**Ecological site Phase**: Two characters as per the plant community guides [e.g. c3] **Ecological Range Site_1**: Two or three characters as per plant community guides [e.g. a21]
PC_1	**Plant Community Code**: Enter the code taken from a plant community guide. If the plant community has not yet been described in any plant community guide, enter CPC and a number for conditional plant community proposed. CPC# is not required in GLIMPS.
Sugg_Stock_1	**Suggested Ecologically Sustainable Stocking Rate**: taken from the Range Plant Community Guides [e.g. 2.0 ha/AUM].
Adj_Stock_1	**Adjusted Stocking Rate:** entered when the suggested ESSR does not represent the site (based on field experience or new data) [e.g. 2.5 ha/AUM]. If the ESSR does not currently reflect a reduction in stocking level to improve range health, adjustments should be made here.
Carry_Cap_1	**Carrying Capacity:** ESSR expressed for the polygon area [AUMs]. Note that this value is not displayed in GLIMPS.
Rge_Use_1	**Range Use Category**: 1-Primary, 2-Secondary, 3-Non-use, 4-Special Use.
Access_Factor_1	**Access Factor:** Accessibility of a rangeland unit to livestock under practical range management. Enter "0" for no access, up to "10" for complete access [e.g. 7 = 70% of unit is accessible to livestock]
Bill_AUMs_1	**Billable AUMs:** In the RMF within GLIMPS, this value is referred to as 'Carrying Capacity'. Expressed as AUMs. See glossary for further information.
Mgm_Factor_1	**Management Factor**: The portion of a rangeland unit used by livestock under current management [i.e. livestock distribution]. Enter "0" for very poor distribution, and up to "10" for full livestock distribution [e.g. 7=70% of rangeland unit is traversed by cattle].
Graz_Cap_1	**Grazing Capacity:** GC = [CC X access factor X management factor]. Expressed as AUMs.
ST_Factor_1	**Short-Term Factor:** adjustment for factors that impact production on a short-term basis. 0 to 100 where "0" = complete short-term loss of production, "10" = 100% of long-term production, "11" = 10% short-term increase in production, "20" = 200% short-term increase in production [or 2 times the long-term production].
ST_Factor_Reas_1	**Short-Term Factor Reason:** justification for short-term change in grazing capacity. 1 = Drought, 2 = Flood, 3 = Grasshoppers, 4 = Other.
ST_Graz_Cap_1	**Short-Term Grazing Capacity:** is equal to the GC multiplied by the Short-term Factor. Expressed as AUMs.
Descript_1	**Description**: description of the plant community type by dominant species.
Guide_1	**Field Guide and version used**: Enter Subregion code [e.g. Lower Foothills = LF] and version number [e.g. second approximation =2]. **Range Guides**: e.g. LF#, UF#, DM&CMW#, DMG#, etc. **Ecosite Guides**: NN, WC or SW
Map_Label	**Map Label**: Complete this based upon the Plant Community code for each decile. GLIMPS automated, can be populated automatically within ArcView as well. Enter the combination of the decile percent value [e.g. 7=70%] and the plant community code for that decile. [e.g. 8e5 2DMC4 is a polygon with 2 deciles – 80% is plant community e5 and 20% is plant community DMC4.]
Rge_Hlth	**Range Health Score**: Consists of the last 2 digits of the current year, followed by a dash, followed by the percentage [e.g. 00-66]. GLIMPS automated.
Source	**Source:** Initials of user entering this data - 2 characters only [e.g. CL]

Note: All numbered field names are repeated for up to 3 deciles [i.e. Decile_2, Ecosite_2, Eco_phase_2, etc.]

6.0 WRITING THE REPORT

For surveyors under contract to ASRD the summary report should include the following:

1. **Abstract**: Present the most important information of the report in a succinct form. Summarize the background, objectives, results and conclusions of the report.

2. **Introduction**: Provide the background and general information necessary to establish the report context. For technical reports this will include the objectives, technical background and the problem/ question being answered.

3. **Methods**: Assumptions and procedures used in the work should be described accurately and clearly. This manual is the primary source for methods and will be followed unless modifications have been discussed with and agreed to by LFS Range Management staff.

4. **Results and discussion**

4.1 Plant community types: This section should include:

1. An overview of the natural subregions represented on the disposition(s) using Strong and Leggat (1992) as the primary reference. For information about Alberta's natural regions: http://www.cd.gov.ab.ca/preserving/parks/anhic/index.asp.
2. Community type descriptions organized into categories of coniferous, deciduous, shrubland, and grassland.

Community type descriptions will include: community name, number of plots, general soils information, moisture regime, elevation (m), aspect (^{o}), slope (%), drainage, and parent material. Forage production of trees, shrubs, forbs, grasses, and the average of all of the plots in this community type should also be included. The scientific name, common name and canopy cover (%) of the dominant graminoids, forbs, shrubs and trees should also be listed.

The discussion should include an ecological description, grazing impact, the reasoning behind assigning a particular community name, range of the community type, and a description of reconnaissance in other areas. The format should follow Table 1.

TABLE 1. Format for vegetation type descriptions

Community: Rough fescue-Bluebunch fescue	
No. of sites: 1 (Carbondale River)	
Soil: Orthic Dark Grey Chernozem	
Slope: 5%	
Aspect: S	
Moisture: Mesic to submesic	
Elevation: 1370 m	
Parent Material: Morainal	
Production: Grass (kg/ha)	422
Forb	788
Total	1210
Stocking rate	5.2 (ac/AUM) or 2.4 (ha/AUM)

Vegetation Type	Scientific Name	Common Name	Canopy Cover (%)
Graminoid			
	Festuca scabrella	Rough Fescue	1
	Danthonia californica	California oatgrass	6
	Koeleria macrantha	Junegrass	6
	Stipa richardsonii	Richardson needlegrass	2
	Festuca idahoensis	Idaho fescue	14
	Poa pratensis	Kentucky bluegrass	26
	Carex obtusata	Blunt sedge	6
Forbs			
	Lithosperma ruderale	Woolly gromwell	T
	Geum triflorum	Old Man's whiskers	8
	Achillea millefolium	Common yarrow	11
	Selaginella densa	Little clubmoss	T
	Anemone multifida	Cut leaved anemone	1

This plant community appears to be representative of low and midslope positions in the Castle area south of Blairmore. Moving upslope from the rough fescue community, Idaho fescue becomes co-dominant with rough fescue. The slightly drier site conditions appear to favour the growth of Idaho fescue. In Montana, Mueggler and Stewart (1980) described a Rough fescue-Idaho fescue habitat type on mountain slopes on both sides of the divide. Looman (1969) described similar vegetation that occurs on warm slopes and stony soils at higher elevations in the southern foothills as the Rough fescue-Intermediate oatgrass association.

Grazing pressure on this site causes rough fescue to decline and Idaho fescue, Kentucky bluegrass and sedge species tend to increase. Continued grazing pressure causes forage productivity to decline or it could be the result of drier site conditions. The original clippings occurred on a drier portion of the site than inside the exclosure.

4.2 Range Management Considerations: this section should include the following (generally, on a management unit basis):

1. Landscape features that limit areas suitable for grazing e.g. topography (cattle are limited to valleys) or drainage,

2. Lightly or heavily used areas - discuss this in terms of patterns of cattle use rather than a reiteration of which range types are over or under used (this is obtainable from the inventory forms),

3. Any ungrazed sites which are too small to be recognized as separate map units but which are surveyed because of their role as comparative sites for determining range condition
4. Poisonous plants, weed infestations,

5. Eroded water courses or trails,

6. Impacts of other resource uses on livestock management,

7. Current management practices
   a. salting
   b. livestock distribution - pattern of use
   c. fencing - general state of repair and type of fencing,

8. Access problems,

9. Wildlife use,

10. Inclusions - any areas of significant cattle grazing but too small to be included on the map.

    Recommendations

    a. where and how use could be improved - e.g. additional salt locations (in specific treed areas or drainages away from primary ranges), better livestock distribution, drift fences or improved fencing, trail upgrading, changes to cattle management
    b. potential range improvement sites (these should have a corresponding vegetation inventory form)
    c. recommendations on controlling weeds, reducing resource conflicts, etc..

5. **Summary/Recommendations**: Suggest a course of action based on the results of the work

6. **Literature cited**

7. **Appendices**

7.1 Characteristics of map polygons and hectares (it is suggested that this appendix could be done as a excel table with same format as outlined in mapping Section 5.0)

7.0 RELATED INFORMATION

Alberta Natural Heritage Information Centre (ANHIC):
http://www.cd.gov.ab.ca/preserving/parks/anhic/index.asp
Alberta Vegetation Inventory Standards Manual
ASRD Public lands Division General Specifications for Digital Orthophoto Production
Alberta Environmental Protection (RDD) Requirements for AVI Orthophoto Production

Canadian System of Soil Classification, second edition (1987)
Canadian Vegetation Classification System
Community Type and Carrying Capacity Guides

Ecological Land Survey Site Description Manual

Forest Management Herbicide Reference Manual, 2000

A Glossary of Terms Used in Range Management, Third edition (1989)

Physical Land Classification methodology
Plant Species of concern Watch and Tracking List (ANHIC)
Pre-Harvest Ecological Assessment Handbook
Pre-harvest Ecological Assessment Short Form

Range Inspection Form
Rangeland/ Pasture Health Assessment Short Form Background and Methodology
Rangeland/ Pasture Health Assessment Short Form
Rare Native plants reporting form
Riparian (Lotic) Health Assessment Form
Riparian (Lotic) Form Derivation
Riparian (Lotic) Health Assessment Short Form

Site Description Form LISD 15B

Tame Pasture Health Assessment Short Form Background and Methodology
Tame Pasture Health Assessment Short Form

Vegetation Inventory Form MF5
Vegetation Inventory Form MF6

Weed Survey Form Instructions
Weed Survey Information Sheet

Links to Related Publications

National Research Council (NRC): http://www.nrc.ca/
NRC Publications: http://www.nrc.ca/cisti/journals/rp2_home_e.html
Canadian Journal of Botany: http://www.nrc.ca/cgi-bin/cisti/journals/rp/rp2_vols_e?cjb
Canadian Journal of Forest Research:
http://www.nrc.ca/cgi-bin/cisti/journals/rp/rp2_vols_e?cjfr
Canadian Journal of Plant Pathology: http://www.nrc.ca/cisti/journals/tcjpp/plant.html

Link to ESD website

IMS Website

The Society for Range Management: http://srm.org/

Range Magazine: http://www.rangemagazine.com/index.shtml

http://www.nhq.nrcs.usda.gov/land/aboutmaps/abbr.html

7.0 GLOSSARY

Access Factor. A value used by Rangeland Agrologists to reduce the CC to obtain billable AUMs for a grazing disposition. It is the percentage of the rangeland unit that is accessible to livestock under practical management. The access factor is used to remove AUMs from productive polygons [or portions of] that are inaccessible [i.e. non-use range] to livestock due to natural barriers [e.g. cliffs, large rivers or standing water, heights of land, slopes, dense understory vegetation or dense forest]. The access factor may also be used to exclude those areas where livestock grazing is not desirable [i.e. special use range] due to the areas sensitive nature and/or value to wildlife [e.g. some subalpine grasslands important to Big Horn Sheep, riparian areas that are identified as fish spawning sites, etc.]. It is one of two factors that are used to adjust CC to obtain GC.

Adjusted Stocking Rate. An adjustment made to the suggested ESSR for a particular plant community type obtained from a Range Plant Community Guide. The adjustment is made when the value in the guide is not representative of the site based on new data, or field experience, or if the ESSR does not currently reflect a reduction in stocking level to improve range health. The RA is required to document any changes made to the stocking rate.

AGRASID. Agricultural Region of Alberta Soil Inventory Database. This database is in the GIS environment and is made up of relational data files. This database is employed to determine range site (ecological site) type in grassland areas of Alberta.

Animal Unit [AU]. The standard animal unit represents the forage requirement equivalent of one mature cow of approximately 1000 lbs. [455 kg] either dry or with calf up to 6 months of age. **AU equivalents** are conversions of non-standard animals [e.g. different animal species] and size [e.g. cows over 1000 lbs] based on metabolic requirements. For example, 1 AU equals 1 1000 lb cow, or 5 sheep or 74% of a 1350 lb cow [which is alternatively 1.35 AUs]. Typically, 1 AU will require 26.5 lbs [12 kg] of dry matter per day plus some allowance for trampling loss.

AUM. The amount of forage required by 1 animal unit for 30 days. It is often expressed as a stocking rate [AUM/ha or ac]. Generally, 1 AUM will require 1000 lbs [455 kg] of dry matter per month that includes a 25% forage loss due to trampling.

Billable AUMS. To determine billable AUMs, the CC is reduced to represent the long-term livestock grazing potential of the disposition and only includes AUMs from those areas that can be grazed with practical management. For calculations, Billable AUMs = [CC X access factor].

Carrying Capacity (CC). The maximum number of AUs that can be supported by a rangeland unit [i.e. pasture, plant community or vegetation polygon] of a given size and for a given period of time. CC is calculated from the ESSR and is expressed in terms of AUMs for the rangeland unit. For calculation purposes CC = [Area divided by ESSR (in area/AUM)] or [Area multiplied by ESSR (in AUM/area)].

- Example #1: If the size of rangeland unit #1 is 80 ac and the assigned ESSR is 1.0AUM/ac, then rangeland unit #1 CC equals 80 AUMs (80 ac X 1.0AUM/ac).
- Example #2: If the size of rangeland unit #2 is 40 ha and the assigned ESSR is 1.8 ha/AUM, then rangeland unit #2 CC equals 22 AUMs (40 ha ÷ 1.8ha/AUM).

- If rangeland units 1 and 2 in the preceding examples make up the entire management unit [e.g. ranch or lease] then the CC for the entire management unit is 102 AUMs (80+ 22).

Ecodistrict. The first subdivision of Subregion based on distinctive physiographic and/or geographic patterns.

Ecological Site. Term used in Rangeland Classification system that is synonymous to **Ecosite**. This new term is used to provide subtle distinction to recognize the blending of the old systems and still be recognizable to readers familiar with the original terminology. See also **Ecological Range Site**.

Ecological Site Phase. Term used in Rangeland Classification system that is synonymous to **Ecosite Phase**. This new term is used to provide subtle distinction to recognize the blending of the old systems and still be recognizable to readers familiar with the original terminology.

Ecologically Sustainable Stocking Rate (ESSR). Represents the maximum number of AUMs for a given plant community or vegetation polygon that can be sustained without causing a downward trend in rangeland health. ESSRs take into account the inherent biophysical constraints, the ecological goals of sustainable health and proper functioning and the long term grazing potential of the unit. ESSRs are usually expressed as animal unit months - [AUM]/area [ac or ha] or area [ac or ha]/AUM [e.g. 1.0AUM/ac or 0.4 ha/AUM]. GLIMPS automatically enters the ESSR from the ESD database. If the Rangeland Agrologist would like to change the ESSR, see the Adjusted Stocking Rate definition.

Ecological Range Site. In the classification of plant communities in the grasslands of Alberta, an **ecological range site** represents the subdivision of a **range site** into recognizable reference plant communities (see **Reference Plant Community** and **Range Site**). Loamy sites near the moist end of the natural subregion might be described, as Loamy 1 and the driest in the sequence would be Loamy^{n}. An **ecological range site** then would be the combination of the plant community name and the subdivision of the range site by plant community (Loamy 1 - Plains Rough Fescue - Western Porcupine Grass). This new term is used to provide subtle distinction to recognize the blending of the old system of range site classification established by Smoliak et al. 1966 and Wroe et al. 1988 and still be recognizable to readers familiar with the original terminology.

Ecosite. A functional ecological unit that develops under similar environmental influences [climate, moisture and nutrient regime]. Each ecosite is designated by a lower case letter and further named by a common plant species typical of the site [e.g. d low bush cranberry]. Ecosites are named from driest to wettest. An 'a' would indicate a drier site than 'g' for example. Ecosites are groups of ecosite phases. An ecological site is defined by the Task Group on Unity and Concepts (1995) as, "*a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation*".

Ecosite Phase. A subdivision of ecosite primarily based on the dominant species in the highest plant layer but may also be influenced by lower strata plant species abundance and pedogenic processes.

Forage. All browse and non-woody plants that are available and palatable to domestic livestock or wildlife.

GLIMPS. Geographic Land Information and Management Planning System used by SRD PLFD to store resource management information.

Grazing Capacity (GC). This value represents the AUMs or stocking level for a rangeland unit [e.g. pasture or disposition] and is applied to prevent over-grazing on primary range. The GC includes adjustment to CC for: 1) livestock access (access factor) and 2) Livestock distribution (management factor). For calculations GC = [CC X access factor X management factor].

Management Factor. A value used by Rangeland Agrologists to reduce the CC to represent the percentage of the rangeland unit that is used sustainably by livestock under current management. It is one of two factors that are used to adjust CC to obtain GC. For example, a livestock producer who is not effectively using range management tools and techniques to modify stock distribution will find grazing pressure confined to primary range with minimal use of secondary range. In order to avoid overuse of primary range the Rangeland Agrologist will reduce the stocking of the disposition by using a management factor.

Natural Region. Provides an overview of the landscape. Each Natural Region contains a combination of similar vegetation, soil and landforms features. [e.g. Boreal Forest Natural Region]

Non-use range. Rangeland that goes unused by livestock, even when primary and secondary ranges are over-utilized.

Plant Community Types. Within forested plant communities, a subdivision of ecosite phase [or ecological site phase] based on differences in understory species composition and abundance. Generally, plant communities are named by combining the ecosite phase name with a dominant plant species in each structural layer. In the grasslands of Alberta, plant communities are a subdivision of range site type based on dominant and/or indicator plant species. Generally, plant communities are named by combining the range site name with a dominant plant species in each structural layer.

PLC. Physical land classification describes landform, surface expression, parent material, soil texture, slope, aspect, and drainage within a polygon.

Primary Range. The area of rangeland that animals prefer to graze when management is minimal.

RMF. Range Management Form used in GLIMPS by Rangeland Agrologists to record resource information and to determine Billable AUMs and Grazing Capacity.

Range Health. The rating of the ability of rangeland to perform certain ecological functions including: net primary production, maintenance of soil/site stability, capture and beneficial release of water, nutrient and energy cycling and plant species functional diversity. Range health categories include: Healthy, Healthy with problems, and Unhealthy. Healthy rangelands will provide sustainable grazing opportunities for livestock producers and also sustain a long list of others products and values. Declines in

range health will alert the range manager to the need for management changes. For a detailed description on how to assess rangeland health for various plant communities please refer to "*Rangeland Health Assessment for Grassland, Forest and Tame Pasture*", [Adams, B.W., G. Ehlert, C. Stone, D. Lawrence, M. Alexander, M. Willoughby, C. Hincz, D. Moisey, and A. Bogen. 2004. Rangeland Health Assessment for Grassland, Forest and Tame Pasture. Alberta Sustainable Resource Development. Public Lands Division. Edmonton. AB. Pub. No. T/044. 104pp.] NOTE: If the ESSR does not currently reflect a reduction in stocking level to improve range health, changes should be made to the adjusted stocking rate.

Rangelands. Areas of the world, which by reason of physical limitations (low and erratic precipitation, rough topography, poor drainage, or cold temperatures) are unsuited to cultivation, and which are a source of forage for free-ranging native and domestic animals, as well as a source of wood products, water, and wildlife.

Rangeland Management. A distinct discipline founded on ecological principles and dealing with the use of rangelands and range resources for a variety of purposes. These purposes include use as/for grazing by livestock, watersheds, wildlife habitat, recreation, and aesthetics, as well as other associated uses and values.

Rangeland Unit. Any delineated landscape area separated from the surrounding area to facilitate management [e.g. pasture, lease, ecological site phase, plant community or other biophysical polygon].

Range Site. Within a natural subregion, a stratification of rangeland based on site characteristics of landscape, soil features and soil texture (Landwise Inc. 1998) and are described in 14 categories using range site names that convey important site characteristics that influence vegetation development and site potential and are easily recognized by names like overflow, loamy, blowout, sandy etc. (Landwise Inc. 1998). **Ecological range sites** result when range sites are further subdivided into recognizable reference plant communities (see Ecological Range Site). Like the concept of **ecosite** employed in forested rangeland classification, the concept of **range site** applied in the Grassland Natural and Central Parkland Natural Regions (Smoliak et al. 1966 and Wroe et al. 1998) is a functional ecological unit that develops under similar environmental influences [climate, moisture and site conditions]. The concept of **range site** is similar to that of **ecological site** as defined by the Task Group on Unity and Concepts (1995) as, "*a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation"*.

Reference Range Plant Community [RPC]. A specific plant community that is chosen to represent an ecological standard based on a given management goal/decision. This RPC is selected from a number of successionally related plant communities described within an ecological site.

RMB. Rangeland Management Branch within the Public Lands and Forests Division of Sustainable Resource Development.

Safe Use Factor. A value used by SRD PLFD to obtain a **suggested** Ecologically Sustainable Stocking Rate which is reported in the rangeland plant community guides. It is the percentage of the total biomass production of the ecological site that is available for utilization by livestock. The safe use factor considers the given inherent biophysical

constraints and the ecological goals of sustainable health and proper functioning of the rangeland unit. The remaining biomass production [carry over] is allocated for the maintenance of ecological functions [e.g. nutrient cycling, viable diverse plant communities, hydrological function, and soil protection, etc.], plant community services [forage production, habitat maintenance, wildlife forage use, etc.]. The allocation of biomass production in this manor is well established, and supported, by the scientific community. Recommended safe use values vary depending on the ecological site and management.

