Agriculture and Agri-Food Canada
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Rural Municipality of Glenwood

Information Bulletin 96-6

Soils and Terrain

An introduction
to the land resource

Land Resource Unit
Brandon Research Centre

Canada

Rural Municipality of Glenwood

Information Bulletin 96-6

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PREFACE

This is one of a new series of information bulletins for individual rural municipalities of Manitoba. They serve to introduce the newly developed digital soils and terrain databases, and illustrate several typical derived map products for agricultural land use planning applications. The bulletins will also be available in diskette format for selected rural municipalities.

Information contained in this bulletin may be quoted and utilized with appropriate reference to the originating agencies. The authors and originating agencies assume no responsibility for the misuse, alteration, re-packaging, or re-interpretation of the information.

This information bulletin serves as an introduction to the land resource information available for the municipality. More detailed information, including copies of the primary soils and terrain maps at larger scales, may be obtained by contacting:

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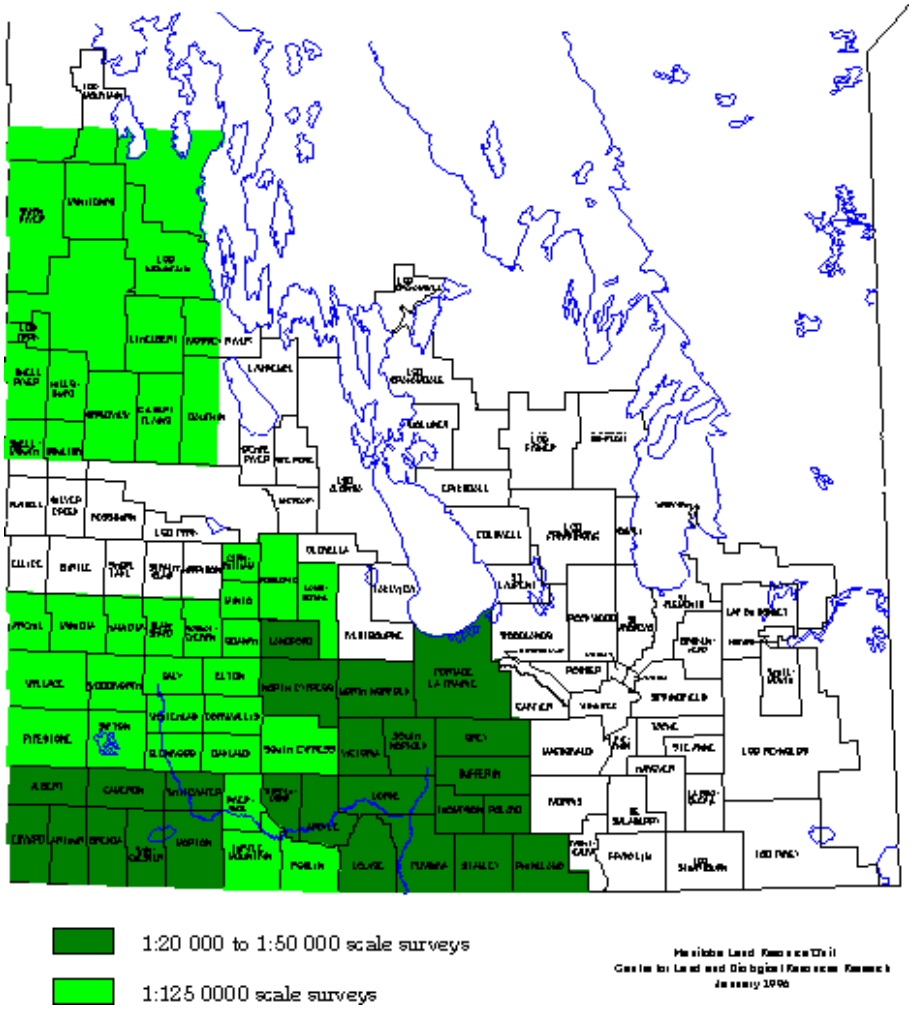


Figure 3. Rural municipalities in southern Manitoba with digital soil and terrain map information (1996).

INTRODUCTION

This information bulletin is one of a new series prepared for selected rural municipalities in southern Manitoba (Figure 1). A brief overview of the soil and terrain database information assembled for each municipality is presented, as well as a set of maps derived from the data for typical agricultural land use and planning applications.

The soil and terrain maps and databases were compiled and registered using the computerized Geographic Information System (GIS) facilities of the Manitoba Land Resource Unit. These GIS databases were used to create the generalized interpretive maps and statistics contained in this report.

LAND RESOURCE DATA

The soil and terrain (landscape) information were obtained as part of a larger project to provide a uniform level of land resource information for agricultural and regional planning purposes throughout Agro-Manitoba. This information was compiled and analyzed in digital form, using Geographic Information System (GIS) techniques. Three distinct layers of information were used, as shown in Figure 2.