Secondary Range. Rangeland that is lightly used or unused by livestock under minimal management and without special management will ordinarily not receive much use until primary range has been over-utilized.

Short-term Factor. A factor used by Rangeland Agrologists [RA] to document short-term fluctuations in production and to determine temporary stocking levels appropriate for current conditions. It can be used to account for short-term (< renewal period) increases or decreases in grazing potential due to: drought, fire, insects, disease, fertilizer etc. The short-term factor has no impact on the long-term CC, Billable AUMs or GC. If there are long-term effects on production, the adjustment should be made to the ESSR and the RA must provide documentation to verify the change.

Short-term Grazing Capacity. Is derived by the following calculation:
STGC = [GC X Short-term Factor]. See **Short-term Factor**.

SRD. The Ministry of Sustainable Resource Development.

Stocking Rates. The amount of land allocated to each animal unit for the entire grazeable period of the year, (e.g. ha/AUM). Stocking rates can also be expressed as the number of AU/area, AUdays/area, AUM/area, or AUyears/area. Any calculation using stocking rates should consider how the value is expressed and adjust the formulas as required [e.g. see CC]

Subregion. The first division of Natural Regions based on areas of similar landscape patterns that are distinct from other Subregions.

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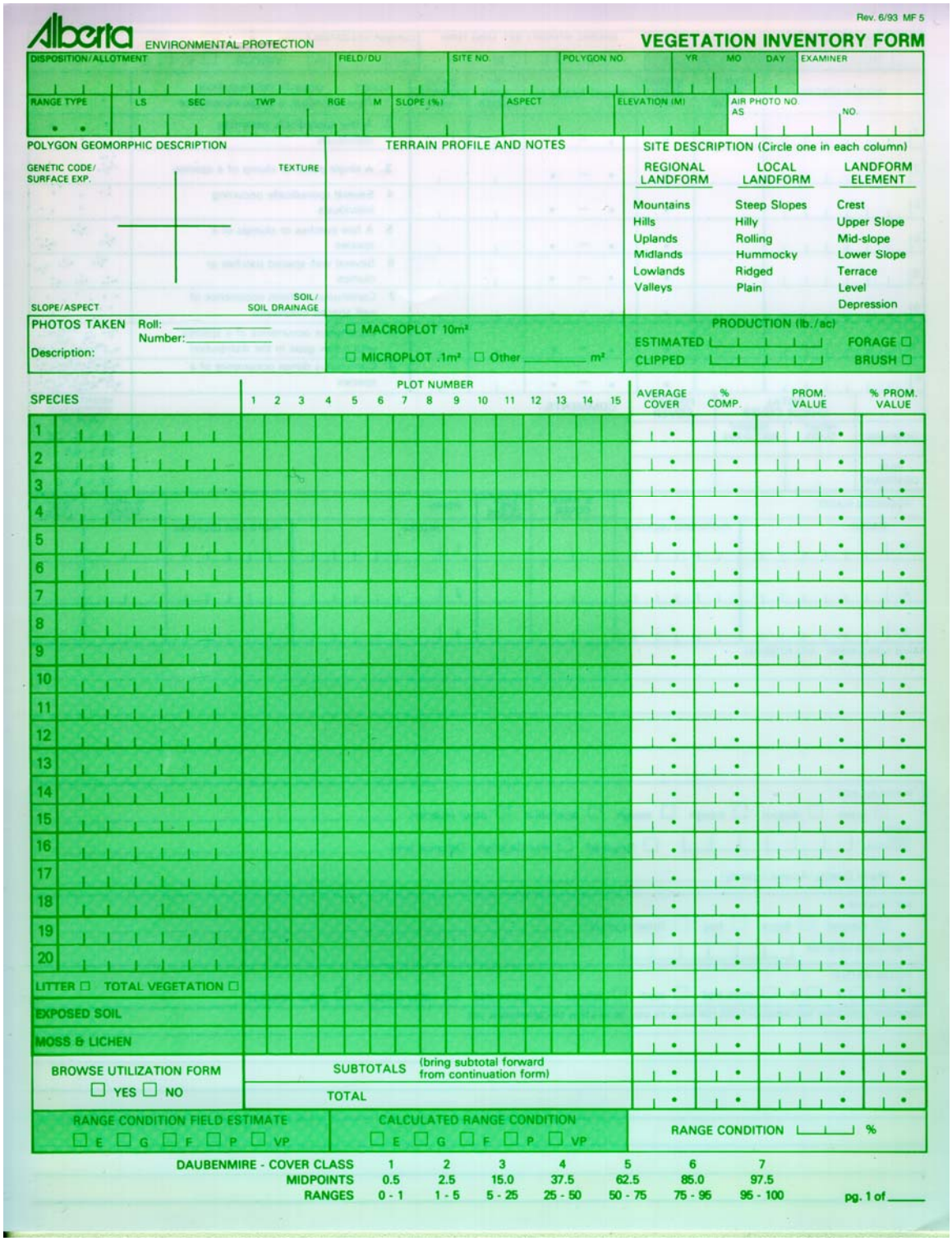


Rev. 6/93 MF 5

Alberta ENVIRONMENTAL PROTECTION

VEGETATION INVENTORY FORM

DISPOSITION/ALLOTMENT | FIELD/DU | SITE NO. | POLYGON NO. | YR | MO | DAY | EXAMINER

RANGE TYPE | LS | SEC | TWP | RGE | M | SLOPE (%) | ASPECT | ELEVATION (M) | AIR PHOTO NO. AS | NO.

POLYGON GEOMORPHIC DESCRIPTION

GENETIC CODE/ SURFACE EXP. | TEXTURE | SLOPE/ASPECT | SOIL/ SOIL DRAINAGE

TERRAIN PROFILE AND NOTES

SITE DESCRIPTION (Circle one in each column)

REGIONAL LANDFORM	LOCAL LANDFORM	LANDFORM ELEMENT
Mountains	Steep Slopes	Crest
Hills	Hilly	Upper Slope
Uplands	Rolling	Mid-slope
Midlands	Hummocky	Lower Slope
Lowlands	Ridged	Terrace
Valleys	Plain	Level
		Depression

PHOTOS TAKEN Roll: _____ Number: _____

Description:

☐ MACROPLOT 10m² ☐ MICROPLOT .1m² ☐ Other _____ m²

PRODUCTION (lb./ac)

ESTIMATED | FORAGE ☐

CLIPPED | BRUSH ☐

SPECIES	PLOT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	AVERAGE COVER	% COMP.	PROM. VALUE	% PROM. VALUE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
LITTER ☐ TOTAL VEGETATION ☐					
EXPOSED SOIL					
MOSS & LICHEN					
BROWSE UTILIZATION FORM ☐ YES ☐ NO	SUBTOTALS (bring subtotal forward from continuation form)				
	TOTAL				

RANGE CONDITION FIELD ESTIMATE ☐ E ☐ G ☐ F ☐ P ☐ VP

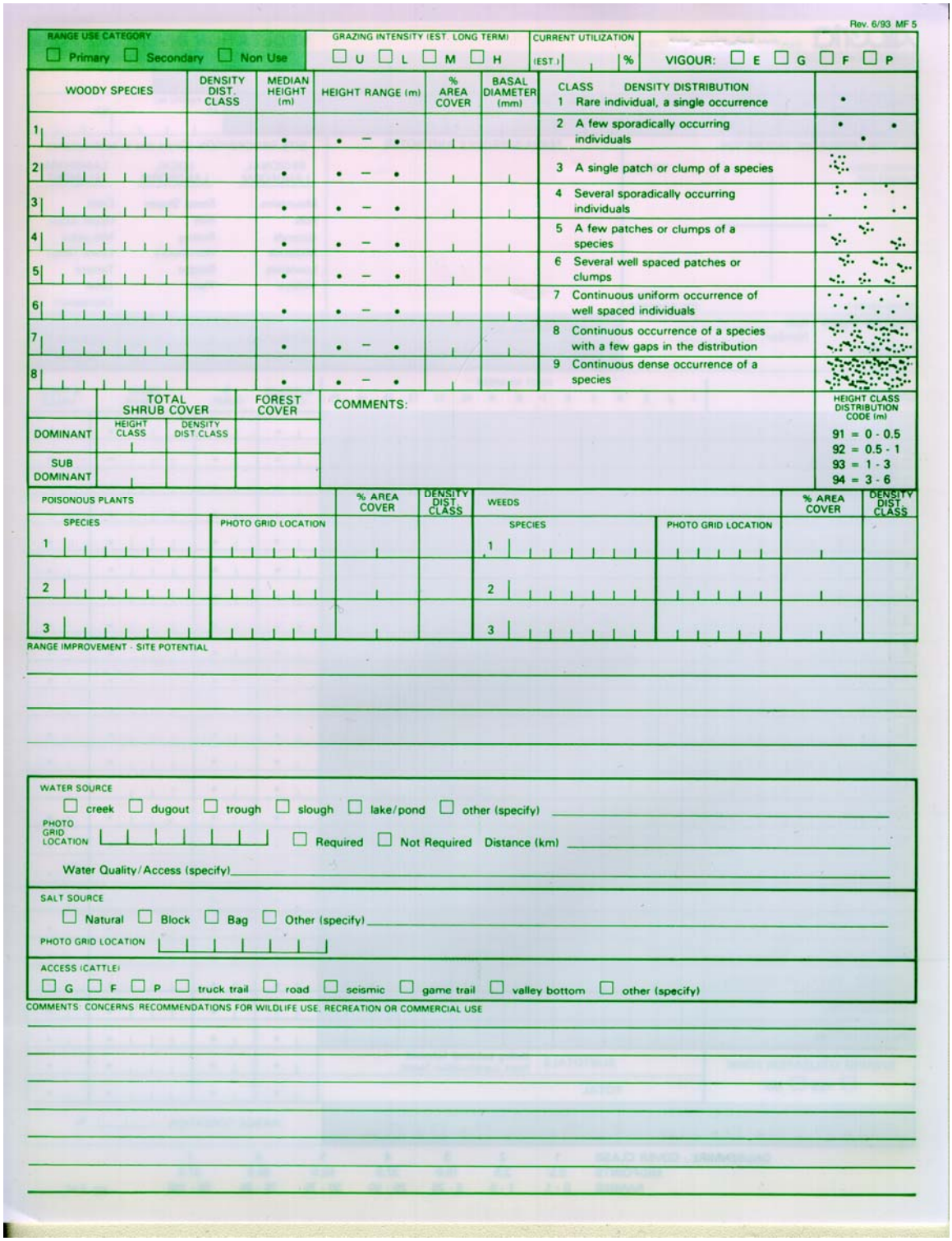
CALCULATED RANGE CONDITION ☐ E ☐ G ☐ F ☐ P ☐ VP

RANGE CONDITION ____ %

DAUBENMIRE - COVER CLASS	1	2	3	4	5	6	7
MIDPOINTS	0.5	2.5	15.0	37.5	62.5	85.0	97.5
RANGES	0 - 1	1 - 5	5 - 25	25 - 50	50 - 75	75 - 95	95 - 100

pg. 1 of _____

APPENDIX 2: BACK OF MF5 FORM



Rev. 6/93 MF 5

RANGE USE CATEGORY ☐ Primary ☐ Secondary ☐ Non Use

GRAZING INTENSITY (EST. LONG TERM) ☐ U ☐ L ☐ M ☐ H

CURRENT UTILIZATION (EST.) ____ % VIGOUR: ☐ E ☐ G ☐ F ☐ P

WOODY SPECIES	DENSITY DIST. CLASS	MEDIAN HEIGHT (m)	HEIGHT RANGE (m)	% AREA COVER	BASAL DIAMETER (mm)
1		•	• – •		
2		•	• – •		
3		•	• – •		
4		•	• – •		
5		•	• – •		
6		•	• – •		
7		•	• – •		
8		•	• – •		

CLASS DENSITY DISTRIBUTION

1 Rare individual, a single occurrence

2 A few sporadically occurring individuals

3 A single patch or clump of a species

4 Several sporadically occurring individuals

5 A few patches or clumps of a species

6 Several well spaced patches or clumps

7 Continuous uniform occurrence of well spaced individuals

8 Continuous occurrence of a species with a few gaps in the distribution

9 Continuous dense occurrence of a species

	TOTAL SHRUB COVER		FOREST COVER
	HEIGHT CLASS	DENSITY DIST CLASS	
DOMINANT			
SUB DOMINANT			

COMMENTS:

HEIGHT CLASS DISTRIBUTION CODE (m)
91 = 0 - 0.5
92 = 0.5 - 1
93 = 1 - 3
94 = 3 - 6

POISONOUS PLANTS				WEEDS			
SPECIES	PHOTO GRID LOCATION	% AREA COVER	DENSITY DIST CLASS	SPECIES	PHOTO GRID LOCATION	% AREA COVER	DENSITY DIST CLASS
1				1			
2				2			
3				3			

RANGE IMPROVEMENT - SITE POTENTIAL

WATER SOURCE

☐ creek ☐ dugout ☐ trough ☐ slough ☐ lake/pond ☐ other (specify) _____

PHOTO GRID LOCATION _____ ☐ Required ☐ Not Required Distance (km) _____

Water Quality/Access (specify) _____

SALT SOURCE

☐ Natural ☐ Block ☐ Bag ☐ Other (specify) _____

PHOTO GRID LOCATION _____

ACCESS (CATTLE)

☐ G ☐ F ☐ P ☐ truck trail ☐ road ☐ seismic ☐ game trail ☐ valley bottom ☐ other (specify)

COMMENTS: CONCERNS: RECOMMENDATIONS FOR WILDLIFE USE, RECREATION OR COMMERCIAL USE

Prairie MF5

Alberta FORESTRY, LANDS AND WILDLIFE

VEGETATION INVENTORY FORM

DISPOSITION/ALLOTMENT	FIELD/DU	SITE NO.	POLYGON NO.	YR MO DAY	EXAMINER

Vegetation Type	LS	SEC	TWP	RGE	M	SLOPE (%)	ASPECT	ELEVATION (M)	

SOILS DESCRIPTION

SCA_____ Field Verified

AGRASID SLM code		Transect Range Site
Soil Series 1		
Soil Series 2		
Other signif SS		
Surface Form		
Slope Class		
Suface Modifier		

TERRAIN PROFILE AND NOTES

SITE DESCRIPTION (Cirde one in each column)

REGIONAL LANDFORM	LOCAL LANDFORM	LANDFORM ELEMENT
Mountains	Steep Slopes	Crest
Hills	Hilly	Upper Slope
Uplands	Rolling	Mid-Slope
Midlands	Hummocky	Lower Slope
Lowlands	Undulating	Terrace
Valleys	Ridged	Level
	Plain	Depression

PC-ORD:
Ecodistricts:

GPS Unit # WPT #
Start
End

Est. Production _____ kg/ha lbs/ac

Est. Litter _____ kg/ha lb/ac

SPECIES	PLOT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	AVERAGE COVER	VEGETATION NOTES
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
LITTER ☐ TOTAL VEGETATION ☐			
EXPOSED SOIL			
MOSS & LICHEN			
SUBTOTALS (bring subtotal forward from continuation form)			
TOTAL			

Range Health Estimate
_____ Healthy
_____ Healthy w/ Problems
_____ Unhealthy

Allowable Cover Percentages: 1-10,15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

pg. 1 of _____

RANGE USE CATEGORY ☐ Primary ☐ Secondary ☐ Non Use

GRAZING INTENSITY (EST. LONG TERM) ☐ U ☐ L ☐ M ☐ H

CURRENT UTILIZATION (EST.) ____ %

VIGOUR: ☐ E ☐ G ☐ F ☐ P

	WOODY SPECIES	DENSITY DIST. CLASS	MEDIAN HEIGHT (m)	HEIGHT RANGE (m)	% COVER	BASAL DIAMETER (mm)
1			.	. — .		
2			.	. — .		
3			.	. — .		
4			.	. — .		
5			.	. — .		
6			.	. — .		
7			.	. — .		
8			.	. — .		

	TOTAL SHRUB COVER		FOREST COVER
	HEIGHT CLASS	DENSITY DIST.CLASS	
DOMINANT			
SUB DOMINANT			

HEIGHT CLASS DISTRIBUTION CODE (m)
91 = 0 - 0.5
92 = 0.5 - 1
93 = 1 - 3
94 = 3 - 6

Density Distribution

Class	Description of abundance in polygon	Distribution
0	None	
1	Rare	
2	A few sporadically occurring individual plants	
3	A single patch	
4	A single patch plus a few sporadically occurring plants	
5	Several sporadically occurring plants	
6	A single patch plus several sporadically occurring plants	
7	A few patches	
8	A few patches plus several sporadically occurring plants	
9	Several well spaced patches	
10	Continuous uniform occurrences of well spaced plants	
11	Continuous occurrence of plants with a few gaps in the distribution	
12	Continuous dense occurrence of plants	
13	Continuous occurrence of plants with a distinct linear edge in the polygon	

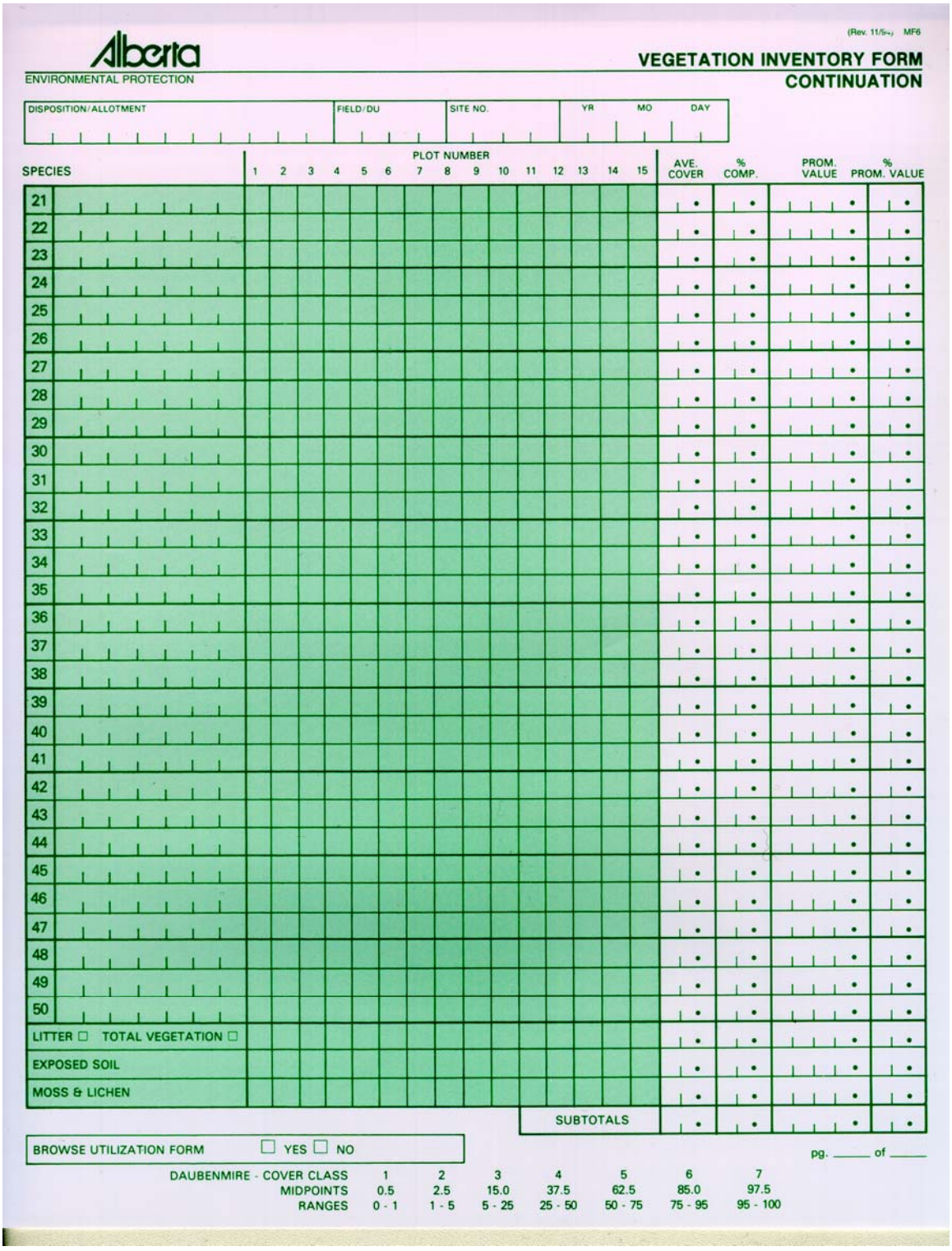
POISONOUS PLANTS		% AREA COVER	DENSITY DIST. CLASS	WEEDS		% AREA COVER	DENSITY DIST. CLASS
SPECIES	GPS LOCATION			SPECIES	GPS LOCATION		
1				1			
2				2			
3				3			

WATER SOURCE
☐ creek ☐ dugout ☐ trough ☐ slough ☐ lake/pond ☐ other (specify) _____
PHOTO GRID LOCATION _____ ☐ Required ☐ Not Required Distance (km) _____
Water Quality/Access (specify) _____

SALT SOURCE
☐ Natural ☐ Block ☐ Bag ☐ Other (specify) _____
PHOTO GRID LOCATION _____

ACCESS (CATTLE)
☐ G ☐ F ☐ P ☐ truck trail ☐ road ☐ seismic ☐ game trail ☐ valley bottom ☐ other (specify)

COMMENTS: CONCERNS / RECOMMENDATIONS



(Rev. 11/5-) MF6

Alberta
ENVIRONMENTAL PROTECTION

VEGETATION INVENTORY FORM CONTINUATION

DISPOSITION/ALLOTMENT	FIELD/DU	SITE NO.	YR	MO	DAY

SPECIES	PLOT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	AVE. COVER	% COMP.	PROM. VALUE	% PROM. VALUE
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
LITTER ☐ TOTAL VEGETATION ☐					
EXPOSED SOIL					
MOSS & LICHEN					
	SUBTOTALS				

BROWSE UTILIZATION FORM ☐ YES ☐ NO

pg. ____ of ____

DAUBENMIRE - COVER CLASS	1	2	3	4	5	6	7
MIDPOINTS	0.5	2.5	15.0	37.5	62.5	85.0	97.5
RANGES	0 - 1	1 - 5	5 - 25	25 - 50	50 - 75	75 - 95	95 - 100

Alberta
ENVIRONMENTAL PROTECTION

SITE DESCRIPTION FORM LISD 15B (Rev. 3/93)

Project ID

Page _____ of _____

Crew: _____

Agency: _____

Project ID (1)	Group / Series (4)	Plot No. (10)	Year (14)	Month (16)	Day (18)

LSD (20)	SEC (22)	TWP (24)	RGE (27)	MER (29)	LATITUDE (30)	LONGITUDE (36)	NTS SHEET (43)
					° ' "	° ' "	

ELEVATION (51)	ASPECT (55)	SLOPE (58)	ECOREGION (61)	ECODISTRICT (63)	AERIAL PHOTOGRAPHY (65) AS	(72) NO.	(75) X	(78) Y	PHOTOS ROLL (81)	PHOTO NOS.

EXPOSURE (87)	FLOOD (88)	DRAINAGE (89)	PERVIOUSNES (90)	SITE - MACRO (91)	SITE - MESO (92)	SITE - SHAPE (93)	E. MOISTURE (94)	NUTRIENTS (95)	FACTORS1 (96)	FACTORS2 (97)	SUCC. STAT.1 (98)	SUCC. STAT.2 (99)	SURFACE SUBSTRATE (% Cover) Decaying Wood (100)	Bedrock (103)	Cobbles and Stones (106)	Mineral Soil (109)	Organic Matter (112)	Water (115)

Regen 1 (118) SP	%	HT(m)	Regen 2 (126) SP	%	HT(m)	Regen 3 (134) SP	%	HT(m)
		.			.			.

EXPOSURE TYPE
1. Not applicable
2. Wind
3. Insolation
4. Frost
5. Cold air drainage
6. Atmospheric toxicity

FLOOD HAZARD
1. No Hazard
2. Rare
3. May be expected
4. Frequent

SOIL DRAINAGE
1. Very rapidly
2. Rapidly
3. Well
4. Moderately well
5. Imperfectly
6. Poorly
7. Very poorly

PERVIOUSNESS
1. Rapidly
2. Moderately
3. Slowly

SITE POSITION - MACRO
1. Apex
2. Face
3. Upper slope
4. Middle slope
5. Lower slope
6. Valley floor
7. Plain
8. Plateau

SITE POSITION - MESO
1. Crest
2. Upper slope
3. Middle slope
4. Lower Slope
5. Toe
6. Depression
7. Level

SITE SURFACE SHAPE
1. Straight
2. Concave
3. Convex

ECOLOGICAL MOISTURE REGIME
1. Very xeric (very dry)
2. Xeric (dry)
3. Subxeric (moderately dry)
4. Submesic (moderately fresh)
5. Mesic (fresh)
6. Subhygric (moderately moist)
7. Hygric (moist)
8. Subhydric (moderately wet)
9. Hydric (wet)

NUTRIENT REGIME
1. Oligotrophic (very poor)
2. Submesotrophic (poor)
3. Mesotrophic (medium)
4. Permesotrophic (rich)
5. Eutrophic (very rich)
6. Hypereutrophic (e.g. saline)

FACTORS INFLUENCING STAND ESTABLISHMENT
1. Atmospheric
2. Cutting and soil disturbance
3. Dumping, disposal and spills
4. Fire
5. Plant/animal effects
6. Terrain related
7. Site improvement
8. Water related

SUCCESSIONAL STATUS
1. Pioneer seral
2. Young seral
3. Mature seral
4. Old seral
5. Young edaphic climax
6. Mature edaphic climax
7. Young climatic climax
8. Mature climatic climax
9. Disclimax
0. Non vegetated

LISD 15B (Rev. 3/93)

Landscape Profile Diagram

Site Location

Direction

Other forms completed:

Location

Plot Representing (list community, soils, parent material, drainage, topographic position)

General Comments On Site Characteristics

Appendix 6 : Forest reserve allotment inspection form

Alberta Sustainable Resource Development Range Inspection Report
Public Lands & Forests Division

DISPOSITION NAME:_____
REGION:_____
FOREST AREA:_____

INSPECTION DATE:_____ . ADDITIONAL INSPECTION FORMS COMPLETED:_____

DISPOSITION HOLDER PRESENT DURING THE INSPECTION:

YES NO

PRIMARY RANGE CURRENT UTILIZATION

Management Unit / Plant Community	Season of Use	Non Use 0–15%	Light 16-35%	Moderate 36–65%	Heavy 66-80%	Severe > 80%	Comments

SECONDARY RANGE CURRENT UTILIZATION

Management Unit / Plant Community	Season of Use	Non Use 0–15%	Light 16-35%	Moderate 36–65%	Heavy 66-80%	Severe > 80%	Comments

1. LIVESTOCK UTILIZATION AND DISTRIBUTION:
Identify and discuss areas where utilization and distribution were good and where there were problems. Identify and discuss the issue and management options to deal with it, i.e. salting, riding, fencing, water development, etc.

2. MANAGEMENT:

A) Riding and Herding _____Satisfactory _____Unsatisfactory

Based on discussions with Disposition holders and observations, comment on the riding program, (i.e. riding for veterinary purposes or management) include dates and locations of all major moves. Recommendations.

Page 2.

2. MANAGEMENT Con't:

B) Salting _____Satisfactory _____Unsatisfactory

Comment on salting program – Is salt being used as a distribution tool? Is the salt well placed? (i.e. distance from water, main trails, primary range, etc.) Suggest improvements to salting program. Identify issue areas on the map.

C) Fencing _____Satisfactory _____Unsatisfactory

Comment on the condition of existing fences and identify any required work (i.e. can any fencing be recommended to improve distribution/protect riparian areas, if so identify on the map).

D) Water Supply and Distribution _____Satisfactory _____Unsatisfactory

What is the condition of existing water developments? What work is required? Are there any water distribution problems? What are they? (Identify water developments/potential developments on the map.)

3. WEEDS:
Identify and provide a location of any noxious weeds that were encountered on the Disposition (note the infestation according to Range Health Density Distribution Guide).

4. OTHER RESOURCE USER ISSUES:
Based on discussions with Disposition holders and observations, are there any issues with other resource users (i.e. random camping, OHV damage, timber harvesting, other industrial activity, etc.).

5. PREDATORS
Were there any problems with predators? If so, what action has been taken?

6. RANGE MAINTENANCE
Identify any new range maintenance projects undertaken since the last inspection. Are any future projects planned? Can any be recommended?

7. OVERALL MANAGEMENT SUMMARY_____Satisfactory _____Unsatisfactory
Discuss the success or failure of the current management strategy. Indicate action to be taken (if any).

8. RANGE CONDITION TREND _____Improving _____Declining _____Stable

_____ _____
Inspectors Name Signature

_____ _____
Disposition Holders Name Signature

AGRASID Training for Public Lands Personnel

January 2004

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INTRODUCTION

AGRASID (ASIC 2001) is a digital database that describes soils and landscapes in the entire White Zone (Agricultural Zone) of Alberta, at a **scale of 1:100,000** (ASIC 2001). **The minimum size polygon in AGRASID is 64 hectares (160 acres).** The AGRASID system uses the Canadian System of Soil Classification (1998), with a modified system for describing landforms.

This manual is arranged in four main parts.

Part 1: provides an overview of the Canadian System of Soil Classification, including a brief description of Soil Orders, Great Groups and Subgroups.

Part 2: provides a summary of AGRASID Soil Landscape Models and Land Systems.

Part 3: provides a description of the correlation of AGRASID Soil Landscape Models to Ecological Range Sites.

Part 4: illustrates the linking of AGRASID SLMs to Ecological Range Sites for the Mixedgrass Natural Subregion, based on the Range Guide for the Mixedgrass Natural Subregion (Adams et al. In Preparation).

Training exercises are contained in Appendix F.

PART 1: THE CANADIAN SYSTEM OF SOIL CLASSIFICATION

The Canadian System of Soil Classification (1998) relies on several levels of taxonomy. The taxonomic levels pertinent to AGRASID, listed from most broad to most specific, are Soil Orders, Great Groups, Subgroups, and Variants.

Soil Orders

Four soil orders occur commonly in the southern half of Alberta: Chernozemic, Solonetzic, Gleysolic and Regosolic. Chernozemic soils are the most common and the most mature soils.

Chernozemic soils are well- to imperfectly-drained soils that have developed under grassland communities. The organic matter content of Chernozemic soils generally ranges from 2 to10%. They form on a variety of parent materials resulting from the melting of the glacial ice (deglaciation) that covered northern North America approximately 12,000 years ago. Chernozemic soils form on non-saline or weakly saline parent materials, and the soil profile is frequently underlain by carbonate-rich horizons.

Solonetzic soils contain a high proportion of sodium in the subsoil and they are characterized by a hardpan layer in the subsoil that is massive and hard when dry, and impervious and very sticky when wet. Solonetzic soils occur commonly in the eastern part of Alberta, from Lamont

through Hanna to Manyberries. Solonetzic soils are formed on saline and sodic parent materials (softrock and thin till over softrock) and in regions prone to groundwater discharge. They are characterized by blowout pits (shallow depressions where the topsoil has been eroded) with sparse vegetation. Solonetzic soils commonly occur in conjunction with Chernozemic soil series.

Gleysolic soils also occur scattered throughout southern Alberta. Gleysolic soils formed in areas of surface water collection or groundwater discharge. Gleysols are sometimes saline due to their location in the landscape. These soils are typically dull-coloured or strongly mottled because of water saturation. Gleysols are also mapped as significant or co-dominant with other series. Gleysols are subject to periodic flooding or prolonged wetting, and typically lack oxygen during a portion, or most, of the growing season. Gleysols are often nutrient poor due to denitrification, and because decomposition is hindered by wetness.

Regosolic soils occur to a minor extent in southern Alberta. Regosols are weakly developed soils for many reasons, which can include development on young geologic materials (floodplains, saline discharge areas, or sand dunes), or in unstable locations, such as steep slopes, active floodplains or locations prone to wind erosion.

Table 1 summarizes the key characteristics of the four main soil orders of southern Alberta, and also includes key characteristics for four Soil Orders that occur less commonly (Luvisolic, Organic, Vertisolic and Brunisolic).

Table 1. Soil Orders occurring in southern Alberta.

Soil Order	Description
Chernozemic	Soils that have a surface horizon (Ah) that is at least 10 cm thick, and darkened by the accumulation of organic matter from decomposition of grasses and forbs
Solonetzic	Soils that have a Solonetzic B horizon, which is hard when dry, and has a very low permeability when wet, due to a high sodium content.
Gleysolic	Soils are saturated with water and under reducing conditions either continuously or during some period of the year, as indicated either by direct measurements of the water table or the oxidation-reduction status.
Regosolic	Soils that are weakly developed. They lack a B horizon, or the B horizon is <5 cm thick.
Luvisolic	Soils characterized by clay movement. Developed under forest vegetation. Occur in SCAs 8 and 16
Organic	Soils with peat deposition of >40 cm thick. Limited occurrence. Known to occur at permanent wetlands subject to high rates of groundwater discharge.
Vertisolic	Soils with a high clay content, that are subject to intense shrink/swell cycles. Vertisols occur in the Edmonton, Drumheller, Black Diamond, and Acadia Valley areas. May only occur as an inclusion in clay-rich SLMs.
Brunisolic	Soils that are moderately developed but lack development specified for any of the above Soil Orders. Occur in SCAs 5, 8, and 16.

Soil Orders are distinguished by particular horizons or the assemblage of horizons (Table 2).

Table 2. Diagnostic Horizons for Classifying Soil Orders (From CSSC 1998).

Order	Diagnostic Horizon
Brunisolic	*Bm**- stronger chromas and redder hues than underlying material
Chernozemic	Chernozemic *A* horizon, including: • at least 10 cm thick. • color value darker than 5.5 dry and 3.5 moist, and the chroma is lower than 3.5 moist. • organic C content is 1-17%; C:N ratio is less than 17. • Ca is the dominant exchangeable cation.
Crysolic	*z* horizon – permafrost.
Gleysolic	Gleyed *C* or *B* horizons within 50 cm of the surface showing strong mottling or gleying due to anaerobic bacteria operating in water-logged conditions.
Luvisolic	Distinct *Ae* (eluvial or leached) and *Bt* (illuvial or clay enriched) horizon.
Organic	40 - 60 cm of *Oh*, *Om*, *Of* (humic, mesic or fibric) horizon at surface or 10 cm if over consolidated bedrock.
Podzolic	Podzolic *B* horizon (*Bf*, *Bh* or *Bhf*); Fe and Al accumulation; also with humic illuviation in Bh or Bhf.
Regosolic	No diagnostic horizon; lacks a will defined *B* horizon.
Solonetzic	Solonetzic *B* horizon (*Bn* or *Bnt*) of prismatic or columnar structure; both hard to extremely hard consistence when dry. The ratio of exchangeable Ca to Na is <10.
Vertisolic	Vertic horizon (*v*); vertical cracks and irregularly shaped intrusions in the solum. Slickenside horizon (*ss*); shear surfaces of at least 4 cm^2 that form when one soil mass moves over another.

* For complete descriptions of soil horizons refer to Canadian System of Soil Classification 1998

Great Groups

Soil orders are divided into several Great Groups, largely based on the thickness and colour of the A horizon (Table 3).

Table 3. Great Groups within each Soil Order. (Adapted from the Canadian System of Soil Classification).

Order	Great Group	Distinguishing Characteristics	General Comments
BRUNISOLIC Sufficient development to exclude from Regosolic order but lacks kind of development specified for other orders.	**Eutric**	Ah < 10 cm; pH > 5.5	Low organic matter levels, especially with Eutric and Dystric Great Groups. Low inherent fertility.
	Melanic	Ah > 10 cm; pH > 5.5	
	Dystric	Ah < 10 cm; pH < 5.5	
	Sombric	Ah >10 cm; pH < 5.5	
CHERNOZEMIC Surface horizons darkened by the accumulation of organic matter from grass and forb decomposition.	**Brown**	Brownish Ah	Organic matter level ranges from approximately 2% (Brown) to 10% (Black).
	Dark Brown	Dark Brown Ah	
	Black	Black Ah	
	Dark Gray	Surface L-H & eluvial Ahe	
GLEYSOLIC Soil features indicative of periodic or prolonged water saturation with reducing or anaerobic conditions.	**Humic Gleysol**	Ah > 10 cm without illuvial clay horizon (Bt)	Groundwater recharge or discharge. Organic matter levels vary markedly between the Great Groups. Contrasting textures between surface and subsurface may occur.
	Gleysol	Ah < 10 cm without illuvial clay horizon (Bt).	
	Luvic Gleysol	Illuvial clay horizon (Bt) and usually has an Ahe or Aeg.	
LUVISOLIC Developed under forest vegetation and characterized by clay translocation.	**Gray Luvisol**	May or may not have Ah, Light colored eluvial horizons (Ae) and illuvial horizons of clay accumulation (Bt);	Low organic matter levels. Low nutrient levels. Prone to surface crusting. pH often limits productivity.
REGOSOLIC weak profile development consisting usually of A horizon over C.	**Regosol**	Ah < 10 cm and Bm absent or < 5 cm thick.	Low inherent fertility due to low organic matter levels. Coarse textures often associated with floodplain deposits.
	Humic Regosol	Ah > 10 cm and Bm absent or < 5 cm thick.	
SOLONETZIC Sodium enriched hardpan B horizon (Bnt or Bn) of columnar or prismatic structure; hard to extremely hard when dry.	**Solonetz**	Lacks a continuous eluvial (Ae) horizon < 2 cm.	Surface crusting potential is high due to low organic matter levels. Subgroups depend on topsoil colour (soil zones). Occasional acidic surface horizons. Salt movement both upward in the profile and horizontally downslope.
	Solodized Solonetz	Eluvial horizon > 2 cm. Intact columnar hardpan layer.	
	Solod	Eluvial horizon > 2 cm. Distinct AB (transitional) horizon which is a disintegrating hardpan layer.	

Soil Subgroups

Soil Orders and Great Groups are further subdivided into subgroups which are indicative of relative soil maturity and soil forming conditions (Table 4).

Table 4. Concise definitions of common subgroups in southern Alberta.

Subgroup	Definition
Orthic	Conformity to the central concept of the Group.
Rego	Lacking a subsoil (B horizon) or less than 5 cm in depth.
Gleyed	Imperfectly drained conditions with a mix of both aerobic and anaerobic conditions due to seasonal groundwater discharge or ponding.
Eluviated	Downward movement of material from the topsoil by leaching (presence of an Ae horizon).
Calcareous	Indicating free calcium and magnesium carbonates within the B horizon (eg. Calcareous Brown Chernozemic).
Solonetzic	Having properties grading to the Solonetzic Order (E.g., Solonetzic Brown Chernozem).
Humic	Indicating a humus enriched horizon greater than 10 cm thick (E.g., Ah in Humic Gleysol).
Cumulic	Possessing buried layers of varying colour and organic matter content. (E.g., Cumulic Regosol).
Terric	Unconsolidated mineral material of at least 30 cm thick beneath the surface tier.
Vertic	Soil horizons subjected to movement or displacement caused by shrinking or swelling of clays.
Brunisolic	Having properties grading to the Brunisolic Order.
Dark	Used with Luvisols that have an Ah or Ahe greater than 5 cm in depth.

Variants

Variants are used in AGRASID in the Soil Names File and often in the Soil Models File. Variants are explained in Part 2 and are listed in Appendix A.

PART 2: AGRASID: SOIL LANDSCAPE MODELS AND LAND SYSTEMS

The basic soil map unit of AGRASID is the Soil Landscape Model (SLM) (ASIC 2001). Each SLM is characterized by a soil series component that describes soil subgroup, texture, and parent material, and a landscape component that describes landform and topographic relief. The components of SLMs are described below, followed by illustrative examples.

Soil Series

Soil series are defined on the basis of detailed features of the soil pedon, such as colour, lithology, texture, and structure. Soil series reflect a unique combination of a soil subgroup and parent material that is present over a representative land area. Soil series are named for geographic points (e.g. towns) located in the area where they occur, and each soil series is denoted with a three-letter symbol. Soil series descriptions include soil subgroup, texture (Fig. 1) and parent material. For example, an Orthic Black soil developed on moderately-coarse-textured fluvial parent material belongs to a different Soil Series than an Orthic Black soil developed on very-coarse fluvial parent material.

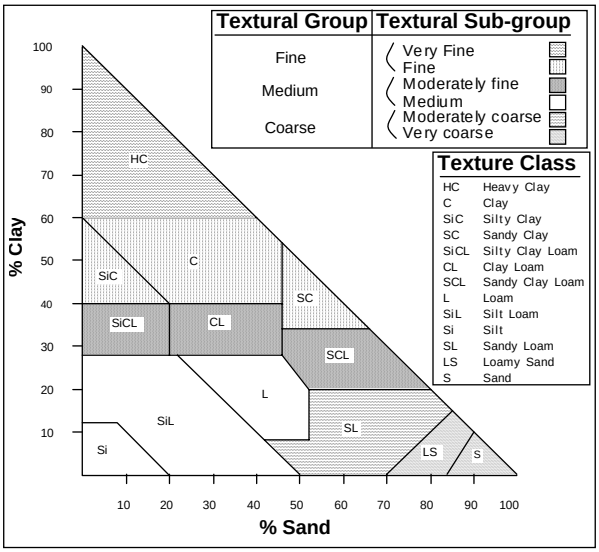

Fig. 1. Textural Triangle.

Dominant and Co-Dominant Soils. The soil series code in SLMs in which one soil series is dominant (present over more than 50% of the area) are denoted with three-letter symbols. The soil series code in SLMs in which two or three soil series are present in approximately the

same proportions (30 to 50% of the area) are denoted with four-letter codes, with the first two letters indicating the first co-dominant soil and the last two letters indicating the second co-dominant soil. For example, an SLM with the soil series symbols HDRO indicates a co-dominant Halliday (HDY, Brown Solodized Solonetz) and Ronalaine (ROL, Solonetzic Brown Chernozemic; both the HDY and ROL soil series are developed on moderately-fine-textured glacial till.

Significant Soils. Soils that cover 10 to 30% of an SLM are termed "significant soils". A soil model unit number between 1 and 21 following the soil series symbol generally indicates a significant component of a particular soil or soils (Table 5).

Table 5. Description of Soil Model Unit Numbers.