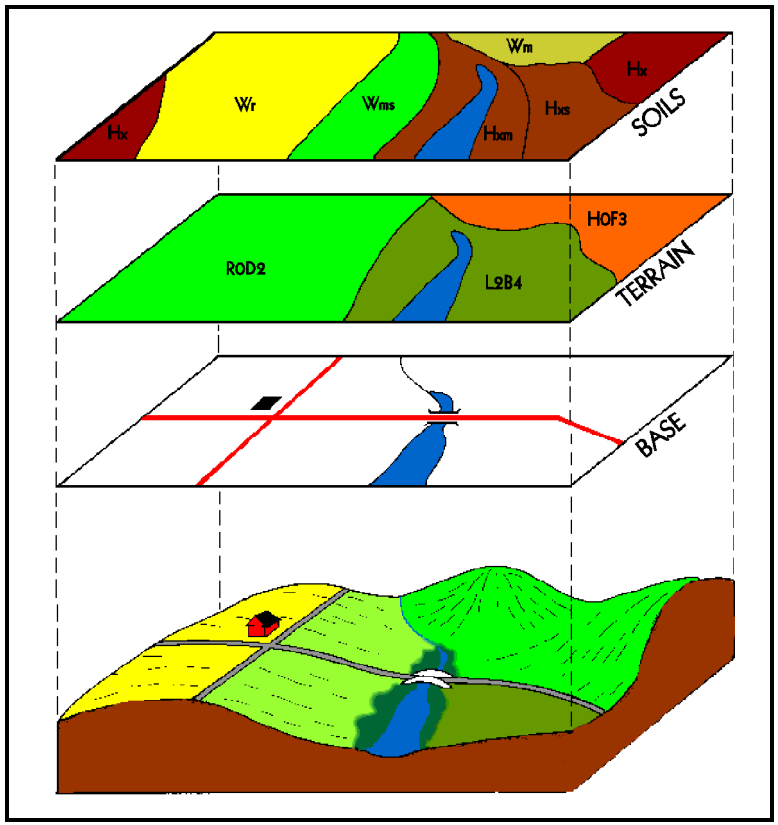


Figure 2. Soil, Terrain, and Base Map data.

Base Layer

Digital base map information includes the municipality and Township boundaries, and major streams, roads and highways. The soil and terrain layers were added and aligned ("georeferenced") to the digital base map. Major rivers and lakes from the base layer were also used as common boundaries for the soil and terrain map layers. Water bodies larger than 25 ha in size were digitized as separate polygons.

Terrain Layer

A separate terrain layer was produced for municipalities for which only reconnaissance scale soil map coverage was available. This was compiled by aerial photo-interpretation techniques, using recent 1:50 000 scale stereo air photo coverage. The terrain information was transferred from the photographs onto the standard RM base and digitized in the GIS. Where the soil and terrain boundaries coincided, such as along prominent escarpments and eroded stream channels, the new terrain line was used for both layers. The terrain line, delineated from modern airphoto interpretation, was considered more positionally accurate than the same boundary portrayed on the historical reconnaissance soil map. Each digital terrain polygon was assigned the following legend characteristics:

Surface form
Slope class
Slope length class
Percent wetlands
Wetland size
Erosional modifiers
Extent of eroded knolls
Polygon number

The first four legend fields are considered differentiating, that is, a change in any of these classes defines a new polygon.

Soil Layer

The most detailed soil information currently available was selected as the data source for the digital soil layer for each rural municipality.

Comprehensive detailed soil maps (1:20 000 to 1:50 000 scale) have been published for many rural municipalities. Where they were available, the individual soil map sheets were digitized and compiled as a single georeferenced layer to match the digital RM base. Map polygons have one or more soil series components, as well as slope and stoniness classes. Soil database information was produced for each polygon, to meet national standards (MacDonald and Valentine, 1992). Slope length classes were also added, based on photo-interpretation.

Older, reconnaissance scale soil maps (1:126 720 scale) represented the only available soil data source for many rural municipalities. These maps were compiled on a **soil association** basis, in which soil landscape patterns were identified with unique surficial geological deposits and textures. Each soil association consists of a range of different soils ("associates") each of which occurs in a repetitive position in the landscape. Each polygon digitized from the reconnaissance soil map was assigned the following legend characteristics:

Polygon number
Map symbol and modifier (overprinted symbol)
Soil Association or Complex name
Soil series and modifier codes

A modern soil series that best represents the soil association was identified for each soil polygon. The soil and modifier codes provided a link to additional databases of soil properties. In this way, both detailed and reconnaissance soil map polygons were related to soil drainage, surface texture, and other soil properties to produce various interpretive maps.

SOIL AND TERRAIN OVERVIEW

The Rural Municipality (RM) of Glenwood covers 6 Townships (58 000 ha) in south-western Manitoba. The town of Souris is the largest population centre in the municipality. Land use is predominantly agriculture.

Soil map data sources for the area were the Reconnaissance Soil Surveys of South-Western Manitoba (Ellis and Shafer, 1940), and the Rossburn and Virden Map Sheet Areas (Ehrlich et al., 1956). More detailed soil information is provided at 1:20 000 scale for the area around the Town of Souris (Podolsky, 1985).

Based on climatic data from Souris (Environment Canada, 1982), mean annual temperature at Souris is 2.3ºC; mean annual precipitation is 456 mm; frost-free period is 105 days and growing degree days above 5ºC is 1697. The seasonal moisture deficit between May to September is 250 to 300 mm. Effective growing degree days (EGDD) above 5ºC accumulated for the period from seeding to the first frost in fall is approximately 1500; this parameter provides an indication of heat energy available for crop growth (Agronomic Interpretations Working Group, 1995). Land use in the RM is mainly cereal crop production.

The majority of the RM is located in the Antler River-Lake Souris Plain (Lake Souris Basin in published soil reports). This area is a level to gently undulating plain with elevations decreasing gradually from 477 m in the west to 457 m in the east. A small outlier of the Brandon Hills in the northeastern portion of the RM ranges in elevation from 460 to 475 masl and is characterized by dominantly hummocky and inclined surface forms. External drainage from the RM is provided by the Souris River, transecting the southern portion of the area in a broad west-east trending valley.

The Antler River-Lake Souris Plain is characterized by Chernozemic Black soils ranging in texture from sand (Souris Association) to loam and clay loam textures (Carroll and Beresford Associations) to clay (Harding Association). Regosolic soils are dominant in sandy areas characterized by the Souris duned phase.

Significant areas of the Souris soils are affected by a high water table and periods of excess moisture. The soils are dominantly imperfectly drained and are rated for agriculture capability as class 3M. Land use includes annual cereal grain production associated with extensive areas of improved and native pasture and forage. Irrigation suitability is fair and these soils have a high potential for adverse environmental impact under irrigation. Well drained sandy soils have low water retention capacity, are somewhat more droughty and are rated in class 4M. Poorly drained areas are rated in capability class 5W or 6W, depending on the length of time during the growing season that the soils are wet. Native grazing with some improved pasture is the dominant land use on the poorly drained soils. Rapidly drained soils associated with areas of stabilized duned sands are rated in capability class 5 and 6M. Duned areas remain under native vegetation and support stands of aspen and oak interspersed with grassland. These soils have a severe risk of wind erosion if disturbed.

Well and imperfectly drained, medium textured soils of the Carroll Association occur in the southern and eastern portions of the municipality. The Carroll soils, together with a small area of Harding clay soils in the north-central portion of the RM, have the highest capability for agriculture (class 2 and 3) and are well suited for annual crop production.

The Hilton soils developed on stony, loam textured glacial till, occur in an outlier of the Tiger Hills along the eastern boundary of the municipality. Thin veneers of lacustrine clay loam overlying the till are mapped as Beresford soils. The soils in this area are rated in class 3T, and have a severe risk of water erosion.

Significant areas of wetlands occur throughout the municipality, particularly in the Harding and Beresford soils north of Souris, and in the Carroll soils to the southwest. These soils, generally rated in capability class 5W, are not shown on the generalized soil map or the agricultural capability map, as they usually constitute less than 50 percent of the soil map units. These poorly drained soils are rated poor for irrigation suitability. The extent of wetlands can be shown on a separate map derived from the terrain data.

The Souris River valley is a major topographic feature in the municipality, traversing the southern portion of the area from west to east. The valley varies from one to two km in width, and has a depth of 20 to 50 metres. Soil and terrain conditions associated with the valley are quite variable. Minor areas of recent alluvium within the valley are characterized by Regosolic soils of the Coulter Association. The steeply sloping valley walls are mapped as Eroded Slopes Complex, and are rated as capability class 5T to 7T. Most soils in the valley area remain in native vegetation, providing wildlife habitat and recreation use. These steeply sloping soils are at severe risk of water erosion if the stabilizing vegetation is removed.

An extensive area of Heaslip soils adjacent to the Souris valley in the southeast portion of the municipality consists of a complex association of severely water-worked till with surface textures ranging from sand and gravel to clay loam. These soils are placed in agricultural capability class 3M and rated as good for irrigation. The potential risk for environmental impact under irrigation varies from low to moderate depending on soil permeability and proximity to the water table.

DERIVED AND INTERPRETIVE MAPS

A large variety of computer derived and interpretive maps can be generated, once the soil and terrain data are stored in digital format. These maps are based on selected combinations of database values and assumptions.

Derived maps show information that is given in one or more columns in the computer map legend (such as soil texture, drainage, stoniness, or slope class).

Interpretive maps portray a more complex evaluation of information presented in the legend which is combined in a unique way to arrive at an entirely new map.