Soil Model Unit Number	Significant Soil	Additional Description
1	Relatively pure unit.	No significant soils identified.
2	Wet, including gleyed subgroups, Gleysols or Organics	Gleyed are imperfectly drained; Gleysols are usually poorly drained
3	Saline or salt-enriched	Saline phase or Saline subgroups
4	Eroded, Rego or Calcareous	Eroded phase, Rego or Calcareous subgroups
5	Finer textured	Soils must be at least one textural group finer (refer to textural triangle, Fig. 1) than the dominant or co-dominant soils.
6	Coarser textured	Soils must be at least one textural group coarser (refer to textural triangle, Fig. 1) than the dominant or co-dominant soils.
7	Solonetzic order	hardpan layer affected by sodium enrichment
8	Wet (2) and Eroded (4)	Both Soil Model Units 2 and 4 are present in significant proportions
9	Wet (2) and coarser (6)	Both Soil Model Units 2 and 6 are present in significant proportions
10	Wet (2) and Solonetzic (7)	Both Soil Model Units 2 and 7 are present in significant proportions
11	Eroded, Rego and Calcareous soils (4) and coarser textured (6)	Both Soil Model Units 4 and 6 are present in significant proportions
12	Wet (2), Eroded, Rego and Calcareous (4) and coarser textured (6)	The three Soil Model Units 2, 4 and 6 are present in significant proportions
13	Significant saline soils (3) and eroded Rego and Calcareous soils (4).	Both Soil Model Units 3 and 4 are present in significant proportions
14	Eroded, Rego and Calcareous (4) and Solonetzic (7)	Both Soil Model Units 4 and 7 are present in significant proportions
15	Coarser textured (6) and Solonetzic (7)	Both Soil Model Units 6 and 7 are present in significant proportions

Soil Model Unit Number	Significant Soil	Additional Description
16	Chernozemic only if the dominant or co-dominant soils are Regosolic, Solonetzic and/or Gleysolic	
17	Significant finer-textured soils (5) and significant Solonetzic soils (7).	Both Soil Model Units 5 and 7 are present in significant proportions
18	Wet (2) and finer-textured (5)	Both Soil Model Units 2 and 5 are present in significant proportions
19	Wet (2) and Chernozemic (16) only if the dominant or co-dominant soils are Solonetzic.	Both Soil Model Units 2 and 16 are present in significant proportions
20	Imperfectly drained Regosolic soils (Gleyed subgroups) only if dominant or co-dominant soils are Gleysolic.	
21	Dominant or two codominant Gleysolic soils with significant Organic soils.	

Variants

Variants of Soil Series are indicated as **modifiers** following the Soil Series code. Three examples are listed below. A complete list of variant codes is contained in Appendix A.

CO: Coarse-textured variation of the noted soil series. Textural class is at least one group coarser (Fig. 1). E.g., FMT is medium-textured, so a FMTco indicates at least a moderately-coarse-textured variation.

GL: Gleyed phase of the noted soil series. Soils are generally imperfectly drained, indicative of temporary wetlands. May also be indicative of a high watertable, which can promote subirrigation.

ST: Stony phase used to indicate surface stoniness class of S3 or greater. Selected classes are defined in Table 6.

Table 6. Selected stoniness classes.

Stoniness Class	Description	% of Land Surface Covered By [Z] Stones or Boulders
S3	very stony	3 – 15
S4	excessively stony	15 – 50
S5	exceedingly stony	>50

[Z] Stones are 25 to 60 cm in diameter; boulders are >60 cm in diameter.

Undifferentiated Soil Models

Some soil landscapes are complex and may contain a wide variety of soil series. For these conditions undifferentiated soil models are used. Undifferentiated soil models begin with the letter Z, and reflect a broad grouping of particular soils that can include a soil order (E.g., ZSZ for Solonetzic), a soil subgroup (E.g., Gleyed is a component of ZGW), or a broad soil textural group (E.g., ZCO for coarse soils, Fig. 1). Nine undifferentiated soil models were used in AGRASID, and five additional undifferentiated models were used in the 1:50,000 Soil Survey of the County of Forty Mile (Table 7).

Table 7. Description of Undifferentiated Soil Models.

Source	Undifferentiated Soil Model Code	Description
AGRASID	ZCO	Coarse soils (gravel and sand)
	ZER	Eroded mineral soils including Regosols and Rego and Calcareous Chernozems
	ZFI	Finer-textured soils (finer than indicated by series)
	ZGW	Gleyed subgroups, Gleysols and water
	ZNA	Saline soils
	ZOR	Organic soils
	ZSZ	Solonetzic order soils
	ZUN	Unidentified mineral soils
	ZWA	Water bodies
McNeil et al. (1994)	ZAV	Alluvium
	ZCV	Colluviated shale
	ZDL	Disturbed land
	ZRB	Rough broken
	ZWW	Water

Table 8 lists the recognized Soil Series occurring within Canadian Forces Base Suffield. All soil series within AGRASID have a particular parent material code that relates to different types of course, medium, fine or layered types. The complete list of parent material codes is contained in Appendix B. Each soil series that occurs at CFB Suffield also has a unique parent material code, which is provided in the Soil Names file of AGRASID 3.0.

Table 8. Soil Series of CFB Suffield, Alberta, entirely within the Brown Soil Zone (the Dry Mixedgrass Natural Subregion). From McNeil 2003a.

Soil Order	Soil Subroup	Parent Material, Surface Expression, Texture													
		Till		Lacustrine				Glaciofluvial						Fluvial- Eolian	
		blanket		blanket		veneer over till	veneer over glacio-fluvial	fans or flood-plain	blanket	veneer over till	veneer over lacustrine	with gravels		blanket	veneer over till
		mod. fine	mod. fine to mod. coarse	fine	med. to mod. fine	med to mod fine	med over v gr and v coarse	med	mod coarse	mod coarse over mod fine	mod coarse over mod fine	very gravelly coarse	v gr and v coarse	very coarse	very coarse over mod fine
Chernozemic	Orthic	Maleb MAB	Foremost FMT	Seven Persons SPS	Chin CHN	Cranford CFD	Ramillies RAM	Bunton BUT	Bingville BVL	Antonio ANO	Rainier RIR	Kangaroo KGO	Pemu-kan PUN	Cavendish CVD	Purple Springs PLS
	Orthic saline Rego	Helms-dale HMS			Lilybrown LLB									Vendisant VST	
	Calcar-eous	Travers TVS		Acadia Valley ACF	Expanse EXP										
	Solon-etzic	Ronalaine ROL		Millicent MCT	Chinz CHZ	Timko TIK									
Solonetzic	Solod	Halliday HDY		Rosemary RMR	Karlsbad KBD	Gem GEM									
	Solod-ized Solo-netz	Hemaruka HUK		Patricia PTA	Wardlow WDW	Duchess DHS									
Regosolic	Orthic							Orion ORN					[Z]Etzikom EZM	Antelope ATP	
	Gleyed saline				Scotfield SFD										
	Cumulic							[Y]Verdigris VGR							
Gleysolic	Rego			Walsh WHL	Ventre VET									Islands INS	
	Rego (saline)				Dishpan DHP										

[Z]Gravelly very coarse Fluvial
[Y]Moderately fine fluvial
Note: Refer to the Soil Names File (ASIC 2001) for complete listing of all attributes.

Soil Series are one component of Soil Models. An example of a Soil Model used in the Suffield Soil Survey is provided in Appendix C.

Landscape Models

Landscape Models reflect landform, surface shape, slope and relief. (Table 9). They are usually denoted with a capital letter followed by a number followed by a small letter. For a complete listing of landscape models, soil model unit numbers, and soil series, please refer to AGRASID Version 3.0 (ASIC 2001).

Table 9. Definition of Selected Landscape Models. (Adapted from AGRASID 3.0, ASIC 2001).

Code	Definition of Landscape Model	Predominant Slope Range (%)
DL	Disturbed land, including communities and facilities.	
D1l	Low-relief longitudinal dunes.	2 – 9
D1m	Moderate-relief longitudinal dunes.	5 – 15
D1h	High-relief longitudinal dunes.	9 – 30
D2l	Low-relief parabolic dunes.	2 – 9
D2m	Moderate-relief parabolic dunes.	5 – 15
D2h	High-relief parabolic dunes.	9 – 30
HR2m	Moderate-relief hummocky and ridged.	5 – 15
HR2h	High-relief hummocky and ridged.	9 – 30
H1l	Low-relief hummocky.	4 - 9
H1m	Moderate-relief hummocky.	7 – 15
H1h	High-relief hummocky.	12 – 30
H5l	Low-relief hummocky draped moraine over softrock.	4 - 9
H5m	Moderate-relief hummocky draped moraine over softrock.	7 – 15
H5h	High-relief hummocky draped moraine over softrock.	12 – 30
I3l	Inclined, generally single slope landform, including fans and aprons.	2 – 9
I3m	Inclined; generally single slope moderate-relief landform.	6 – 15
I3h	Inclined and steep; generally single slope high relief landforms with 0 to 10% exposed bedrock.	15 – 60
I4l	Inclined; generally single slope low-relief landforms with >10% exposed softrock.	2 – 9
I4m	Inclined; generally single slope moderate-relief landforms with >10% exposed softrock.	6 – 15
I4h	Inclined and steep; generally single slope high-relief landforms with >10% exposed softrock.	15 – 60
I5	Inclined steep with extensive failure slumps.	15 – 60

Code	Definition of Landscape Model	Predominant Slope Range (%)
IUl	Combination of inclined and undulating; generally a wavy pattern of gentle slopes on an overall inclined landscape.	1 – 5
IUh	Combination of inclined and undulating to hummocky; generally a wavy pattern of gentle to moderate slopes on an overall inclined landscape.	3 – 9
U1l	Gently undulating or wavy pattern.	0.5 - 2
U1h	Undulating or wavy pattern.	2 – 5
R2l	Low-relief ridged landscape.	2 – 5
R2m	Moderate-relief ridged landscape.	6 – 15
R2h	High-relief ridged landscape.	12 – 30
M1m	Moderate-relief rolling, including multi-directional inclined slopes greater than 400 m in length.	6 – 15
M1h	High-relief rolling, including multi-directional inclined slopes greater than 400 m in length.	15 – 30
SC1-l	Steep-sided valleys with a confined floodplain; low relief.	1 – 9
SC1-h	Steep-sided valleys with a confined floodplain; high relief.	9 - 60
SC2	Incised stream channel in wide valley with one or more terraces.	2 – 60
SC3	V-shaped valley with no terraces or floodplain.	2 – 60
SC4	Intermittently incised subglacial stream channel; partially infilled with glacial deposits.	2 – 60
FP1	Unconfined meander floodplain.	0 – 5
FP2	Unconfined braided channel.	0 – 5
FP3	Confined floodplain with or without low-level terraces.	0 – 5
L1	Level plain.	0 – 2
L2	Level closed basin (depression with raised edges).	0 – 2
L3	Level and terraced; not within modern stream channels.	2 – 5
W1	Channels, sloughs and ponds in a linear arrangement.	0 - 1
W2	Sloughs in a non-aligned aggregation.	0 - 1
W3	Level basin that may be filled or partially filled with water. Semi-permanent to permanent water body.	0 - 1

Landscape models sometimes include the following **surface form modifiers.**

c: Channeled or rilled due to water erosion. Includes narrow and shallow temporary watercourses. Used when four or more channels occur within a cross-sectional distance of 800 m.

d: Dissected or gullied due to water erosion. Includes narrow to wide deep watercourses that interfere with ground transportation.

e: Eroded pits. Includes greater than 40% blowouts.

n: Concave or basinal water collection areas affected by surface water collection and/or groundwater discharge.

r: Shallow to bedrock. Bedrock is 1 to 5 m below ground surface.

Examples of SLM codes are listed below, followed by a diagram illustrating the components, which are described following the diagram.

Examples to Illustrate the Use of Soil Landscape Models

- A simple SLM with one dominant soil (ROL) is indicated as ROL1/U1l. The soil model number 1 indicates a relatively pure unit with no significant identified soils. The landscape model U1l indicates a low-relief undulating landscape with slopes generally less than 2%.
- A complex SLM with two co-dominant soils (ROL and SIL) is indicated as ROSI2/H1l. The soil model number 2 indicates a significant proportion of wet soils (Gleysols or gleyed subgroups). The landscape model H1l indicates low relief hummocky topography (slope classes 3 to 4, slopes of 2 to 9%).

An example of an SLM code is shown in Fig. 2.

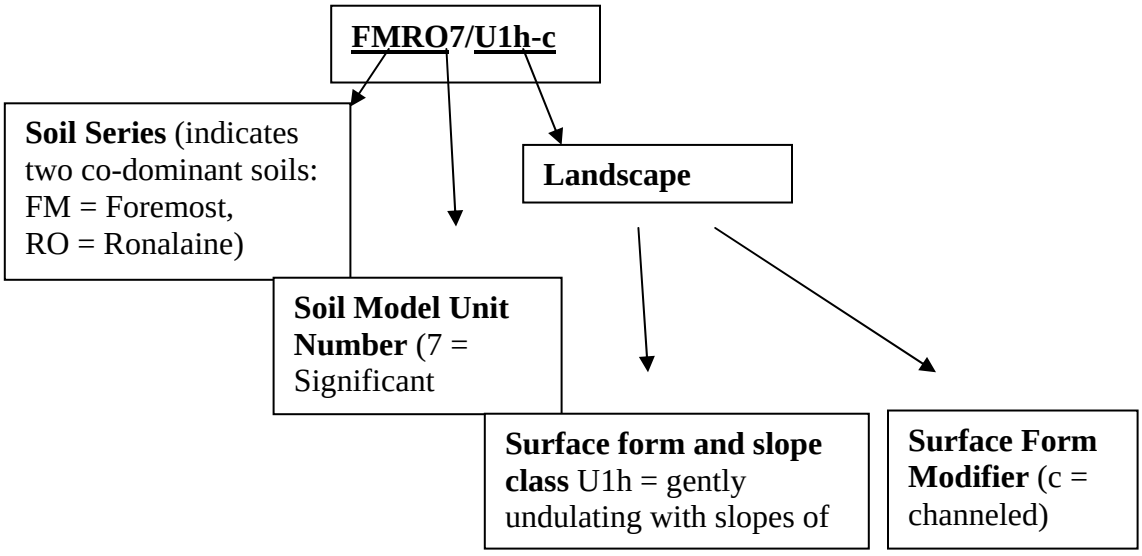

Fig. 2. Example of a Soil Landscape Model Code.

Further examples of AGRASID Soil Landscape Models used in a 1:50,000 Soil Survey, and a brief legend, are contained in Appendix D.

Land Systems

Land Systems are used to group features that can be applied to land-use planning, such as the development of municipal conservation plans. The definition of Land Systems involves soil climate, parent material and surface form, and soil taxonomy, principally the most commonly occurring soil series in a region.

Land Systems provide a further subdivision of Ecodistricts. Ecodistricts are characterized by distinctive relief, geology, landform, soil Great Groups, and vegetation. AGRASID contains about 150 Ecodistricts and 789 Land Systems. The reporting of Land Systems in AGRASID separates plains from uplands, hills, benches and valleys. Land Systems are designed to be presented in AGRASID 3.0 at a scale of 1:250,000.

Selected Land Systems from a portion of southwestern Alberta are presented in Table 10.

Table 10. Land Systems from a portion of southwestern Alberta.

Land System	Name	Mor-phology	SCA	Soil Zone	Ag. Climate	Order	Soil Series				Surface Form
							Major 1	Major 2	Minor 1	Minor 2	
04.00.15	Three Rivers	Valley	5	Thin Black	2AH	RG	ZERzbl		RND	BFT	FP3
04.1a.01	Cardston	Plain	5	Thin Black	3H	CH	CTN	BZR	CWY		U1h
04.1a.08	Todd Creek	Bench	5	Thin Black	3H	CH	BZR		CWY	ZERzbl	U1h
04.1d.01	Lyndon	Hills	5	Thin Black	3H	CH	BZR		NFK	PSO	R2m
04.1d.03	Willow Creek	Hills	5	Thin Black	3H	CH	BZR	OKY	NFK	PSO	HR2h
04.1d.02	Five Mile Creek	Hills	8	Black	5H	CH	DVG	HFD	MFT		R2h
04.2.22	Pekisko	Plain	8	Black	4H	CH	MFT		FSH	ZERzbl	IUh
05.1.07	Chain Lakes	Valley	8	Black	4H	CH	DVG		MFT	FSH	U1h
05.1.08	Cross Creek	Hills	8	Black	4H	CH	DVG	HFD	CBD		R2h
05.1.09	Sheppard	Hills	8	Black	4H	CH	DVG		HFD	ZERzbl	R2m
17.2a.08	Beauvais Lake	Upland	8	Black	5H	CH	DVG		BVA	WLB	H1m
17.2a.09	Chapel Rock	Hills	8	Black	5H	CH	HFD	DVG	CBD	BZR	R2h
17.2a.12	Leeyon	Hills	8	Black	5H	CH	DVG	HFD	CBD	ZERzbl	R2h
17.1a.07	Sullivan	Hills	16	Gray	5H	LU	SPR		LTC	BDY	R2m
17.2a.11	Porcupine	Hills	16	Gray	5H	CH	MSB	BDY	SKL	LTC	R2h
17.2a.13	Langford	Hills	16	Gray	5H	CH	BDY	LTC	MSB	FRK	R2h

PART 3: THE CORRELATION OF AGRASID TO ECOLOGICAL RANGE SITES

Initial Work

Soil and landscape mapping has allowed pedologists to observe and document the relative maturation of soil landscapes. Some soil landscapes are very young (i.e. immature) while others are fully developed. An example of a soil development sequence associated with a valley setting in the Dry Mixedgrass Natural Subregion is shown in Fig. 3. The soil development sequence provides a tool to relate the relative maturity and development of different but related soils.

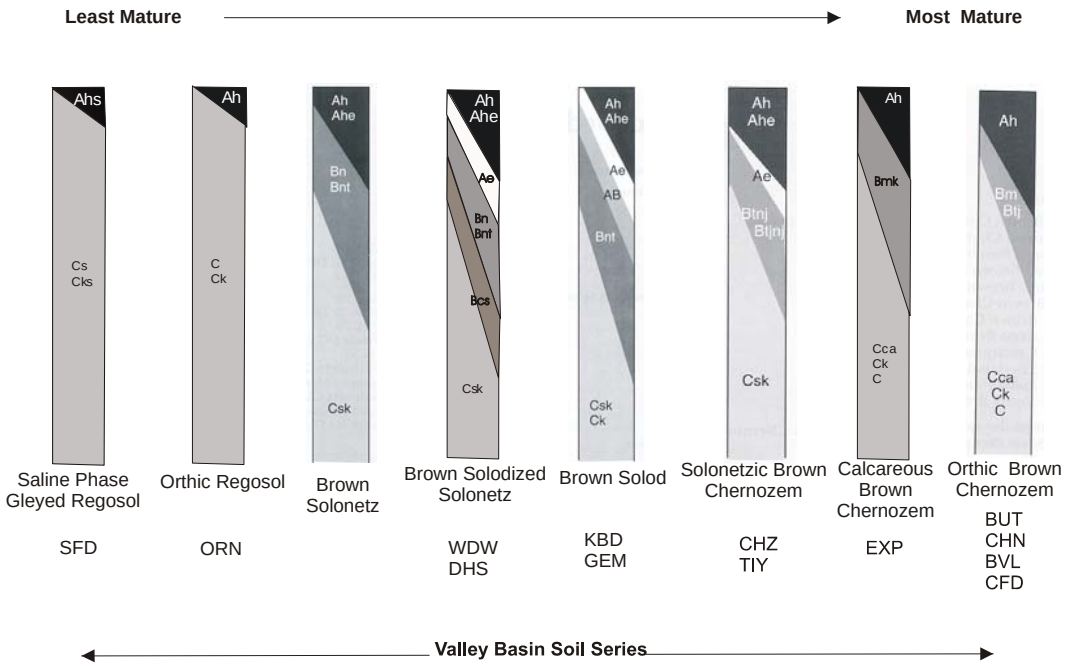

Fig. 3. An example of soil profile development and the applicable soil series related to a valley or basin setting in the Dry Mixedgrass Natural subregion.

Public Lands requested the development of a tool to link soil series to ecological range sites for southern Alberta. This work has led to "cross-walk" tables (Tables 11 to 21) that correlate soil series to ecological range sites. The tables also provide a brief soil or landscape description.

Notes on Tables 11 to 21

- For a complete description of soil series attributes please refer to the Soil Names file in AGRASID 3.0 (ASIC 2001).
- aa: indicates soil series that occur mainly in a bordering SCA, with only a small area in this SCA.
- Soil series codes in bold occur in more than one ecological/range site.

Table 11. Soil Series of SCA 1 Linked to Ecological Range Sites.

Natural Subregion: Dry Mixedgrass
Brown Soil Zone of South-Eastern Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**BUT, MCN, MKR, ORN**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	MHN
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	INS, IWT, NDP, SKF, SLY, TEP, WLH, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	**ACV**, MCT, RMR, SPS, WDN
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	**BUT**, CCL, CFD, CHN, CHZ, EXP, FMT, MAB, **MCN**, MSN, **PHN**, ROL, TIK, TIY, **TVS, VGR**
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	ANO, BVL, **CMY, GPH**, **MKR**, PLS, **RHS**, RIR, **RRD**, **SYK**, TAB, **VGR**, **YTW**
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	ZCV
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	BLP, DHS, GEM, **GPH**, HDY, HUK, KBD, PTA, **RHS**, RMR, **RRD**, SIG, **SIL**, **SYK**, WDW, **YNY**, **YTW**
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	ATP, **VST**
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	EZM, KGO, PUN
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	**ACV**, CLR, **EXP**, HMS, **MCN**, **MKR**, **ORN**, **TVS**, **VGR**, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	DHP, GLS, KTM, LYB, **MCN**, SFD, ZNA
	Sands (Sa)	Very coarse (VC) and <u>not</u> duned (CSSC 1998)	CVD, **VST**, **YNY**
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	RAM
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	**CMY, PHN, SIL**

Table 12. Soil Series of SCA 2 Linked to Ecological Range Sites.