Several examples of derived and interpretive maps are included in this information bulletin. The maps have all been reduced in size and generalized (simplified), in order to portray conditions for an entire rural municipality on one page. Only interpretations based on the dominant soil and terrain conditions in each polygon are shown at such reduced scales. These generalized maps provide a useful overview of conditions within a municipality, but are not intended to apply to site specific land parcels.

The digital databases may also contain more detailed information concerning significant inclusions of differing soil and slope conditions in each map polygon, particularly where they have been derived from modern detailed soil maps. This information can be portrayed at larger map scales.

Information concerning particular interpretative maps, and the primary soil and terrain map data, can be obtained by contacting the Manitoba Land Resource Unit.

Slope Map.

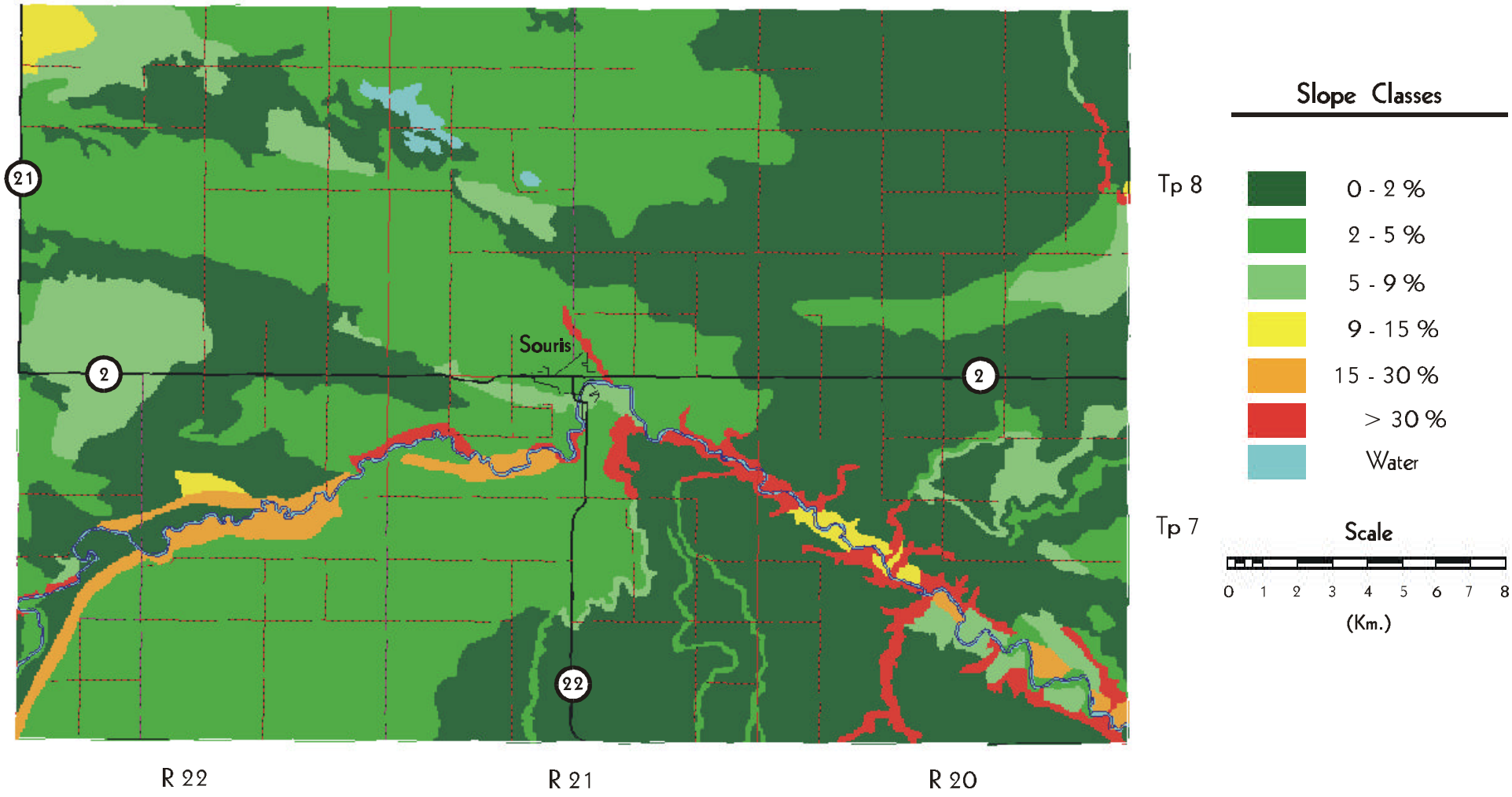
Slope describes the steepness of the landscape surface. The slope classes shown on this map are derived from the digital terrain layer database. Specific colours are used to indicate the most significant, limiting slope class for each terrain polygon in the RM. Additional slope classes can occur in each polygon area, but cannot be portrayed at this reduced map scale.

Table 1. Slope Classes[1]

Slope Class	Area (ha)	Percent of RM
0 - 2 %	26434	45.5
2 - 5 %	23747	40.9
5 - 9 %	4485	7.7
9 - 15 %	502	0.9
15 - 30 %	1029	1.8
> 30 %	1353	2.3
Water	528	0.9
Unclassified	0	0.0
Total	58077	100.0

[1] Area has been assigned to the most significant limiting slope for each terrain polygon. Significant areas of lesser slope, and smaller areas of greater slope may occur in each terrain polygon.

Rural Municipality of Glenwood Slope Map



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Centre for Land and Biological Resources Research
October 1994

Surface Form Map.

Surface forms describe the overall shape of the earth's surface. The various surface forms may exhibit a regular (or irregular) pattern of convexities and concavities, and are commonly associated with characteristic ranges of slope gradients and slope lengths. They may also imply particular modes of origin. For example, scrolled and terraced surface forms are created by river and stream deposits, while undulating and hummocky landforms are frequently associated with glacial moraines. A description of the various surface form classes are contained in a separate Soil and Terrain Classification System Manual (Manitoba Land Resource Unit, 1996).

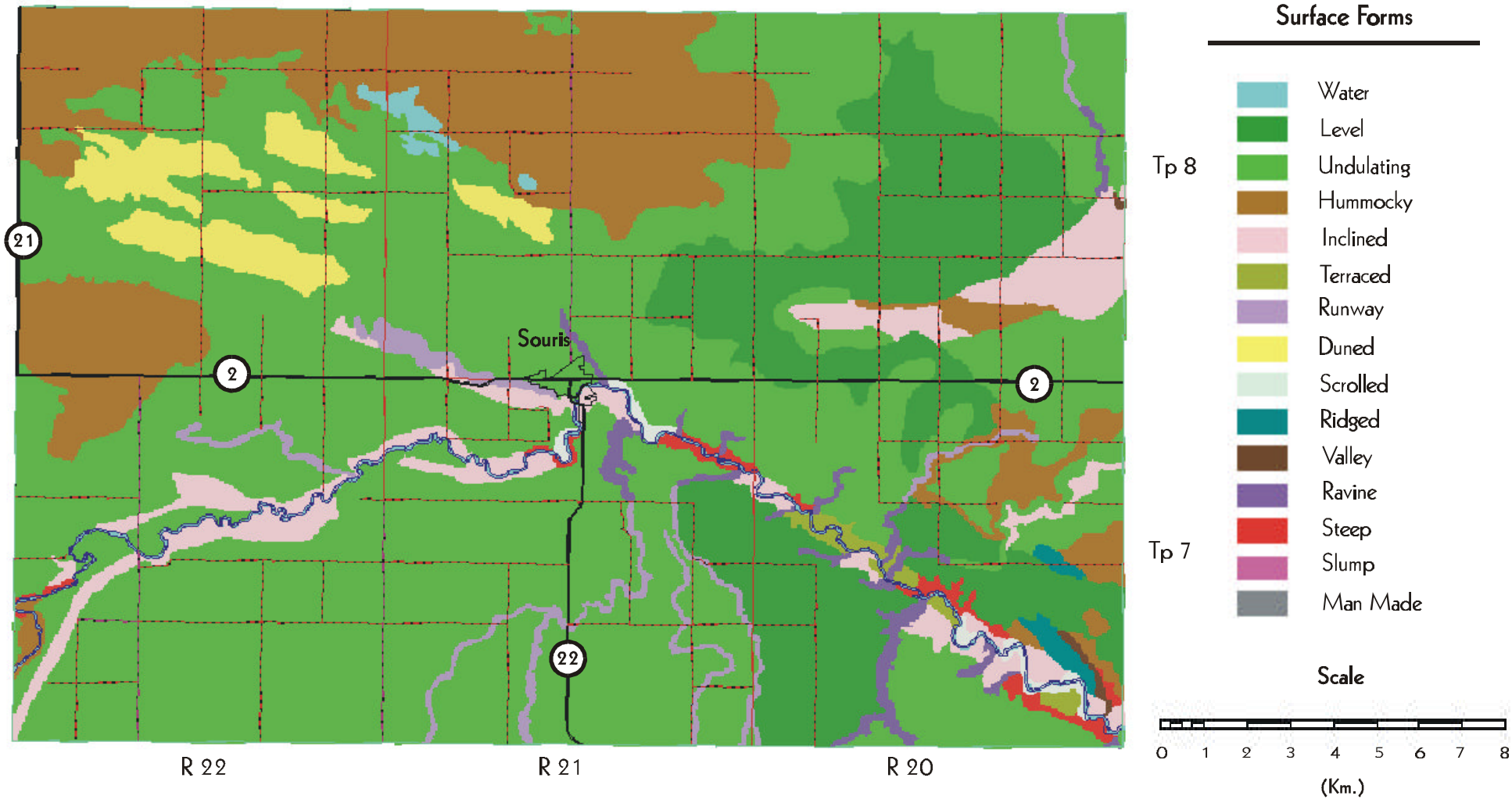
Surface form and slope class are two key features of the digital terrain map layer. Both of these characteristics are important controlling and influencing factors to consider for sustainable land use planning and management.