Natural Subregion: Mixedgrass
Dark Brown Highlands of southern Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**CGW, GNN**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	HEG, RLK
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	EKW, FOR, **GNN**, LUP, MMD, PLP, **PME**, PUR, **RSR**, SOL, **THA**, TTH, WSM
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	LVYaa, MGA, MKRaa
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	ZCV
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	**CGW**, GRG, MHR, MCA, MNA, ZSZ
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	DMS, NEDaa, **RSR**
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	**PME**, WCR, WID, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	ZNA
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	HRK, KSRaa
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	BFTaa, CFTaa, **THA**
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	DPT, PLP

Table 13. Soil Series of SCA 3 Linked to Ecological Range Sites.

Natural Subregion: Mixedgrass
SCA3: Dark Brown soil zone associated with the plains of southern Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	MNH, SGY, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig.)	CLD, MGT, **WLG**
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	CRD, FOR, FSTaa, KCH, LET, LUP, MGA, OAS, PUR, PGT, PUY, RDM, WNY
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	KSR, CMY, MGRaa
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	AWD, BFDaa, IMY, KHO, KRK, LSD, PAR, **TLAaa**, ZSZ
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	**HRKaa**
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	MAC, NED, WOL
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	BKE, CIO, DIM, MCNaa, NEM, OSN, SXT, VEB, **WLG**, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	ZNA, HSR, KCP, LLD, WTN
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	**HRKaa**
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	CFT
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	MKN, **TLAaa**, VAC

Table 14. Soil Series of SCA 4 Linked to Ecological Range Sites.

Natural Subregion: Northern Fescue
Dark Brown Soil Zone of East-Central Alberta

Productivity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**BKF**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	FBG, FLT, THR, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	DMH
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	CNN, **DLA**, FST, HAN, HND, KUR, LFE, OVE, PRO, THB
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	DCY, LHD, MET, SUL
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	BFD, CUR, FNR, HKR, LHD, MIC, SHR, SUL, **TLA**, VTR, WES
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	ERT
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	SCD
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	ALT, NUT, MTR, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	**BKF**, GLK
	Sands (Sa)	Very coarse (VC) and <u>not</u> duned (CSSC 1998)	HCH, RIB, WWT
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	**TLA**, **OLA**, PTE

Table 15. Soil Series of SCA 5 Linked to Ecological Range Sites.

Natural Subregion: Foothills Fescue
Thin Black Soil Zone of Southwestern Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**HLM**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	JAT, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	CTN, PNR, **SND**
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	BUL, BZR, **DLB**, **HLM**, **ODM**, **OWD**, RFD, SAK, SOF
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	KNT
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	CGE, KGT, NNK, **OXY**, PGN
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	RFD, RND
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	CWY, **MKN**, **ODM**, PSO, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	ZNA
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	BFT, **DLB**, SAK
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	**MKN**, NFK, OKY, **OWD**, **OXY**, **SND**

Table 16. Soil Series of SCA 6 Linked to Ecological Range Sites.

Natural Subregion: Foothills Fescue
Thin Black Soil Zone of South-Central Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**KEO**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	**KEO, KYN**
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	DWT, IND, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig.)	THH, TWG
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	ADY, DEL, LTA, RKV
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	**HIW, HPV**, MDP
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	BED, **KEO**
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	BOV
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	EBO, **HIW, HPV**, NSKaa, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	BZC, GAY, **KYN**, ZNA
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	ARE
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	RSB
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	

Table 17. Soil Series of SCA 7 Linked to Ecological Range Sites.

Natural Subregion / Ecoregion: Aspen Parkland
Thin Black Soil Zone of East-Central Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**GLD**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	**GLD**
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	COR, DSJaa, FLTaa, FMN, HGTaa, HYLaa
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	**BTH,** KTY, TOA
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	ACE, BEL, BLL, **DYD**, EOR, HER, **KPO**
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	AMT, IRM, METaa, ROS
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4h, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	**BTH**, **DYD**, GDB, KLM, **KPO,** LOG, SDG, **SHS**
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	**RED**
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	KNA
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	
	Saline Lowlands (SL)	Saline discharge; salt-enriched	
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	CPL, HCHaa, **RED**
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	**SHS**

Table 18. Soil Series of SCA 8 Linked to Ecological Range Sites.

Natural Subregion: Foothills Parkland
SCA8: Thick Black Soil Zone of Southwestern Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	**RDL, TBR**
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	POT, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	ELBaa**, FSH
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	BVA, DVG, MFT, OTP, PPE, SPY, SRC, RSN-aa**
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	CRW, **GST, SHL, TBR**
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	**RDL**
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	**BUR**, LNB
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	**BUR, GST, SHL**, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	ZNA
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	DRW
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	**HFD**

Table 19. Soil Series of SCA 9 Linked to Ecological Range Sites.

Natural Subregion / Ecoregion: Aspen Parkland
SCA9: Thick Black Soil Zone of Southwest Portion of Central Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	ATOaa
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	BZCaa, COH, DEVaa, GSPaa, HAR, MLTaa, RCSaa, TUT
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	BPW, EAT, LLK, **WKNaa**
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	ATL, BENaa, CYG, DDY, EVLaa, LPN, MKV, MYK, **NIB, NSK**, PED, RMYaa, WTBaa
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	HPVaa, RDWaa, TWS, UKTaa
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	**KVGaa**
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	**KVGaa**, MYK, **NIB, WKNaa**
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	**MGS**
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	BOVaa, FTHaa
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	**NSK**
	Saline Lowlands (SL)	Saline discharge; salt-enriched	
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	**MGS**
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	SCO, ISF
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	

Table 20. Soil Series of SCA 10 Linked to Ecological Range Sites.

Natural Subregion / Ecoregion: Aspen Parkland
SCA10: Thick Black Soil Zone of Central and East-Central Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**GUR**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	ANR, ATO, EDG, NMP, **NVR**
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	BIT, BOA, DMY, DSJ, GSP, HGT, HYL, JVE, MAK, MLT, MNTaa
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	CCB, **DUG**, ELL, LOM, MCO, MIQ, MJU, MLA, MLS, NMO, **MNK, NVR**, SLW, STL, **WKN**
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	AGS, **ARM**, ATO, BEN, BVH, **BWF**, SMO, COA, EDG, EVL, FLU, HBM, KHS, MVL, NRM, POK, RLV, RMY, **TBY, TFD**, UCS, **UKT, WHF**, WSR, WTB
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	**ATM**, BRK, ELP, **FTH**, GBL, HLB, MSW, NTV, PHF, PHS, RDW, TGL, **UKT**
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	**ARM**, CMO, **DUG, KVG, KWO**, MLS, **MNK**, NMP, **TBY, TFD, WHF, WKN**
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	DWGaa
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	**FTH**, LBK, **TWH**
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	**BWF**
	Saline Lowlands (SL)	Saline discharge; salt-enriched	
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	**GUR**, HLW, MDR, NTWaa, PRM, **TWH**
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	**ATM**
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	**KWO, KVG**

Table 21. Soil Series of SCA 16 Linked to Ecological Range Sites.

Natural Subregion: Montane
SCA16: Moderate to High Elevations in Southwestern Alberta

Productiv-ity Rating	Ecological/Range Site	Soil or Landscape Description	Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	TBRaa, **TDC**
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	DNL, MTF, POTaa, WDC, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 1)	ELB
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 1)	**BDY**, BPE, **CCR**, LTC, **MSB**, RSN, SPR, WCT, **WLB**, WTX
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	CON, **SKL**
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 1)	
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	MGV, MRY
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	ZNA
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	BRG, **TDC, WLB**
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	**BDY**, BEV, **CCR**, FRK, **MSB, SKL**, TUC

Overview of the Second Phase: Plant Communities

LandWise Inc. (McNeil 2003b) was contracted by the Integrated Resource Management Branch of Alberta Environment to assist in developing a method to extend known ecological range sites and associated plant community information from individual locations to the entire southern Alberta region. A map showing the aerial extent of each range site was prepared by developing **rules to link ecological range sites and their associated major plant communities to soil and landscape information in AGRASID.**

Integrated Regional Services, Resource Information Unit Staff in Lethbridge used the rules to develop an automated system to create an ArcView-based GIS map linking SLMs to ecological range sites and plant communities. Each ecological range site was assigned current updated definitions and a specific AGRASID match.

The GIS map product is the first attempt to identify the link between AGRASID 3.0 and ecological range sites and plant communities. The map product provides a general overview of ecological range sites and plant communities, and therefore it is not recommended for use on a site-specific basis.

The study area encompassed all of southern Alberta except the Rocky Mountain Natural Region, which includes the Montane, Sub-Alpine and Alpine Natural Subregions. The study area includes the Dry Mixed Grass, Mixed Grass, Foothills Fescue, Northern Fescue, Foothills Parkland and Aspen Parkland Natural Subregions. These natural subregions correspond to Soil Correlation Areas (SCAs) 1, 2, 3, 4, 5, 6, 8 and 9 in AGRASID. Each SCA reflects a particular soil climate and landscape ecology (Table 22).

Table 22. Correlation between selected natural regions/subregions, SCAs and soil zones.

Natural Region or Subregion	Soil Correlation Area (SCA)	Soil Zone
Dry Mixed Grass	1	Brown
Mixed Grass Highlands	2	Dark Brown
Mixed Grass	3	Dark Brown
Northern Fescue	4	Dark Brown
Foothills Fescue (South)	5	Black
Foothills Fescue (North)	6	Black
Aspen Parkland	7	Thin Black
Foothills Parkland	8	Thick Black
Aspen Parkland	9	Thick Black
Aspen Parkland	10	Thick Black
Southern Montane	16	Dark Gray / Luvisolic

An ecological range site as defined by the Task Group on Unity and Concepts (1995), "is a distinctive kind of land in its ability to produce a distinctive kind and amount of vegetation". Fifteen range sites were originally defined for Alberta (Smoliak et.al 1966). "Range site names are based on easily-recognized permanent physical features such as the kind of soil, climate, and topography, or combinations of these features...and are recognized in the... potential vegetation" (Wroe et al. 1988). Range sites are associated with recognizable plant communities, and they are an important tool used by agrologists and ranchers to optimize the use of range lands.

Rules Used to Correlate AGRASID to Ecological Range Sites

An initial list of ecological range sites and corresponding plant communities was provided by the Alberta Public Lands Division for each SCA. Definitions for some ecological range sites were modified, and ecological range sites that occur in additional SCAs were identified. Plant communities in some of the additional ecological range sites require future characterization.

Rules were developed to link ecological range sites and corresponding plant communities to the 13,371 AGRASID polygons in the study area. The rules were designed to apply to all or almost all Soil Landscape Models (SLMs). The rules were originally based on AGRASID categories, as summarized in Table 22. After several iterations of rule building it was concluded that soil series was the most useful AGRASID category for linking SLMs to ecological range sites. Some of the categories listed in Table 23 were retained, including the landscape models and the undifferentiated soil models in combination with landscape models. Refer to Tables 24 and 25 for the complete rules developed for SCAs 4 (Northern Fescue) and 8 (Foothills Parkland).

Table 23. AGRASID categories originally used to link SLMs to ecological range sites.

AGRASID Category (file)	Ecological Range Site
Parent Material (PM)	Clayey (Cy), Loamy (Lo), Sandy (Sy), Sand (Sa), Thin Breaks (TB), Shallow to Gravel (SwG), and Gravel (Gr)
Drainage classes (mas wet)	Sub-irrigated (Sb) and Wetland (WL)
Regional Soil Choice	Blowout (BlO)
Landscape Models	Riparian (Ri), Overflow (Ov) and Badlands (BdL)
Regional Soil Choice in combination with Landscape Models	Choppy Sandhills (CS)
Soil Series	Limy (Li) and Saline Lowland (SL)
Undifferentiated Soil Models in combination with Landscape Models	Water (Wa) and Urban (Urb)

All soil series present in each SCA are used in the rules for that SCA, and additional categories are used as necessary to supplement the soil series information. AGRASID land systems, the provincial digital elevation model, and the Alberta Vegetation Inventory were also used for some rules.

Several SLMs that have been incorrectly coded in AGRASID were identified during this project. These errors were corrected by manually manipulating the rules for these few SLMs. Minor additional rule refinements were conducted when the program was run for the entire study area.

Rules for Co-dominant Soil Series

For SLMs with co-dominant soils, the co-dominant soil series that is most limiting to range production is associated with the corresponding range site and plant community.

The ranking of range-site productivity used in the GIS is based on an established understanding (Wroe et. al 1988), and is used for comparative purposes only. Although the ranking is currently only relative, it will probably be quantified in the future, as knowledge of ecological range sites expands.

Multiple ecological range sites occasionally occur within one SLM, but this project selects only the ecological range site that is most limiting to range productivity. SLMs that contained the same dominant and co-dominant soils but different significant soils were generally linked to the same range sites, with the exception of cases where the significant soils caused association with a different reference plant community.

Disclaimers

- For SLMs with co-dominant soils, the soil series that is most limiting to range production is linked to the corresponding ecological range site and the reference plant community. The ranking used in the GIS is based on an established understanding of range site productivity associated with the Alberta stocking guide (Wroe et. al 1988), and is used for comparative purposes only. Although the ranking is currently only relative, it will probably be quantified in the future, as knowledge of ecological range sites expands.
- The linkages between AGRASID polygons and ecological range sites and reference plant communities rely on the reliability of AGRASID data. The map product generally applies on an AGRASID polygon basis, rather than a site-specific basis. Multiple ecological range sites occasionally occur within one SLM, but this project selects only the ecological range site that is most limiting to range productivity. SLMs that contained the same dominant and co-dominant soils but different significant soils were generally linked to the same range sites, with the exception of cases where the significant soils caused association with a different reference plant community.
- The GIS map product assumes that plant community boundaries coincide with AGRASID boundaries. In reality, plant community boundaries will also be influenced

by sun angle, aspect, and numerous other factors. Plant community boundaries may grade into one another over many kilometers, particularly in level and undulating areas. Plant community boundaries may not coincide with SLM boundaries, and on a site-specific basis, the identified plant community may not occur in the identified ecological range site.

- The reference plant community associated with each ecological range site is based on site expression of potential natural community, or the plant community that would exist when the range is in good to excellent condition. In reality, range plant communities may exist at lower seral stages of plant succession, previously termed fair and poor condition, now termed unhealthy or healthy with problems. Lower seral stages are due mainly to alteration by grazing, with a resulting dominance of more grazing-resistant species.
- Some plant communities are first approximations and will be revised as additional vegetation survey data becomes available.
- Some of the native rangeland mapped as grassland cover in the Native Prairie Vegetation Inventory may be modified rangeland implying grassland that has become more or less permanently invaded by agronomic species like Timothy, smooth brome, Kentucky bluegrass and crested wheatgrass.
- The rules used to develop this GIS map product are a best attempt based on testing and validation as explained in this report.
- The rules do not account for variability of slope position. For example, each slope position (upper, mid, lower and depressional) may belong to a unique soil series. In recent detailed soil surveys, and in the next version of AGRASID, each slope position is assigned a unique soil series. An example of soil landscape models with identified soil series related to varying slope positions is contained in Appendix E.

Rules used to link Soil Landscape Models to Ecological Ranges Sites in SCAs 1 and 8

Table 24. Reference Plant Communities of SCA1 (Dry Mixedgrass) (From McNeil 2003b).

Soil Landscape Models (SLMs) are indicated as soil series unit number/landscape model (e.g. MAB10/U1h). Three-letter soil series codes indicate that one soil series is dominant (e.g., Maleb = MAB). SLMs with four-letter soil series codes indicate two co-dominant soil series that are represented by the first two and the last two letters (e.g., Maleb-Cranford = MACF). Unit numbers range from 1 to 22 (10 in the above example), and represent a particular assemblage of significant soils. The landscape model indicates surface form, relief and slope characteristics. Refer to AGRASID 3.0 for further details (ASIC 2001).

Reference Plant Communities of SCA1 (Dry Mixedgrass – Brown Soil Zone of Southeastern Alberta) as Related By Ecological Range Site – Soil Landscape Model Correlations Rule Building (From McNeil 2003b).

[Z]Plant Community Number	Range Site and Rank	Rules for Using AGRASID Files With the SARS-ALCES Model	Comments
----------	[Y]Wa 1.0.0	Use for the undifferentiated soil model ZWA only if associated with a water-dominated landscape model (W1, W2, or W3).	Any permanent body of water; (e.g., lakes, reservoirs and rivers).
DMA17 not characterized	Sb 1.1.1	Use for all 3-letter [X]SLMs coded as MHN; **OR** for all 4-letter SLMs with MH in the code as either of the first two or the last two letters, 50% of the SLM is DMA17 – Sb; **OR** for SLMs where the dominant or co-dominant PM equals C0 or C2 AND with the soil model unit #2, 8, 9, 12 or 18, 15% of the SLM is DMA17-Sb (the other 85% is assigned to Sa or CS).	Correlates to MHN soil series. Limited occurrences in SCA 1.
Complex	[Y]Ri 1.1.5	Use for landscape models of stream channel or floodplain (SC1-l, SC1-h, SC2, SC3, SC4, FP1, FP2, or FP3); **OR** any soil model coded as VGR (Verdigris).	The zone most closely adjacent to stream channels.
DMA10 Silver Sagebrush/ Western Porcupine grass – Needle and thread	Ov 1.2.1	For any SLM that has the landscape model I3l, and the dominant or co-dominant [W]PM <u>does not</u> equal L3 or M4, assign 50% of the SLM to DMA10 - Ov; **OR** for all 3-letter SLMs coded as BUT, MKR or ORN, assign 30% of the SLM to DMA10 - Ov; **OR** for all 4-letter SLMs with BU, MK or OR in the code as either the first two or the last two letters (meaning BU, MK or OR are co-dominant), 15% of the SLM is assigned to DMA10 – Ov.	DMA10 occurs with I3l landscape model in the mid- to lower positions, or with the BUT, MKR, or ORN soil series. Usually the 50% non-overflow associated with I3l landscapes is Lo or Cy. The 70% non-overflow component associated with BUT is Lo, while MKR is Li and ORN is SL- 1.13.1.

Reference Plant Communities of SCA1 (Dry Mixedgrass – Brown Soil Zone of Southeastern Alberta) as Related By Ecological Range Site – Soil Landscape Model Correlations Rule Building (From McNeil 2003b).

[Z]Plant Community Number	Range Site and Rank	Rules for Using AGRASID Files With the SARS-ALCES Model	Comments
Complex	WL 1.3.1	Use for all 3-letter SLMs coded as INS, IWT, NDP, SKF, SLY, TEP, VET, WLH, or ZGW; **OR** for any 4-letter SLMs with IN, IW, ND, SK, SL, TE, VE, WL, ZG or ZW in the code as either the first two or the last two letters(indicating co-dominance), 50% of the SLM is WL 1.3.1; **OR** for any 3-letter SLM coded as ZWA if the landscape model is not W1, W2 or W3.	
DMA04 Western Wheatgrass – Sandberg Bluegrass	Cy 1.4.1	Use for all 3-letter SLMs coded as MCT, SPS or WDN (now WHN); **OR** use for all 4-letter SLMs with MC, SP or WD (now WH) in the code as either the first two or the last two letters.	Includes weakly expressed Solonetzic (MCT) or Chernozemic soils (SPS or WDN). WDN changed to WHN for this project, to avoid confusion with WDW.
DMA03 Needle and Thread – Thread-leaved Sedge	Lo 1.5.1	Use for all 3-letter SLMs coded as PHN that border the Sweetgrass Hills Land Systems; **OR** use for all SLMs that border the Sweetgrass Hills Land Systems if the landscape model does not equal M1h, M4, R2h, H1h, H5h, or HR2h; **OR**, for all SLMs located in Land Systems that border the Sweetgrass Hills or Milk River Ridge, provided the 3-letter code is MSN, or the 4-letter code contains MS as either the first two or the last two letters.	Acceptable Land System numbers that border the Sweetgrass Hills or Milk River Ridge include 01.1.2a.19c, 01.1.2a.19a, 01.2a.20b, 01.2a.20a, 01.2a.19b, 01.2a.17b, 01.1.12b, 01.1.05c, 01.1.11b, 01.1.11a, 01.1.12a.
DMA02 Needle and Thread – June Grass – Blue Grama	Lo 1.5.2	Use for all 3-letter SLMs coded as MSN or PHN that do not border the Sweetgrass Hills or the Milk River Ridge, and that do not fit in the DMA03-Lo category; **OR** use for all 4-letter SLMs with MS or PH in the code as either the first two or the last two letters, provided the SLMs do not border the Sweetgrass Hills or Milk River Ridge and that do not fit in the DMA03-Lo category; **OR** use for all 3-letter SLMs coded as CCL, CFD, CHN, FMT or MAB, and for all 4-letter SLMs with CC, CF, CH, FM or MA in the code as either the first two or the last two letters, EXCEPT those with soil model numbers 7, 10, 14, 15 or 17.	This is the most extensive Lo range site in the Dry Mixedgrass Natural Subregion.
DMA01 Silver Sagebrush/ Needle and Thread – Blue Grama	Lo 1.5.3	Use for all 3-letter SLMs coded as CHZ (now CIZ), ROL, TIK, or TIY; **OR** use for all 4-letter SLMs with CH (now CI), RO, or TI in the code as either the first two or the last two letters; **OR** use for any 3-letter SLMs coded as CCL, CFD, CHN, FMT or MAB, or for any 4-letter SLMs with CC, CF, CH, FM or MA in the code, PROVIDED the soil model number is 7, 10, 14, 15 or 17; **OR** for any 3-letter SLM coded as BUT, EXCEPT I3l, assign 70% of the SLM to DMA01-	CHZ changed to CIZ for this project, to avoid confusion with CHN.