Table 2. Surface Form and Slope Classes[1]

Surface Form Slope Class	Area (ha)	Percent of RM
Scrolled	**199**	**0.3**
C (2.0 to 5.0%)	172	0.3
D (6.0 to 9.0%)	27	0.0
Duned	**1788**	**3.1**
C (2.0 to 5.0%)	1355	2.3
D (6.0 to 9.0%)	433	0.7
Hummocky	**9333**	**16.1**
C (2.0 to 5.0%)	6318	10.9
D (6.0 to 9.0%)	2762	4.8
E (10.0 to 15.0%) 253	0.4	
Inclined	**2922**	**5.0**
C (2.0 to 5.0%)	761	1.3
D (6.0 to 9.0%)	869	1.5
E (10.0 to 15.0%) 79	0.1	
F (16.0 to 30.0%) 997	1.7	
H (31.0 to 70.0%) 216	0.4	
Level	**7971**	**13.7**
B (0.5 to 2.0%)	7971	13.7
Ravine	**707**	**1.2**
H (31.0 to 70.0%) 124	0.2	
J (> 70.0%)	583	1.0
Ridged	**185**	**0.3**
D (6.0 to 9.0%)	185	0.3
Steep	**370**	**0.6**
J (> 70.0%)	370	0.6
Terraced	**256**	**0.4**
D (6.0 to 9.0%)	54	0.1
E (10.0 to 15.0%) 171	0.3	
F (16.0 to 30.0%) 31	0.1	
Undulating	**32771**	**56.4**
B (0.5 to 2.0%)	18463	31.8
C (2.0 to 5.0%)	14308	24.6
Runway	**989**	**1.7**
C (2.0 to 5.0%)	834	1.4
D (6.0 to 9.0%)	155	0.3
Valley	**61**	**0.1**
J (> 70.0%)	61	0.1
Water	**528**	**0.9**
Total	**58077**	**100.0**

[1] Area has been assigned to the most significant limiting slope for each terrain polygon. Significant areas of lesser slope, and smaller areas of greater slope may occur in each terrain polygon.

Rural Municipality of Glenwood Surface Form Map



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November 1994

Generalized Soil Map.

All soil polygons on the original published reconnaissance maps were digitized to create the soil layer. In some cases, areas of overprinted symbols on the original maps were delineated as additional new soil polygons.

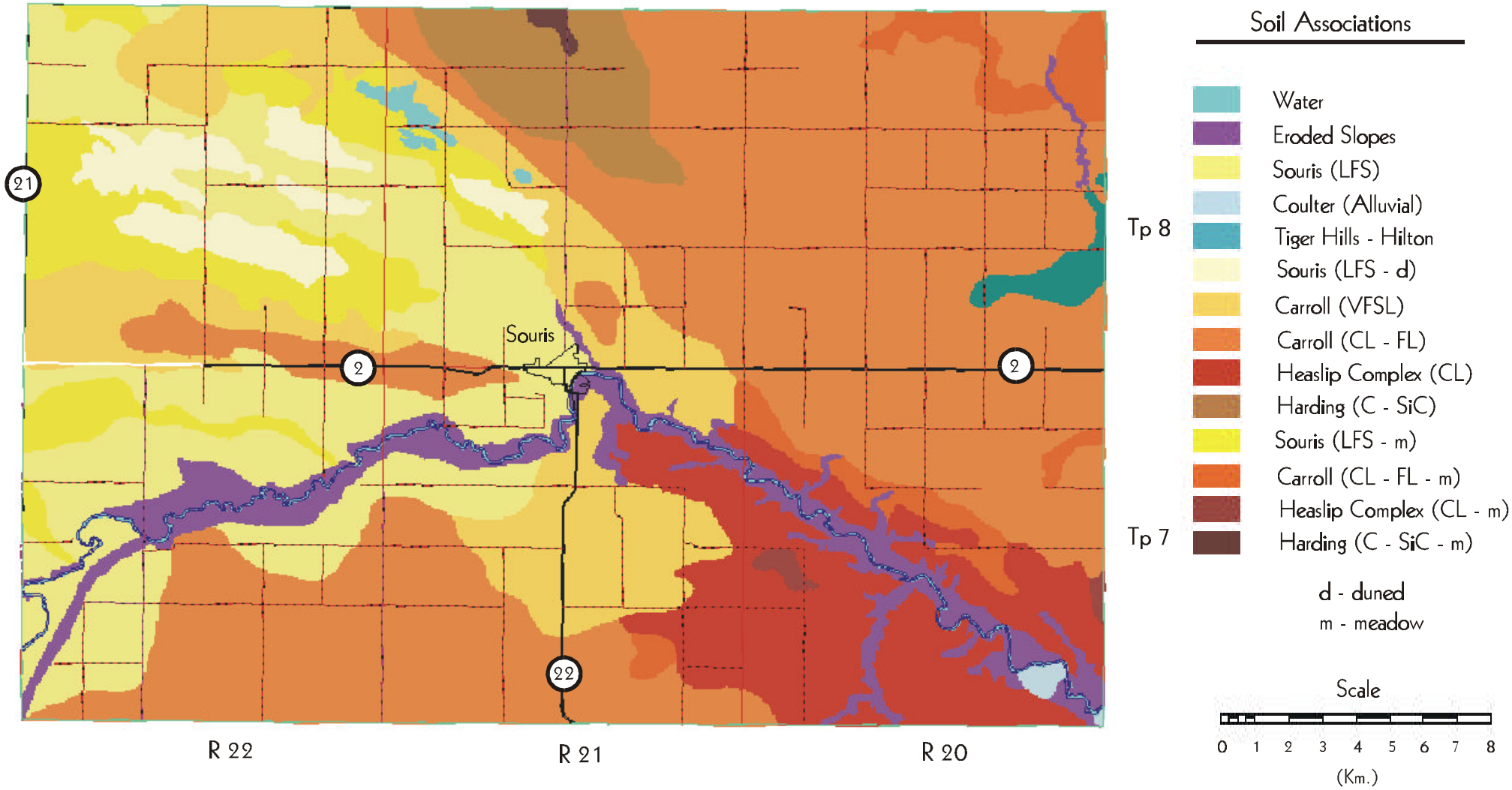
This generalized soil map has been reduced in size and simplified by grouping the original soil association polygons. The groups have been colour themed according to similar modes of origin, texture, and soil drainage. Soils derived from glacial till deposits (typically loam to clay loam in texture) have been assigned blue and green colours. Soils developed from glacial lake deposits are coloured yellow (sandy), orange (loam), or brown (clay). Sand and gravel deposits are coloured in pink.

The groups have been named after the dominant soil association, and the statistics for each of the groups have been summarized (in bold). The original reconnaissance map symbol types and their areal extent in the municipality are shown within each group.

Table 3. Generalized Soil Association Groups

Association Group Associate	Area (ha)	Percent of RM
Water	**528**	**0.9**
Eroded Slopes	**3223**	**5.5**
Er	3223	5.5
Souris (LFS)	**9426**	**16.2**
Slfs	3889	6.7
Sls	5537	9.5
Coulter (Alluvial)	**99**	**0.2**
Co	99	0.2
Tiger Hills - Hilton	**404**	**0.7**
T-H	404	0.7
Souris (LFS - d)	**1788**	**3.1**
Slfs (duned)	1788	3.1
Carroll (VFSL)	**6994**	**12.0**
Cl	3092	5.3
Sfsl	3902	6.7
Carroll (CL - FL)	**22558**	**38.8**
Bd	7904	13.6
Cc	6328	10.9
Ccl	7571	13.0
Ccl (degraded)	162	0.3
Ccs	595	1.0
Heaslip Complex (CL)	**5256**	**9.1**
Hx(cl)	5256	9.1
Harding (C - SiC)	**1957**	**3.4**
Hc	1957	3.4
Souris (LFS - m)	**3898**	**6.7**
Slfs (meadow)	3113	5.4
Sls (meadow)	785	1.4
Carroll (CL - FL -m)	**1714**	**3.0**
Cc (meadow)	889	1.5
Ccl (saline)	825	1.4
Heaslip Complex (CL - m)	**151**	**0.3**
Hx(cl) (meadow)	151	0.3
Harding (C- SiC -m)	**81**	**0.1**
Hc (meadow)	81	0.1
Total	**58077**	**100.0**

Rural Municipality of Glenwood Generalized Soil Map



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Centre for Land and Biological Resources Research
October 1994

Agricultural Capability Map.

This evaluation utilizes the 7 class Canada Land Inventory system (CLI, 1965). Classes 1 to 3 represent the prime agricultural land, classes 4 and 5 represent marginal lands, and classes 6 and 7 are considered unsuitable for dryland agriculture.