Reference Plant Communities of SCA1 (Dry Mixedgrass – Brown Soil Zone of Southeastern Alberta) as Related By Ecological Range Site – Soil Landscape Model Correlations Rule Building (From McNeil 2003b).

[Z]Plant Community Number	Range Site and Rank	Rules for Using AGRASID Files With the SARS-ALCES Model	Comments
		Lo; **OR** for any 4-letter SLM with BU in the code, EXCEPT I3l, assign 85% of the SLM to DMA01-Lo.	
DMA06 Silver Sagebrush/ Needle and Thread – Blue Grama	Sy 1.6.1	Use for all 3-letter SLMs coded as ANO, BVL, RAM, RIR or TAB; **OR** use for any 4-letter SLM with AN, BV, RA, RI or TA in the code as either of the first two or the last two letters; **OR** use for landscape models **that do not equal** M1h, M4, R2h, H1h, H5h or HR2h where the 3-letter soil model code is CMY or the 4-letter code contains CM.	Use CMY on low to moderate relief landscape models only. Sy-DMA06 also includes the SwG-RAM soil series.
DMA15 not characterized	Li 1.7.1	Use for all 3-letter SLMs coded as ACV, CLR, EXP, HMS or TVS; **OR** use for any 4-letter SLM with AC, CL, EX, HM or TV in the code as either of the first two or the last two letters; **OR** for any 3-letter SLM coded as ORN or MKR, assign 50% of the SLM to DMA15-Li; **OR** for any 4-letter SLM with OR or MK in the code, assign 25% of the SLM to DMA15-Li. **OR** where ZER is <u>not equal</u> to I3l or I3h, I4m or I4h landscape models; **OR** use for the ZUN/I3m SLM.	
DMA07 Silver Sagebrush/ Needle and Thread – Sandgrass	Sa 1.8.1	Use for all 3-letter SLMs coded as CVD, KGO or PLS; **OR** use where any 4-letter SLM has CV, KG or PL in the code as either the first two or the last two letters; **OR** use for any 3-letter SLM coded as VST or any 2-letter SLM with VS in the code, PROVIDED the landscape model does not equal D1m, D2m, D1h or D2h; **OR** for SLMs where the dominant or co-dominant PM equals C0 or C2 AND with the soil model unit #2, 8, 9, 12 or 18, 85% of the SLM is assigned to DMA07-Sa, PROVIDED the landscape model does not equal D1m, D2m, D1h or D2h	For the final rule, the 15% that is not DMA07-Sa is assigned to DMA17-Sb.
DMA13 Northern and Western Wheatgrass	BlO 1.9.1	Use for all 3-letter SLMs coded as RMR, PTA or SIG (now SRG); **OR** use for all 4-letter SLMs with RM, PT or SI (now SR) as either the first two or the last two letters.	SIG changed to SRG for this project to avoid confusion with SIL.
DMA12 Silver Sagebrush/	BlO 1.9.2	Use for all 3-letter SLMs coded as BLP, DHS, GEM, GPH, HDY, HUK, KBD, RHS, RRD, SYK, WDW, YNY or YTW; **OR** use for all 4-letter SLMs with BL, DH, GE, GP, HD, HU, KB, RH, RR, SY, WD, YN or YT in the code as	The most extensive BlO Range Site in the Dry Mixedgrass Natural Subregion, and covers a range of parent materials from

Reference Plant Communities of SCA1 (Dry Mixedgrass – Brown Soil Zone of Southeastern Alberta) as Related By Ecological Range Site – Soil Landscape Model Correlations Rule Building (From McNeil 2003b).

[Z]Plant Community Number	Range Site and Rank	Rules for Using AGRASID Files With the SARS-ALCES Model	Comments
Northern Wheatgrass – Blue Grama		either the first two or the last two letters; **OR** for 3-letter SLMs coded as SIL or 2-letter SLMs with SI in the code, use DMA12-BlO if the landscape model is not any of M1h, M4, R2h, H1h, H5h or HR2h.	Sa to Lo.
DMA08 Chokecherry/Low sedge – sandgrass	CS 1.10.1	Use for all 3-letter SLMs coded as ATP; **OR** use for all 4-letter SLMs with AT as either the first two or the last two letters; **OR** use for all 3-letter SLMs coded as VST and all 4-letter SLMs with VS in the code, PROVIDED the landscape model equals D1m, D1h, D2m or D2h; **OR** for SLMs where the dominant or co-dominant PM equals C0 or C2 AND with the soil model unit #2, 8, 9, 12 or 18, 85% is assigned to DMA08-CS, PROVIDED the landscape model equals D1m, D1h, D2m or D2h.	Correlates to ATP (Orthic Regosolic) or VST (Rego Chernozemic); the latter only on duned moderate to high relief landscapes.
DMA14 Northern Wheatgrass – June grass - Sedge	TB 1.11.1	Use for all SLMs using I3m or I3h landscape models; **OR** for all 3-letter SLMs coded as PHN, CMY or SIL, and for all 4-letter SLMs with PH, CM or SI as either the first two or the last two letters, PROVIDED the landscape model is any of M1h, M4, R2h, H1h, H5h, or HR2h.	------
DMA11 Silver Sagebrush / Western Wheatgrass	SL 1.13.1	For all 3-letter SLMs coded as MKR or ORN, assign 20% to DMA11-SL; **OR** for all 4-letter SLMs with MK or OR as either the first two or the last two letters, assign 10% to DMA11-SL.	Approximately 30 to 50% bare soil with dwarf Silver Sagebrush on sodic lowlands and lower reaches of aprons and fans (particularly in Pakowki Basin).
DMA09 Silver Sagebrush/ Wheatgrass	SL 1.13.2	Use for all 3-letter SLMs coded as MCN (now MNB) or WTNaa; **OR** use for all 4-letter SLMs with MC (now MN) or WT as either the first two or the last two letters.	MCN changed to MNB for this project to avoid confusion with MCT. Approximately 75% bare soil with decimeter high Silver Sagebrush usually on saline and sodic soils.
DMA18 not characterized	SL 1.13.3	Use for all 3-letter SLMs coded as DHP (now DSP), GLS, KTM, LYB, SFD or ZNA; **OR** use for all 4-letter SLMs with DH (now DS), GL, KT, LY, SF or ZN as either the first two or the last two letters.	DHP changed to DSP for this project to avoid confusion with DHS. Dominantly bare soil in isolated depressions (evaporative flats); with saline Gleysolic or saline Gleyed soils.

Reference Plant Communities of SCA1 (Dry Mixedgrass – Brown Soil Zone of Southeastern Alberta) as Related By Ecological Range Site – Soil Landscape Model Correlations Rule Building (From McNeil 2003b).

[Z]Plant Community Number	Range Site and Rank	Rules for Using AGRASID Files With the SARS-ALCES Model	Comments
DMA05 Silver Sagebrush/ Needle and Thread – Fringed Sage	Gr 1.14.1	Use for all 3-letter SLMs coded as EZM, or PUN; **OR** use for all 4-letter SLMs with EZ, or PU as either the first two or the last two letters.	
DMA16 Thread-leaved Sedge – Moss Phlox	BdL 1.15.1	Use for all SLMs where: **the** 3-letter code equals ZCV; **OR** where the 4-letter code has ZC as either the first two or the last two letters; **OR** for any SLM with the landscape model I4m, I4h or I5.	Badlands are usually areas with >10% exposed Cretaceous softrock.
----------	[Y]Urb 1.16.1	Use for disturbed land (DL) landscape model.	Cities, towns or disturbed land. The soil model is usually ZUN (undifferentiated).

[Z]Ecological range sites are arranged in order from most productive to least productive to facilitate the identification of the most limiting ecological range site and plant community for co-dominant soil models.
[Y]Indicates an ecological range site that has been added for the purposes of this project.
[X]Soil Landscape Model. [W]Parent material in the master file of AGRASID

Table 25. Reference Plant Communities of SCA8 (Foothills Parkland) (From McNeil 2003b).

Soil Landscape Models (SLMs) are indicated as soil series unit number/landscape model (e.g. MAB10/U1h). Three-letter soil series codes indicate that one soil series is dominant (e.g., Maleb = MAB). SLMs with four-letter soil series codes indicate two co-dominant soil series that are represented by the first two and the last two letters (e.g., Maleb-Cranford = MACF). Unit numbers range from 1 to 22 (10 in the above example), and represent a particular assemblage of significant soils. The landscape model indicates surface form, relief and slope characteristics. Refer to AGRASID 3.0 for further details (ASIC 2001).

Reference Plant Communities of SCA8 (Foothills Parkland Natural Subregion – Thick Black Soils in Southwestern Alberta) as Related By Ecological Range Site – Soil Landscape Model Correlations Rule Building. (From McNeil 2003b).

[Z]Plant Community Number	Range Site and Rank	Rules for Using AGRASID Files With the SARS-ALCES Model	Comments
----------	[Y]Wa 8.0.0	Use for the undifferentiated soil model ZWA only if associated with a water-dominated landscape model (W1, W2, or W3).	Any permanent body of water; (e.g., lakes, reservoirs and rivers).
------	Sb	No occurrences in SCA8 after running rules (for rules see SCA1).	
Complex	[Y]Ri 8.1.5	Use for landscape models of stream channel or floodplain (SC1-l, SC1-h, SC2, SC3, SC4, FP1, FP2, or FP3).	The zone most closely adjacent to stream channels.
------	Ov 8.2.1	Use for any [X]SLM coded as I3l where the dominant or co-dominant [W]PM does not equal L3 or M4, 50% of the SLM is Ov; **OR** for all 3-letter SLMs coded as MFT or FSH, 20% of the SLM is Ov; **OR** for all 2-letter SLMs with MF or FS in the code, 10% is Ov.	This rule commonly applies to ZUN or ZER soil models. The non-overflow portion is usually assigned to the Lo- 8.5.1 range site.
See comments	WL 8.3.1	Use for all SLMs where the 3-letter code equals POT or ZGW; **OR** for any 4-letter SLM with PO, ZG, or ZW in the code as either the first two or the last two letters (indicating co-dominance), 50% of the SLM is WL 8.3.1; **OR** use for any 3-letter SLM coded as ZWA if the landscape model is not W1, W2 or W3.	Two plant communities identified by Alberta Public Lands): FPA01 (Sedge, Marsh Reedgrass), and FPA02 (Willow-Bog Birch/Sedge – Tufted Hair Grass). Attempted to separate FPA01 using AVI data, but no polygons correlate to AGRASID.
FPA10 Willow / Rough Fescue – Parry's Oatrgrass	Lo 8.5.1	For any 3-letter SLM coded as MFT or FSH, 80% of the SLM is FPA10-Lo; **OR** for any 4-letter SLM with MF or FS in the code as either the first two or the last two letters, 90% of the SLM is FPA10-Lo.	The 10 or 20% remainder is assigned to Ov-8.2.1. FSH is Clayey (Cy), but only minor ha remain in native cover, so Cy was included with Lo.
FPA03	Lo	Use for all 3-letter SLMs coded as BVA, DVG, PPE or SPY; **OR** use for all 4-	FPA03 unit should be dominantly grasses.

Reference Plant Communities of SCA8 (Foothills Parkland Natural Subregion – Thick Black Soils in Southwestern Alberta) as Related By Ecological Range Site – Soil Landscape Model Correlations Rule Building. (From McNeil 2003b).

[Z]Plant Community Number	Range Site and Rank	Rules for Using AGRASID Files With the SARS-ALCES Model	Comments
Rough fescue – Parry's Oatgrass	8.5.2	letter SLMs with BV, DV, PP or SP in the code as either the first two or the last two letters; **OR** use for SLMs coded as HFD or with HF in the code where the landscape model is low relief (U1l, U1h, IUl, IUh, L1, L2, L3, M1m, M3, R2l, H1l, H1m, H5l).	AVI was checked for forested tracts mapped as PPE or SPY. However, the AVI splits are not suitable to establish detailed plant communities. Forested tracts should be FPA04 or FPA06.
FPA04 Aspen / Rose / Fireweed	Lo-Asp 8.5.3	Use for azonal montane series in SCA08, including BDYaa, LTCaa, SPRaa, FRKaa, BPEaa, CCRaa, RSNaa, and SCTaa; **OR** use for 4-letter SLMs coded as BDaa, LTaa, SPaa, FRaa, BPaa, CCaa, RSaa or SCaa in the code as either the first two or the last two letters.	Forested plant community. Hardwood (aspen) is mapped as both hardwood and mixed wood in the AVI data, and therefore the AVI splits are not suitable to establish detailed plant communities.
FPA06 Lodgepole Pine / Blueberry / Bunchberry-Pinegrass	Lo-Pi 8.5.3	AVI data was used for the separate field of Pine and overlaid with AGRASID to determine acceptable Lo Soil Landscape Models. Therefore, any Lo polygons within FPA10, FPA03 or FPA04 that coincide with locations of Pine in the AVI data automatically change to FPA06-Lo.	Forested community dominated by Lodgepole Pine. BVA is a common soil series in FPA06, either in combination with DVG, or to a lesser extent with FSH and MFT. Surface soil textures vary from Lo to Sy, with Lo parent material.
FPA11 Rough fescue – Sandgrass	Sy 8.6.1	Use for all 3-letter SLMs coded as CRW, OTP, SHL or SRC; **OR** use for any 4-letter SLM with CR, OT, SH or SR in the code as either of the first two or the last two letters.	FPA11 unit is dominantly graminoid. Lodgepole Pine areas of Sy are classified as FPA06.
To be Determined----------	Li 8.7.1	Use for all 3-letter SLMs coded as GST; **OR** for any 4-letter SLM with GS in the code as either the first two or last two letters; **OR** for the ZUN/I3m SLM; **OR** use where ZER or ZE do not occur with landscape models I3l, I3h, I4m or I4h.	Correlates to GST soil series. ZER is associated with the limy range site on I3m or non-inclined landscape models, and also with ZUN/I3m.
----------	Sa	No occurrences in SCA8 after running rules (for rules see SCA6).	
----------	BlO	No occurrences in SCA8 after running rules (for rules see SCA6).	Includes RDL soil series.
----------	CS	No occurrences in SCA8 after running rules (for rules see SCA6).	
FPA09 Bearberry – Parry's Oatgrass – Rough Fescue	TB 8.11.1	Use for all SLMs with I3h or I4m landscape models; **OR** use for all high-relief landscape models that are combined with SLMs coded as CBD, HFD or OKYaa, or use for all high-relief landscape models that are combined with 4-letter SLMs with CB, HF or OK in the code as either the first two or the last two	Correlates to HFD soil series on strong topography.

Reference Plant Communities of SCA8 (Foothills Parkland Natural Subregion – Thick Black Soils in Southwestern Alberta) as Related By Ecological Range Site – Soil Landscape Model Correlations Rule Building. (From McNeil 2003b).

[Z]Plant Community Number	Range Site and Rank	Rules for Using AGRASID Files With the SARS-ALCES Model	Comments
		letters. High-relief landscape models include I3m, M1h, M4, R2m, R2h, H1h, H5m, H5h, HR2h or HR2m.	
FPA07 Rough fescue – Parry's Oatgrass	SwG 8.12.1	Use for all SLMs where the dominant or co-dominant PM equals M1, L4 or L5; **OR** use for any 3-letter SLM coded as DRW, TBR, or TDC; **OR** use for any 4-letter SLM with DR, TB, or TD in the code as either the first two or the last two letters.	
----------	SL	No occurrences in SCA8 after running rules (for rules see SCA4).	
FPA08 Rough fescue – Parry's Oatgrass – Idaho Fescue	Gr 8.14.1	Use for all SLMs where the dominant or co-dominant PM equals C1, L1, or L14; **OR** use for any 3-letter SLM coded as BUR or LNB; **OR** use for any 4-letter SLM with BU or LN as the first two or the last two letters.	------
------	BdL 8.15.1	Use with all SLMs using landscape model I4h or I5.	Minor ha of BdL in SCA8
----------	[Y]Urb 8.16.1	Use for disturbed land (DL) landscape model.	Cities, towns or disturbed land. The soil model is usually ZUN (undifferentiated).

[Z]Ecological range sites are arranged in order from most productive to least productive to facilitate the identification of the most limiting ecological range site and plant community for co-dominant soil models.
[Y]Indicates an ecological range site that has been added for the purposes of this project.
[X]Soil Landscape Model. [W]Parent material in the master file of AGRASID

PART 4: RANGE CLASSIFICATION GUIDE FOR THE MIXEDGRASS AND FOOTHILLS FESCUE NATURAL SUBREGIONS: SELECTED EXERPTS

From Adams et al. In Preparation.

Overview

The **Mixedgrass** Natural Subregion is one of four Natural Subregions in the Grassland Natural Region (Achuff 1994), along with the Dry Mixedgrass, Foothills Fescue, and Northern Fescue. The Mixedgrass accounts for 19.8% of the Grassland Natural Region area, and 2.9% of the area of Alberta (ASIC 2001).

The Mixedgrass Natural Subregion occurs in **four geographic areas**. The largest area (78.3% of the Mixedgrass, ASIC 2001) occurs on the plains, including the towns or cities, from south to north, of Warner, Lethbridge, Vulcan, and Gleichen, and extending to the Wintering Hills near Hussar. Smaller areas of Mixedgrass occur in three highland areas to the southeast: 1) surrounding the Cypress Hills Escarpment and Plateau, 2) the Sweetgrass Hills Upland, and 3) the eastern portion of the Milk River Ridge.

The boundaries of the Mixedgrass Natural Subregion correspond closely to the boundaries of the Agricultural Regions of Alberta Soil Information Database (AGRASID) Soil Correlation Areas (SCAs) 2 and 3 (ASIC 2001). The plains portion of the Mixedgrass Natural Subregion is correlated with SCA 3, while the three highland areas are correlated with SCA 2.

The climate in the **Foothills Fescue** Natural Subregion is characterized by short summers with warm days and cool nights, and long cold winters, similar to the climate throughout southern Alberta. However, winter temperatures in the Foothills Fescue Natural Subregion are moderated by frequent chinook winds, which are strong westerly winds that occur most frequently in late fall and winter. Table 26 compares the climate of the Foothills Fescue to neighbouring Natural Subregions.

Table 26. Key distinguishing features of the Foothills Fescue Natural Subregion compared with neighbouring Natural Subregions.

Natural Subregion	Dominant Soils	Dominant Vegetation	General Climate compared to Foothills Fescue
Foothills Fescue	Black Chernozemic	Rough Fescue	winter climate moderated by chinooks. high frequency of snowfall in late winter and early spring (Achuff 1994).
Mixed Grass	Dark Brown Chernozemic	Wheat grasses and Needle and Thread grass.	drier, warmer summers, less intense chinooks
Foothills Parkland	Deep Black Chernozemic	Rough Fescue (mixedwood)	cooler and moister
Northern Fescue	Dark Brown Chernozemic and Dark Brown Solonetz	Rough Fescue	colder, more continental, drier and few chinooks
Central Parkland	Black Chernozemic	Rough Fescue with aspen poplar	colder with significantly fewer chinooks

Table 27 provides a 30-year summary of meteorological data for six stations located in the Foothills Fescue Natural Subregion.

Table 27. Summary of climatic data for selected stations in the Foothills Fescue Natural Subregion.

Ecodistrict	Station	Mean Daily Temp. (^{o}C)	Total precip. (P) (mm)	Mean precip. as rain (%)	% of ppt. from May to Sept.	[Z](P-PE) (mm)	Effective Growing Degree Days (EGDD > 5^{o}C)	Frost-free period (days (>0^{o}C)
Del Bonita Plateau	Del Bonita	[Y]4.3	397	76			1390	
	Whiskey Gap	3.8	452	61			1321	88
Cardston Plain	Cardston	[X]4.8 (5.4)	550 (557)	58 (61)	(58)		1543 (1579)	111
	Pincher Creek Town	4.1	589	59			1396	106
Willow Creek Upland	Claresholm/ Meadow Creek		444	67	61			
Delacour Plain	Calgary Int. Airport	3.6 (4.1)	423 (413)	(78)	70 (76)	-204	1281 (1431)	113

[Z] Precipitation – Potential Evapotranspiration

[Y]Values without brackets are compiled from Atmospheric Environment Service (1951 – 1980 Normals), and most are published in Brierley et al. (1991), MacMillan et al. (1987).

[X]Values in brackets are Canadian Climate Normals for the 1971 – 2000 period (From www.msc-smc.ec.gc.ca/climate/climate_normals/results

[W]Values are published in Walker et al. (1991).

[V]Values from AIWG (Agronomic Interpretations Working Group) 1995, interpolated by LandWise Inc..

Public Lands initially requested the development of "cross-walk" tables to correlate soil series to ecological range sites (Tables 11 to 21). The Range Classification Guides contain revised and updated ecological range site definitions, and an enhanced soil or landscape description for the AGRASID 3.0 correlation (Table 28).

Table 28. Ecological/range sites, with definitions and abbreviated AGRASID correlations. From McNeil (2003).

[Z]Ecological/ Range Site	Revised Definition	AGRASID 3.0 Correlation
Water (Wa)	Any permanent open body of water, including lakes, reservoirs and rivers.	Undifferentiated water bodies (ZWA) and W1, W2 or W3 landscape model.
Subirrigated (Sb)	Water table is close to surface during growing season, but rarely above.	Gleyed non-saline medium- to coarse-textured soils.
Riparian (Ri)	Zone most closely adjacent to stream and river channels. Also known as the lotic zone.	Any SLM with floodplain or stream channel landscape model (FP1,FP2, FP3, SC1-l, SC1-h, SC2, SC3or SC4)
Overflow (Ov)	Areas subject to water spreading and sheetflow. Typically on gentle inclines or terraces prone to stream overflow.	Inclined, low relief landscapes including fans and aprons; or soils developed on fans, aprons or terraces.
Wetland (WL)	Typically low-lying or depressional positions subject to occupation by water ranging from temporary to semi-permanent in duration. Also known as the lentic zone.	Non or weakly saline Gleysols or Organic soils. OR undifferentiated water bodies (ZWA) with any landscape model **except** W1, W2 or W3.
Clayey (Cy)	Clayey textured soils including silty clay, sandy clay, clay, and heavy clay. Generally >40% clay.	Fine- and very-fine-textured soil groups.
Loamy (Lo)	Includes loam, silt loam, silt, clay loam, sandy clay loam, and silty clay loam.	Medium- and moderately-fine textured soil groups.
Sandy (Sy)	Sandy-loam-textured soils.	Moderately coarse soil group.
Limy (Li)	Eroded or immature soils with free lime ($CaCO_3$) at the soil surface. Soil pH generally >7.5.	Eroded, Rego and Calcareous soils or subgroups.
Sand (Sa)	Loamy sand and sand soils, and not with a duned surface.	Very-coarse-textured soil group and not on duned landscape models.
Blowouts (BlO)	Areas with eroded surface pits reflecting the presence of abundant Solonetzic (hardpan) soils.	Dominant or Co-dominant Solonetzic Order Soils.
Choppy Sandhills (CS)	Loamy sand and sand soils with a duned land surface.	Very-coarse-textured soil groups with duned landscape models.
Thin Breaks (TB)	Areas with bedrock at or near the soil surface; largely vegetated. May include thin, eroded or immature soils on gentle to steep landscapes.	Landscape models I3m and I3h; OR layered, medium, or fine materials with mas pm of L6, L7, L8, L16, M5, or F5.
Shallow to	Soil with 20 to 50 cm of a sandy or loamy surface	Layered materials denoted by mas pm

[Z]Ecological/ Range Site	Revised Definition	AGRASID 3.0 Correlation
Gravel (SwG)	overlying a gravel or cobble- rich substrate.	(parent material) codes L4 or L5.
Saline Lowland (SL)	Areas with negligible vegetation due to electrical conductivity (salts) and/or sodium adsorption ratio limitations.	Saline Regosolic or Saline Gleysolic series OR sodic Regosolic series.
Gravel (Gr)	Dominated by gravels or cobbles (>50% coarse fragments). May be covered by a mantle with few gravels, up to 20 cm thick.	Layered or coarse materials with mas pm codes L1, L17, L19, L21 or C1.
Badlands/ Bedrock (BdL)	Nearly barren lands with exposures of softrock or hardrock. Includes steep valley walls.	Specific Landscape Models I4h, I5.
[X]Urban (Urb)	Cities, towns, or disturbed lands.	Any SLM with DL landscape model.

[Z]Ecological/range sites are listed in order from most productive to least productive.

Ecodistrict Descriptions

Each Range Classification Guide provides a summary of climate data and a description of each Ecodistrict within the Natural Subregion. Table 29 contains an example of Ecodistrict characteristics for four Ecodistricts in the Mixedgrass Natural Subregion.

Table 29. Major soils and associated ecological/range sites, by selected Ecodistrict.

Ecodistrict or Sub-Ecodistrict	Major Soil Series	Soil Subgroup	Parent Material	Ecological/Range Site
Upper Cypress Hills (>1110m)	DMS (Delmas)	Orthic Dark Brown Chernozemic	gravelly very coarse fluvial	Loamy (Lo) and Gravel (Gr)
	MCA (McAlpine)	Dark Brown Solodized Solonetz	glacial till	Blowouts (BlO)
	MMK (Marmaduke)	Orthic Dark Brown Chernozemic	medium fluvial veneer over gravelly very coarse fluvial	Loamy (Lo)
	PME (Plume)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)
	WSM (Wisdom)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
Lower Cypress Hills (1025-1110m)	CGW (Craigower)	Dark Brown Solodized Solonetz	moderately fine glaciolacustrine	Blowouts (BlO) and Overflow (Ov)
	GNN (Glenbanner)	Orthic Dark Brown Chernozemic	moderately fine glaciolacustrine	Overflow (Ov) and Loamy (Lo)
	MNA (Minda)	Dark Brown Solodized Solonetz	glacial till over fine residual	Blowouts (BlO) or Thin Breaks (TB)
	TTH (Tothill)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	WCR (Woolchester)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)

Ecodistrict or Sub-Ecodistrict	Major Soil Series	Soil Subgroup	Parent Material	Ecological/Range Site
Milk River Upland	GRG (Grudge)	Dark Brown Solodized Solonetz	glacial till	Blowouts (BlO)
	KSR (Kessler)	Orthic Dark Brown Chernozemic	moderately coarse fluvial	Sandy (Sy)
	LUP (Lupen)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)
	PUR (Purescape)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	VEB (Verburg)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)
	WID (Wilda)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)
Lethbridge Plain	BKE (Brocket)	Rego Dark Brown Chernozemic	fine glaciolacustrine	Limy (Li)
	CLD (Coaldale)	Orthic Dark Brown Chernozemic	fine glaciolacustrine	Clayey (Cy)
	CMY (Carmangay)	Orthic Dark Brown Chernozemic	moderately coarse glaciofluvial over moderately fine glaciolacustrine	Sandy (Sy)
	CRD (Cradduck)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	KSR (Kessler)	Orthic Dark Brown Chernozemic	moderately coarse glaciofluvial	Sandy (Sy)
	LET (Lethbridge)	Orthic Dark Brown Chernozemic	medium glaciolacustrine	Loamy (Lo)
	RDM (Readymade)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	WNY (Whitney)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)

Procedural Key to Ecological/Range Sites

Each Range Classification Guide provides a procedural key that allows the user to link ecological range sites to Soil Landscape Models (SLMs) or components of SLMs in AGRASID 3.0. The following procedural key for the **Mixedgrass Ecoregion** divides ecological range sites into three groups based on their main defining feature of landscape, soil or texture.

Landscape Features of the Mixedgrass Ecoregion

Badlands/Bedrock (BdL): Applies to all inclined to steeply sloping landscapes with greater than 10% bedrock exposures of softrock or hardrock. Slopes generally range from 15% to 60% (in isolated cases 7% to 100%). Includes I4m, I4h and I5 landscape models from AGRASID 3.0.

Overflow (Ov): Applies to non-saline Chernozemic (soils with A, B and C horizons) and/or Regosolic soils (soils that lack a B horizon >5 cm thick, and may lack an A horizon) on landscapes that are low-relief inclines in valley or basinal settings. Overflow sites are usually fan or apron deposits, where upslope streams enter lowland areas and experience a marked decrease in gradient. Slopes generally range from 2% to 9% (in isolated cases from 0.5% to 15%). Overflow occurs only on lower slope positions or adjacent to stream(s), and the percentage of eligible overflow ranges from 10% to 50% per SLM (specific rules within each SCA). Ov includes I3l and I4l landscape models from AGRASID 3.0, and also applies to the soil series Glenbanner (GNN) and lowland areas of hummocky landscapes in SCA2.

Riparian (Ri): Applies to all stream channels and floodplains. Includes FP1, FP2, FP3, SC1-l, SC1-h, SC2, SC3 and SC4 landscape models from AGRASID 3.0. True riparian areas only include the valley floor (from bottom of bank to bottom of bank on the other side of the valley).

Thin Breaks (TB): Applies to: **1**) all steeply-sloping landscapes with less than 10% bedrock exposures; **2**) largely vegetated areas with bedrock at or near (within 5 m of) the surface; **3**) the soil series Dempster (DPT), Mokowan (MKN), Torlea (TLAaa), and Van Cleeve (VAC) and **4**) AGRASID 3.0 landscape models I3m, I3h or I4m.

Soil Features of the Mixedgrass Ecoregion

Blowouts (BlO): Applies to all SLMs where soils from the Solonetzic order are dominant (>50%) or co-dominant (30 to 50%). Solonetzic soils have an impervious hardpan layer (Bnt horizon) in the subsoil that is caused by excess sodium (Na^+). The land surface is frequently characterized by eroded pits. Applies

to the soil series Arrowwood (AWD), Brownfield (BFDaa), Craigower (CGW), Grudge (GRG), Idamay (IMY), Kehol (KHO), Kirkcaldy (KRK), Lakesend (LSD), MacAlpine (MCA), Maher (MHR), Minda (MNA), and Parr (PAR), and also applies to undifferentiated Solonetz (ZSZ).

Limy (Li): Applies to all immature or eroded soils with free lime (calcium carbonates) at the soil surface or in the B horizon. Free lime is detected by effervescence when soil is treated with 10% hydrochloric acid (HCl). Li soils include Rego or Calcareous Chernozemics, eroded phases, and subgroups from the Regosolic order if they are calcareous. Applies to the soil series Brocket (BKE), Chokio (CIO), Diamond (DIM), McNab (MCNaa), NineMile (NEM), Olsen (OSN), Sexton (SXT), Verburg (VEB), Welling (WLG), Woolchester (WCR), Wilda (WID) and for ZER if not on I3l, I3h, I4m or I4h landscapes.

Sub-irrigated (Sb): Applies to all Gleyed, non-saline, medium to very coarse textured soils. Gleyed soils occur where the water table occurs near the soil surface, but does not often occur above the soil surface. Gleyed subgroups have faint to distinct mottles within 50 cm, or prominent mottles between 50 and 100 cm.

Saline Lowland (SL): Applies to all salt-enriched soils, including Saline phase Chernozemic, Saline phase Regosolic, and Saline phase Gleysolic soils. Saline phase soils have an electrical conductivity greater than 4.0 dS/m, which retards most plant growth. Applies to the soil series Hussar (HSR), Kyiscap (KCP), Lilydale (LLD), and Weston (WTN), and also applies to undifferentiated saline soils (ZNA).

Wetlands (WL): Applies to all non-saline or weakly-saline of the Gleysolic and Organic orders. Gleysolic soils occur in seasonal to semi-permanent wetlands. They are typified by dull colours or prominent mottles with 50 cm, due to prolonged periods of intermittent or continuous saturation, and the lack of oxygen in the soil. Organic soils are dominated by the accumulation of decomposing peat material derived mainly from sedges and reeds. Applies to the Gleysolic soil series Monarch (MNH) and Sloughay (SLY), and also applies to undifferentiated wet soils (ZGW).

Textural Groupings for the Mixedgrass Ecoregion

Soil particles are divided into three main size fractions: clay, silt and sand (Fig. 4, Table 30). Soils may also include particles larger than 2.0 mm (coarse fragments) (Table 30).

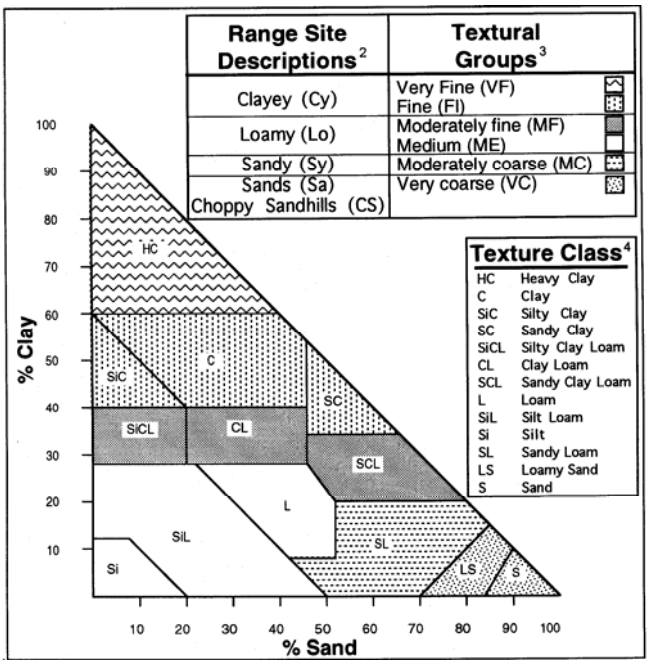

Fig. 4. Soil textures and their relationship to ecological/range sites.

Table 30. Definition of particle sizes.

Category	Particle	Diameter (mm)
Components of soil texture	clay	<0.002
	silt	0.002 to 0.05
	sand	0.05 to 2
Coarse fragments	gravel	2 to 75
	cobbles	75 to 250
	stones	250 to 600
	boulders	>600

Clayey (Cy): Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the **fine or very fine** (E.g., clay and silty clay) textural subgroups (>40% clay, Fig. 4). Applies to the soil series Coaldale (CLD), Hegson (HEG), Rush Lake (RLK), and Magrath (MGT).

Loamy (Lo): Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the **medium and moderately fine** textural subgroups (E.g., loam and clay loam, Fig. 4). Applies to the soil series Cradduck (CRD), Fork (FOR), Kirkchamp (KCH), Lupine (LUP), Lethbridge (LET), Migra (MGA), Marmaduke (MMD), Oasis (OAS), Pageant (PGT), Philp (PLP), Plume (PME), Pultenay (PUY), Purescape (PUR), Readymade (RDM), Sprole (SOL), Thelma (THA), Tothill (TTH), Whitney (WNY), and Wisdom (WSM). Note that the Marmaduke soil series is technically correlated with the SwG range site, but in the Mixedgrass Highland climate it is better correlated with the Loamy ecological range site.

Sandy (Sy): Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the **moderately coarse** (sandy loam) textural subgroup. Applies to the soil series Carmangay (CMY), Kessler (KSR) and Lonely Valley (LVYaa).

Sands (Sa): Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the **very coarse** (loamy sand) textural subgroup. Sa does not apply to duned landscapes. Applies to the soil series Heartbreak (HRK).

Choppy Sandhills (CS): Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the **very coarse** (loamy sand) textural subgroup. CS applies to soils that occur on duned landscapes, including Dl1, D1m, D1h, D2l, D2m and D2h in AGRASID 3.0. Applies to the soil series Heartbreak (HRK), but only on duned landscapes.

Gravel (Gr): Applies to any soil with less than 20 cm of a surface mantle of any textural class over **very gravelly or very cobbly** (>50% gravel or cobbles) material. Applies to the Delmas (DMS), Macleod (MAC), New Dayton (NED), Reesor (RSR) and Wollim (WOL) soil series.

Shallow to Gravel (SwG): Applies to any soil with 20 to 50 cm of a surface mantle of any textural class overlying **gravelly or very gravelly or cobbley to very cobbly** (>20% gravel or cobbles) material. Applies to the Crowfoot (CFT) soil series.

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Appendix A: AGRASID Soil Series Variant Codes

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

Appendix B: AGRASID Parent Material Codes

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
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)

Appendix C: Example of an AGRASID Soil Model With a Detailed Description

Antelope - Vendisant (ATVS) Soil Model
Parent material: very coarse (loamy sand to sand) eolian blanket.

Soils and proportion	Horizon (depth in cm)	Colour, Texture, Structure, Other Comments
ATP Orthic Regosolic 30 – 50%	Ah (0 – 5) C (5 – 100)	thin and weakly developed; brown; loamy sand to sand; very loose structure; neutral pH lacks soil profile development; colours become gradually grayer with depth, and gradually changes from neutral to mildly alkaline below 1 m depth.
VST Rego Brown Chernozemic >50%	Ah (0 – 8) AC (8 – 20) C (20 – 100)	loamy sand; weakly developed; marked only by a slight accumulation of organic matter; loose, single-grain soil structure; neutral pH sand or loamy sand; loose, single-grain soil structure; neutral sandy or loamy sand; loose, single-grain soil structure; mildly alkaline pH
Occurrences and SLMs: ATVS16/D2h (2 polygons) and ATVS16/D2m (3 polygons). All occurrences are in the National Wildlife Refuge (Amiens and Ypres).		
Significant soils: No. 16 indicates the significant (10 to 30%) presence of Chernozemic soils, which for both SLMs are Orthic Brown Chernozems of the Cavendish (CVD) series.		
Landscape Model: D2h indicates high-relief duned landscapes, with slopes of 9 to 30%. D2m indicates moderate relief duned landscapes, with slope range of 5 to 15%.		

Comments: The ATVS soil model is always associated with duned landscapes. Antelope usually occupies the more severe slopes and active dunes, while Vendisant can be found in the areas between the heights of dunes, and also on the stabilized dunes. Antelope and Vendisant soil series are highly prone to wind erosion. All duned areas include both parabolic (u-shaped) and longitudinal (single-axis) dunes.

Appendix D: Example of a Legend for 1:50,000 Soil Survey Using AGRASID Soil Landscape Model Conventions.

Note: Soil models are separated with borders.

SLM Poly-gon No.	Air Photo Line No	Final Version of SLM – 2003	Dominant or Co-Dominant Soils			Significant Soils				2002 Field Investigation	NAD 83 Location		Comments
			Dom or Co. 1	Co. 2	Co. 3	Sig. 1	Sig. 2	Sig. 3	Sig. 4		East-ing	North-ing	
377	4-233	ANFM9/R2m	ANO	FMT		PUN	ZGW			Visual of SLM	78	818	
689	7-107	ANFM9/R2m	ANO	FMT		ZCO	ZGW	CFD		Visual of SLM	186	34	
487	5-191	ANPU5/H1l	ANO	PUN		FMT	KGO			Visual of SLM	146	878	Scoured till and fluvial veneer to blanket on benchland
506	5-194	ANPU5/H1l	ANO	PUN		KGO	FMT	PLS		Visual of SLM	240	928	
218	3-013	ANRA9/IUh-c	ANO	RAM		FMT	PUN	ZGW	KGO	Visual of SLM and pedon- BURA	10	806	Significant U1l terraces; in meltwater channel floodplain
250	3-019	ANRA9/IUh-c	ANO	RAM		PUN	KGO	ZGW	FMT	Visual of SLM and pedons- KGO and PUN	96	783	Landsacpe also includes IUh and U1h.
267	3-022	ANRA9/IUh-c	PUN	RAM		PUN	FMT	ZGW	KGO	Air photo only			Terraced unit with scarp edges at South and East; landscape also includes IUh-c.
548	5-205	ATVS16/D2h	ATP	VST		CVD				Air photo only			Also includes D1m
728	8-049	ATVS16/D2h	ATP	VST		CVD				Air photo only			
253	3-019	ATVS16/D2m	ATP	VST		CVD				Visual of SLM	118	752	Minimum size polygon
547	5-203	ATVS16/D2m	ATP	VST		CVD				Air photo only			
720	7-116	ATVS16/D2m	ATP	VST		CVD				Air photo only			
460	5-185	BUBV2/IUh	BUT	BVL		FMT	ZGW			Visual of SLM and pedon-BVL	72	896	Partially infilled coulee setting
489	5-191	BUBV2/IUh	BUT	BVL		ZGW	FMT	KGO		Visual of SLM	168	897	
564	6-142	BUBV2/IUh	BUT	BVL		ZGW				Air photo only			

Appendix E: Example of the Most Commonly Occurring Soil Series by Slope Position for Selected Soil Landscape Models

Note: Soil models are separated with borders.

Final Version SLM – 2003	No. of Poly-gons	Slope Position							
		Upper	Upper	Mid	Mid	Lower	Lower	Dep.	Dep.
ANBV4/U1h	3	ZER	FMT	ANO	BVL	ANO	BVL		
ANFM4/IUh-c	9	ZER	FMT	FMT	ANO	ANO	BVL		
ANFM6/H1l	5	FMT	PLS	ANO	FMT	ANO	BVL		
ANFM9/R2m	2	FMT	ZCO	ANO	FMT	ANO	BVL	ZGW	
ANPU5/H1l	2	FMT	ANO	PUN	ANO	PUN	KGO		
ANRA9/IUh-c	3	FMT	ANO	RAM	ANO	RAM	PUN	ZGW	
ATVS16/D2h	2		ATP		VST		CVD		
ATVS16/D2m	3		ATP		VST		CVD		
BUBV2/IUh	4	FMT	BVL	BUT	BVL	BUT	KGO	ZGW	
BUCV4/U1l	3	ZER	CVD	BUT	CVD	BUT	BVL		
BUEX11/FP3	5	ZER	EXP	BUT	EXP	BUT	ZCO		
BUEX4/FP3	8	ZER	EXP	BUT	EXP	BUT			
BUFM10/SC4	8		FMT	BUT	FMT	BUT	ZSZ	ZGW	
BUFM15/I3l	3	ZCO	FMT	BUT	FMT	BUT	ZSZ		
BURA6/I3l	3	stTVS	PUN	BUT	RAM	BUT	RAM		
BUSP10/IUh	2	FMT	BUT	SPS	BUT	SPS	ZSZ	ZGW	
BUT1/I3l	4		BUT		BUT		BUT		
BUT11/U1l	6		ZER	ZCO	BUT	BVL	BUT		
BUT14/U1l	5		ZER	BUT	EXP	BUT	ZSZ		
BUT18/U1l	2		BUT	BUT	CHN	BUT	ZFI	ZGW	
BUT2/I3l	4		BUT		BUT		BUT	ZGW	
BUT6/I3l	9		ZCO		BUT		BUT		
BUT6/I3l-c	4		ZCO		BUT		BUT		
BVCH1/U1h	2		BVL	CHN	BVL	CHN			
BVCH2/U1h-n	2		BVL	BVL	CHN	BVL	CHN	ZGW	
BVCV1/H1l	6	PLS	CVD	BVL	CVD	BVL	ANO		
BVCV1/IUh	14	PLS	CVD	BVL	CVD	BVL	ANO		
BVCV18/U1h	7		CVD	BVL	CVD	BVL	ZFI	ZGW	ZNA
BVKG9/H1l	7	stFMT	CVD	BVL	GKO	BVL	KGO	ZGW	
BVL10/U1h	2		BVL		BVL	BVL	ZSZ	ZGW	
BVL18/IUh	8		BVL		BVL	BVL	ZFI	ZGW	
BVL6/U1h	7		BVL	CVD	BVL		BVL		
BVL9/H1m	3		KGO		BVL		BVL	ZGW	ZNA
BVZG3/U1h-n	4	PLS	BVL	RIR	BVL	ZGW	ZNA	ZGW	
CFD1/U1h	3	FMT	CFD		CFD	CHN	CFD		
CFD2/U1h	2	CFD	FMT	CFD		CFD	CHN	ZGW	
CFFM1/H1l	6		FMT	CFD	FMT	CFD	CHN		
CFFM1/U1h	9		FMT	CFD	FMT	CFD	CHN		

Appendix F: Training Exercises

Seven SCAs account for 34% of the agricultural area of Alberta.

SCA	Percentage of AGRASID Area	SCA	Percentage of AGRASID Area
1	18	6	3
2	2	8	2
3	6	16	1
5	2		

The following table lists the top ten Soil Landscape Models occurring in SCAs 1,2, 3, 5, 6, 8, and 16. Please provide an interpretation of each SLM based on the Soil Series, the Soil Model Number and the Landscape Model. Also list the expected Ecological Range Site. You may also indicate multiple Ecological Range Sites.

Training Exercise 1

SCA	Top 10 SLMs in SCA		% of SCA Area	Interpretation	ERS
1: Dry Mixedgrass; Brown Soil Zone, 4.6 M ha	1	MAB1/U1h	2.20		
	2	CFMA1/U1h	1.74		
	3	CFD1/U1h	1.71		
	4	ZUN1/I4h	1.39		
	5	HUK5/U1hr	1.23		
	6	ZUN1/I3h	1.11		
	7	HDRO1/U1h	0.97		
	8	CFMS1/U1h	0.96		
	9	HDHU16/U1h	0.90		
	10	CVD1/U1h	0.87		

Training Exercise 1

SCA		Top 10 SLMs in SCA	% of SCA Area	Interpretation	ERS
2: Mixedgrass Highlands; Dark Brown Soil Zone; 0.4 M ha	1	PUR2/H1m	4.09		
	2	THA1/U1h	3.15		
	3	TTH7/I3l	3.08		
	4	WSM2/H1m	2.88		
	5	DMMM5/I3m	2.68		
	6	ZUN1/I3h	2.40		
	7	PUR1/H1l	2.15		
	8	RSR4/I3h	2.06		
	9	PUWI1/H1m	1.99		
	10	PUWI1/I3m-d	1.82		
3: Mixedgrass Plains; Dark Brown Soil Zone; 1.5 M ha	1	PGRD8/H1m	2.65		
	2	LET1/U1h	2.36		
	3	WNY4/U1h	2.19		
	4	LET4/U1h	1.99		
	5	LEWN4/U1h	1.90		
	6	LEWN1/U1h	1.36		

Training Exercise 1

SCA	Top 10 SLMs in SCA		% of SCA Area	Interpretation	ERS
	7	ZUN16/SCl-h	1.32		
	8	RDWN1/U1h	1.27		
	9	LET5/U1l	1.24		
	10	LET13/U1h	1.22		
5: Foothills Fescue South; Black Soil Zone; 0.5 M ha	1	BZR2/H1m	3.86		
	2	BZCT1/U1h	3.82		
	3	BZR1/H1l	3.36		
	4	BZOK1/R2h	2.62		
	5	CWY1/U1h	2.60		
	6	ZUN1/SC2	2.26		
	7	BZR1/H1m	2.12		
	8	BZR2/H1l	1.90		
	9	CTN1/U1h	1.85		
	10	BZR4/H1l	1.72		

Training Exercise 1

SCA		Top 10 SLMs in SCA	% of SCA Area	Interpretation	ERS
6: Foothills Fescue North; Black Soil Zone; 0.7 M ha	1	DERK1/U1h	7.73		
	2	ZUN1/DL	6.16		
	3	DEL1/U1h	2.67		
	4	RKV1/U1h	2.43		
	5	ADRK1/U1h	2.20		
	6	DERK2/U1h	2.08		
	7	DEL2/U1h	2.07		
	8	DERK1/IUl	1.72		
	9	ADRK13/U1h	1.36		
	10	DERK7/U1h	1.28		
8:Foothills Parkland; Thick Black Soil Zone; 0.6 M ha	1	DVHF1/R2h	8.50		
	2	DVG2/H1l	2.72		
	3	DVG1/H1l	2.59		
	4	DVHF1/R2m	2.10		
	5	DVHF1/R2h-d	2.09		
	6	DVG1/U1h	2.03		

Training Exercise 1				
SCA	**Top 10 SLMs in SCA**	**% of SCA Area**	**Interpretation**	**ERS**
	7 ZUN1/SC2	1.96		
	8 MFT1/U1h	1.60		
	9 DVG2/H1m	1.57		
	10 DVG2/U1h	1.37		

The following table lists four SLMs that are most likely to occur in range or pasture holdings in each SCA. Please provide an interpretation of each SLM based on the Soil Series, the Soil Model Number and the Landscape Model. Also list the expected Ecological Range Site. You may also indicate multiple Ecological Range Sites.

Training Exercise 2			
SCA	**Complex SLMs**	**Interpretation**	**ERS**
1	PLVS2/U1h		
	BVCV1/U1h		
	ORSI16/R2m-d		
	HDHU4/H5l		
2	DMDP1/I4h		
	MHTT4/R2l		
	HRKSaa2/D1l		
	CGGN7/I3l-c		

Training Exercise 2			
SCA	**Complex SLMs**	**Interpretation**	**ERS**
3	CIDI1/U1h-r		
	CLD4/U1l		
	CMKS3/D1l		
	WTZG1/L2		
5	KNT6/H1l		
	BZCT7/IUl-c		
	BFRN4/L3		
	NFOK6/R2h-r		
6	ARBO4/U1h		
	BEBZ16/U1l		
	MDLT1/U1h		
	NSK6/R2m-r		
8	FSH6/IUl		
	CRW1/IUh		
	BULN1/IUl		
	DRW4/SCl-h		

Training Exercise 2			
SCA	**Complex SLMs**	**Interpretation**	**ERS**
16	BDLT6/R2h-r		
	FRTU16/R2h-r		
	BPCC1/HR2h		
	MSSK4/R2m-r		
	SKL1/R2h-r		
	SKL1/U1h		
	FRK1/I4h		
	MSB5/R2h-r		

Appendix 8: Paradox Prairie Database Instructions

STARTING UP:
1. Open project viewer
2. Select directory
3. Set current directory as working directory
4. Choose form to work with, only enter data in the form.

Part I: Land Data (for both LC55 and MF5)

Form will open up to a blank record:

To add a new record, type in identification number in "**Year_twp_rge_sec_q_mer_ply**"field. The ID number is 16 digits long and consists of: Year (4)_ Township (3)_ Range (2)_ Section (2)_Quarter Section (1)_ Meridian (1)_ Soil Polygon (3)

*Quarter Sections: 0-TOTAL 1-SE 2-SW 3-NW 4-NE 5-N1/2 6-S1/2 7-W1/2 8-E1/2 9-N/A
**To move from field to field use the TAB key.

DATE: MM/DD/YY

EXAMINER: Initials (all caps)

LEASE: Name (all caps)

SITE_NO: Accepts up to 5 characters (numbers, letters or both)

FIELD_NO: Accepts up to 8 characters (numbers, letters or both)

ELEVATION (m): (Hint: if given in feet, divide by 3.273 ft/m to convert into metres).

ECO REGION: Find this on the right hand side of field sheet under Landform information. Use look-up table to locate. (Hint: CTRL-spacebar gives look-up table. Begin typing name you are looking for, when found, push ENTER).

ECO SUBREGION: Locate same as Eco Region

ECO DISTRICT: Three-letter code, type as seen. Also contains a look-up table.

SCA: 1 or 2 digits

VEG(RANGE) TYPE: Enter as one or two letter code (all caps). Look-up table available.

SOILS INFORMATION

Soils information is entered in a format similar to that of PLC information on the field sheets. (See appendix for the detailed PLC Legend). Complex fields occur when there is more than one parent material, texture, slope class, etc. For example, if more than one parent material is present, enter the multiple parent materials into the PM_complex box, not the Parent Material box.

PARENT MATERIAL (PM): 1 or 2 letter code, enter dominant PM (all caps). Look-up table available.

PM COMPLEX: Place the dominant PM (excluding any modifiers) in the PM box and write the same PM with the modifiers and/or minor PMs in the complex box (eg. PM = 'Lv' – place 'L' in PM box and 'Lv' in PM complex box or PM = Lv/Fu – place L in PM box and Lv/Fu in PM complex box)

-if you see Lv on a field sheet, input Lv_Fu (Lv underscore Fu)
Fu

-if you see Lv/Fu on a field sheet, input Lv/Fu

-if you see Lv//Fu on a field sheet, input Lv//Fu

-if you see Lv / Fu on a field sheet, type Lv_Mb/Fu_Rb.
Mb Rb

Note: A dash means 'approximately equal to' (50-55%-45-50%) or (0-10% difference)
A single slash means 'more than' (55-70%/30-45%) or (10-40% difference)
A double slash means 'considerably more than' (70-90%//10-30%) or (40-80% difference)

**Use the same symbols for parent material types in the complex as listed in the look-up table (i.e. GL instead of GLLC)

TEXTURE: 1 to 4 letter code (all caps), enter only one texture. Look-up table available.

TEXTURE COMPLEX: Same conventions as PM complex

SLOPE CLASS: Slope is to be entered as slope class, if written as a % use look-up table to convert the % to a class. Can only have a single slope class entered in this field.

SLOPE CLASS COMPLEX: Same conventions for PM complex (using slope class). If the slope extends over more than one class (for eg. 2 to 3), then separate the range of classes with a dash (eg.type 2-3).

ASPECT: Enter up to 5 letters (all caps).

SOIL ORDER SUBGROUP: Enter as seen, including periods (all caps). Look-up table available.
*If the soil obtained from the AGRASID soil series (or soil series complex) 1)does not match the *soil type* obtained from a more reliable source or 2)matches only a part of the soil complex , THEN, place a question mark after the AGRASID and the soil series or soil series complex (if obtained from AGRASID) and in Comments write: "*AGRASID code (eg. DVCF1/R2d) (eg.DVG-CFD) refers to (eg. O.BL) soil;(actual soil source – eg. PLC) indicates (soil type eg. O.DG) soil*."
Example – it should look like this: *AGRASID code DVCF1/R2d (DVG-CFD) refers to O.BL soil; PLC indicates O.DG soil*.

SOIL ORDER SUBGROUP COMPLEX: See asterisks under "Soil Order Subgroup' heading.
*Use the following conventions to describe proportions:
A dash means 'approximately equal to' (50-55%-45-50%) or (0-10% difference)
A single slash means 'more than' (55-70%/30-45%) or (10-40% difference)
A double slash means 'considerably more than' (70-90%//10-30%) or (40-80% difference)
**When entering data from soil survey maps, use the conventions listed above and follow the specified instructions for each type of map used (as listed below) In every case, write the actual proportions in complete form in the comments field.

Example 1 - WARNER soil survey map:

-Record only 'dominant' soil series and soil order sub-groups in their respective fields on the form; record actual proportions of all soils (including significant soils) in the comments.
a) ANBV1/3 (O.B - ANO 30-90% and O.B - BVL 30-60%): write soil series complex as ANO-BVL and write soil order sub-group as O.B.
b) BUT1/3-2 ('O.B and R.B or O.DB' - BUT 40-60%): write soil series as BUT and write soil order sub-group as O.B-R.B-O.DB.
c) SXT1/2-3 (O.HR - SXT 40-60% and CUO.R – SXT 30-50%): write soil series as SXT and write soil order sub-group as O.HR-CUO.R.

Example 2 - CARDSTON soil survey map:

-Record only 'major soil components' series and soil order sub-groups in their respective fields on the form; record actual proportions of all soils in the comments (including any listed that cannot be described using normal conventions – eg. 'Gleysolics and water' OR 'Coarse textured variants' **In such cases, place an asterisk after the complex description in the soil order sub-group complex box to indicate that the full description can be found in comments).
a) MGLE4/2-3 (O.DB –LET 30-50%, O.DB – MGT 30-50% and R.DB WLG-DIM 20-40%); write soil series complex as LET-MGT/WLG-DIM and write soil order sub-group as O.DB/R.DB.
b) PUBZ4/4 (O.DB – PUR 50-70%, O.BL – BZR 20-30% and R.DB – WID 20-40%); write soil series complex as PUR/(BZR-WID) and write soil order sub-group as O.DB/(O.BL-R.DB).
c) HEG7/3D (O.DB – HEG 60-80% and SZ. – HEG 20-30%) write soil series as HEG and write soil order sub-group as O.DB//SZ.

Example 3 - PINCHER CREEK- CROWSNEST PASS soil survey map:

-Record only 'major soils' series and soil order sub-groups in their respective fields on the form; record actual proportions of all soils in the comments [including 1) any described in the comments section of the map legend or 2) any listed under major soils that cannot be described using normal conventions – eg. 'Gleysolics and water' OR 'Coarse textured variants' **In such cases, place an asterisk after the complex description in the soil order sub-group complex box to indicate that the full description can be found in comments].
a) BZOK1/5 (O.BL – BZR 30-60% and O.BL - OKY 15-30%); write series complex as BZR/OKY and write soil order sub-group as O.BL.
b) BVBV2/3 (O.BL – DVG 30-50%, O.DG – BVA 20-40% and Gleyed soils, Gleysolics and water 15-25%); write series complex as DVG-BVA and write soil order subgroup complex as O.BL-O.DG and in comments record actual proportions including the Gleyed/Gleysolics/water description
c) RND4/T3 (O.BL – RND 40-70% and CA.BL & R.B – RND 5-40%); write soil series as RND and write soil order sub-group as O.BL/(CA.BL-R.B).

Example 4 - NEWELL soil survey map:

-Proportions are listed in the actual soil map unit (the description found on the actual map rather than legend). The soil map unit lists proportions of soil series. Look up the soil series in the legend to determine the corresponding soil order sub-group.
a) $Cd^{5}Bv^{3}Pl^{2}/3$ (O.B – CVD 50%, O.B – BVL 30% and O.B – PLS 20%); write soil series complex as CVD- (BVL-PLS) and write soil order subgroup as O.B.
b) $Bv^{7}Cd^{3}/6$ (O.B – BVL 70% and O.B – CVD 30%); write soil series complex as BVL//CVD and write soil order sub-group as O.B.
c)$Cf^{6}Ri^{2}Cc^{2}/2$ (O.B – CFD 60%, O.B – RIR 20% and B.SO – CCL 20%); write soil series complex as CFD/RIR-CCL and write soil order sub-group as O.B//B.SO.

Example 5 - COUNTY OF FORTY MILE soil survey map:

-Record only 'major soils' series and soil order sub-groups in their respective fields on the form; record actual proportions of all soils in the comments [including 1) any described in the minor soils and comments section of the map legend or 2) any listed under major soils that cannot be described using normal conventions – eg. 'Gleysolics and water' OR 'Coarse textured variants' **In such cases, place an asterisk after the complex description in the soil order sub-group complex box to indicate that the full description can be found in comments].
a) HDRO1/4c:R [B.SO – HDY 20-50%, SZ.B – ROL 20-40%, B.SS – HUK 15-25% and O.B – (MAB-MSN) 15-25%]; write soil series complex as HDY-ROL/(HUK-MAB-MSN) and write soil order sub-group as B.SO-SZ.B/(B.SS-O.B).
*Hint – to explain the soils described above, look at the mid-points and use the following logic: 0-10% difference = (-), 10-40% difference = (/) and 40-80% difference = (//).
b) HMS1/4-5 (Eroded soils - HMS and TVS 40-70% and O.B – MAB 15-30%); write soil series complex as HMS-TVS//MAB and in complex box write 'Eroded//O.B*' and include further details in comments.

Example 6 – Soil survey map and AGRASID data description:

-AGRASID code MAB4/U1h (soil series MAB) refers to O.B soil; The County of Forty Mile Soil Survey Map indicates O.B (MAB) 20-50% - O.B (CFD) 20-50% - Eroded soils 20-40% with minor inclusions (<15%) of O.B (CHN), SZ.B (ROL and TIK) and Gleyed and Gleysol soils. The Eroded soils component includes HMS and TVS.

DRAINAGE: Enter up to 3-letter code for a single type of drainage (found in look-up table). [Note: Historically different recording methods have been used (ie. different scale of drainage classes). Please ensure you understand which one is used on the forms you are entering].

DRAINAGE COMPLEX: Same conventions as slope class complex. Use the numbers for this field, found using the look-up table in the drainage field.

SOIL SERIES UNIT: if a single soil series is present at the site, a 3-letter code will be written on the form somewhere in the top right hand corner, with an (SS) behind it. This is to be used as the soil series.

A. If the AGRASID soil series (or soil series complex) does not match a soil series obtained from a more reliable source but the soil order subgroup is the same, THEN, place a question mark after the AGRASID code and in the comments write: "*AGRASID soil series is (eg. CVD-HFD) and refers to (eg. O.BL) soil*.
Example – it should look like this: *AGRASID soil series is CVD-HFD and refers to O.BL soil*.

B. If the AGRASID soil series (or soil series complex) does not match a soil series obtained from a more reliable source and the soil order subgroup is **not** the same, THEN, place a question mark after the AGRASID code and in the comments write: "*AGRASID soil series (eg. CVD-HFD) refers to (eg. O.BL) soil; PLC soil series (eg.ERT) indicates (eg. O.R.) soil.*
Example – it should look like this: *AGRASID soil series CVD-HFD refers to O.BL soil; PLC soil series ERT indicates O.R. soil*.

SOIL SERIES COMPLEX: found in the same location as soil series unit, but may consist of 3 letters followed by a "?", or 6 letters divided by a backslash, etc. This entry will have a (SC) behind it. Enter exactly as seen.
Note: A dash means 'approximately equal to' (50-55%-45-50%)
A single slash means 'more than' (55-70%/30-45%)
A double slash means 'considerably more than' (70-90%//10-30%
*See notes under 'Soil Series Unit' heading above and for data obtained from a soil survey map, see information under 'Soil Order Sub-group Complex'.
-If a Complex is obtained from AGRASID, all series should be separated by a dash since all series are represented as co-dominant.

AGRASID: found in the same location as soil series unit, but with an (A) behind it. Enter exactly as seen.
**If the main soil source for a project is AGRASID, look up all possible soil information associated with the series indicated in the AGRASID code and enter on the form (this

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information can be found 1) in the Soil Correlation Area (SCA) book 2)on the AGRASID disc under: Data Dbf Snf.dbf *3)find a soil survey map within the same SCA as the area you are working on and read the detailed information on that particular soil series.
*This is the preferable source

PC-ORD: Six characters. Found on the top left-hand side of the field sheet. Or create using this method:
For inventories->
Lease (2 letters)/Year (2 #'s)/Soil Polygon (2 #'s)
e.g. SC9835
For benchmarks->
Lease (3 letters)/Year (2 #'s)/Exclosure/Grazed (X/G)
e.g. WOS96X

REGIONAL LANDFORM: Taken off field sheet, use look-up table to locate, enter as word description.
e.g. Mountains

LOCAL LANDFORM (LL): Taken off field sheet, use look-up table to locate, enter as word description.
e.g. Undulating

LL COMPLEX: Convert each local landform into its corresponding number using the look-up table in local landform field. List associated numbers in ascending order separated by dashes.

LANDFORM ELEMENT (LE): Taken off field sheet, use look-up table to locate, enter as word description.
e.g. level

LE COMPLEX: Convert each landform element into its corresponding number using the look-up table in landform element field. List associated numbers in ascending order separated by dashes.

Part II: Veg Data (Prairie MF5 Form)

1. To move from the land data sheet to the veg data sheet, click on the "vegetation data" button.

2. TAB or click on the first line of the vegdata form, push left arrow key until you get to the first column and you will see the ID # and date come up.

3. Enter the first seven-letter veg species code into the species code column. Always use all caps to enter any veg code anywhere on the form.

4. After entering the veg species, push the TAB button and this will take you to the number of frames column. Input the number of frames. (Hint: If you cannot move off the species code column, then you have entered a species name the database does not recognize. Use look up table to figure this out).
Always check the bottom left of the form to see the Paradox message.

5. After number of frames is inputted, enter the number located under each frame into the appropriate slot. Enter the cover as an exact percentage as recorded on the Prairie MF5 field sheet, and not as a cover class. Enter "T"(trace) as 0.5. Enter blanks as "0".

6. Go to next line and do the same for each veg species listed. (Hint: The veg species are automatically alphabetized, so do not be alarmed if the record you just entered seems to disappear, if you push the up arrow key you will locate the record). (Hint: If you cannot go to the next line, then you may have entered the same veg species twice. To delete this record, push CTRL-Delete).

7. Enter ZZVEG, ZZSOIL and ZZMOSS in the same manner as the veg species. Enter blanks as "1", not "0".

8. Enter shrub species line by line in the same manner as you entered veg species. Do the same for poisonous species and weeds. This is most efficiently done after you have entered veg and zz spp.

9. You have to recalculate the % prominance field <u>after</u> you have entered the <u>last</u> veg spp. This can be done in two ways:
i. Mouse click on each % prominance field
for each veg. Spp. (zz's are not included).

ii. Select the 1st vegetation record (row) in any field on the row. Click the "Recalculate record % prominance" button on upper right of form. Use your down arrow key to move to the next record (row) and click the recalculate button again. Do this for each veg spp. on the form.

10. To go from veg data to land data, click on "land data" button