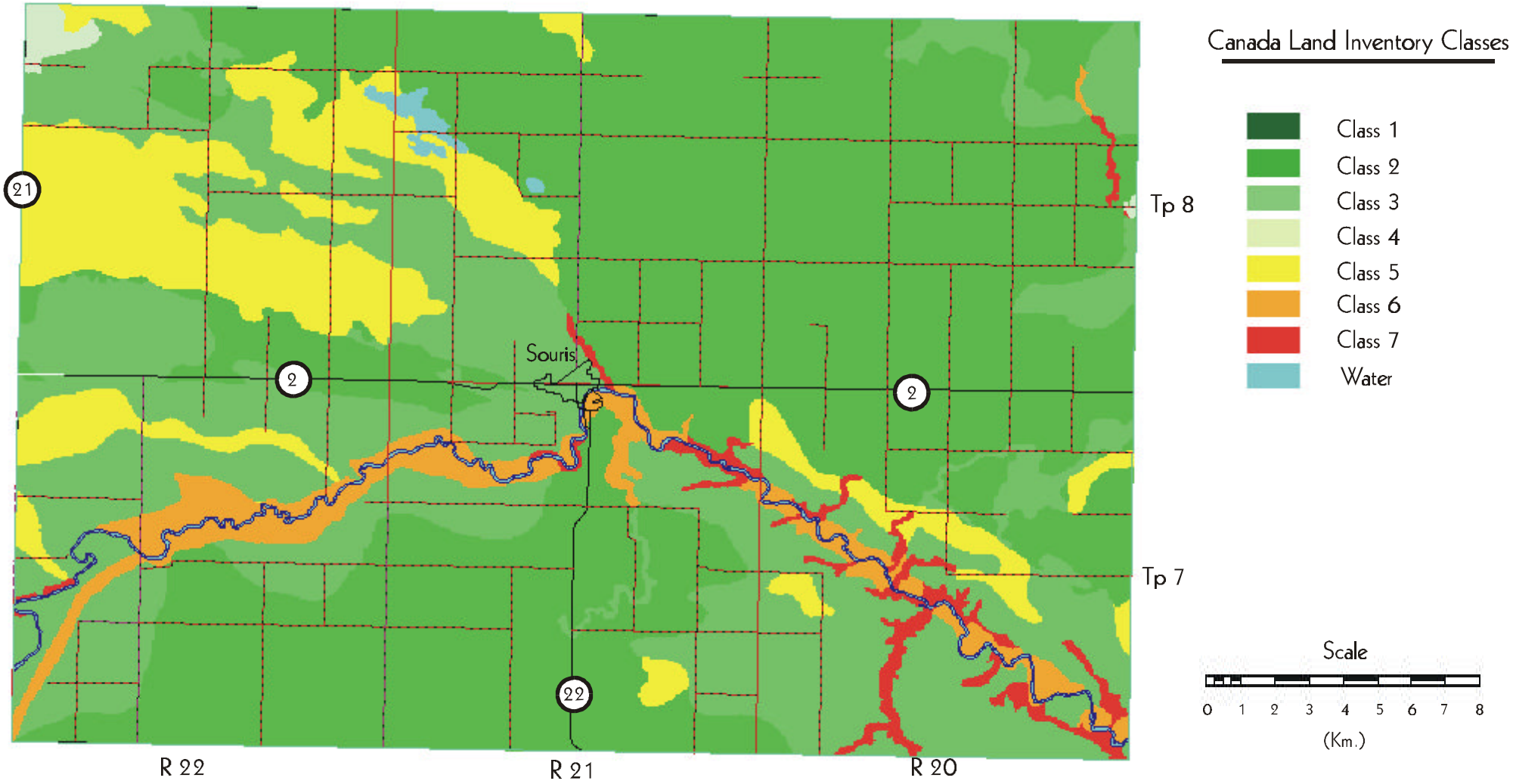
This generalized interpretive map is based on the dominant modern soil type for the soil polygon, in combination with the dominant slope class identified from the terrain polygon layer. The nature of the CLI subclass limitations and the classification of subdominant components cannot be portrayed at this generalized map scale.

Table 4. Agricultural Capability[1]

Class Subclass	Area (ha)	Percent of RM
2	**29352**	**50.5**
2M	2658	4.6
2T	63	0.1
2W	26624	45.8
2X	7	0.0
3	**17920**	**30.9**
3	2822	4.9
3I	31	0.1
3M	13614	23.4
3MT	300	0.5
3N	825	1.4
3T	329	0.6
4	**227**	**0.4**
4	223	0.4
4T	4	0.0
5	**6808**	**11.7**
5	440	0.8
5M	1788	3.1
5W	4580	7.9
6	**2240**	**3.9**
6	455	0.8
6T	1785	3.1
7	**1515**	**2.6**
7	20	0.0
7T	984	1.7
Water	**528**	**0.9**
Total	**58077**	**100.0**

[1] Based on **dominant** soil and slope of the respective soil and terrain maps.

Rural Municipality of Glenwood Agriculture Capability Map



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Irrigation Suitability Map.

Irrigation suitability is a four class rating system. Classes are **Excellent, Good, Fair, and Poor**. Irrigation ratings are based on an assessment of the most limiting combination of soil and landscape conditions. Soils in the same class have a similar relative suitability or degree of limitation for irrigation use, although the specific limiting factors may differ. These limiting factors are described by subclass symbols at detailed map scales. The irrigation rating system does not consider water availability, method of application, water quality, or economics of irrigated land use.

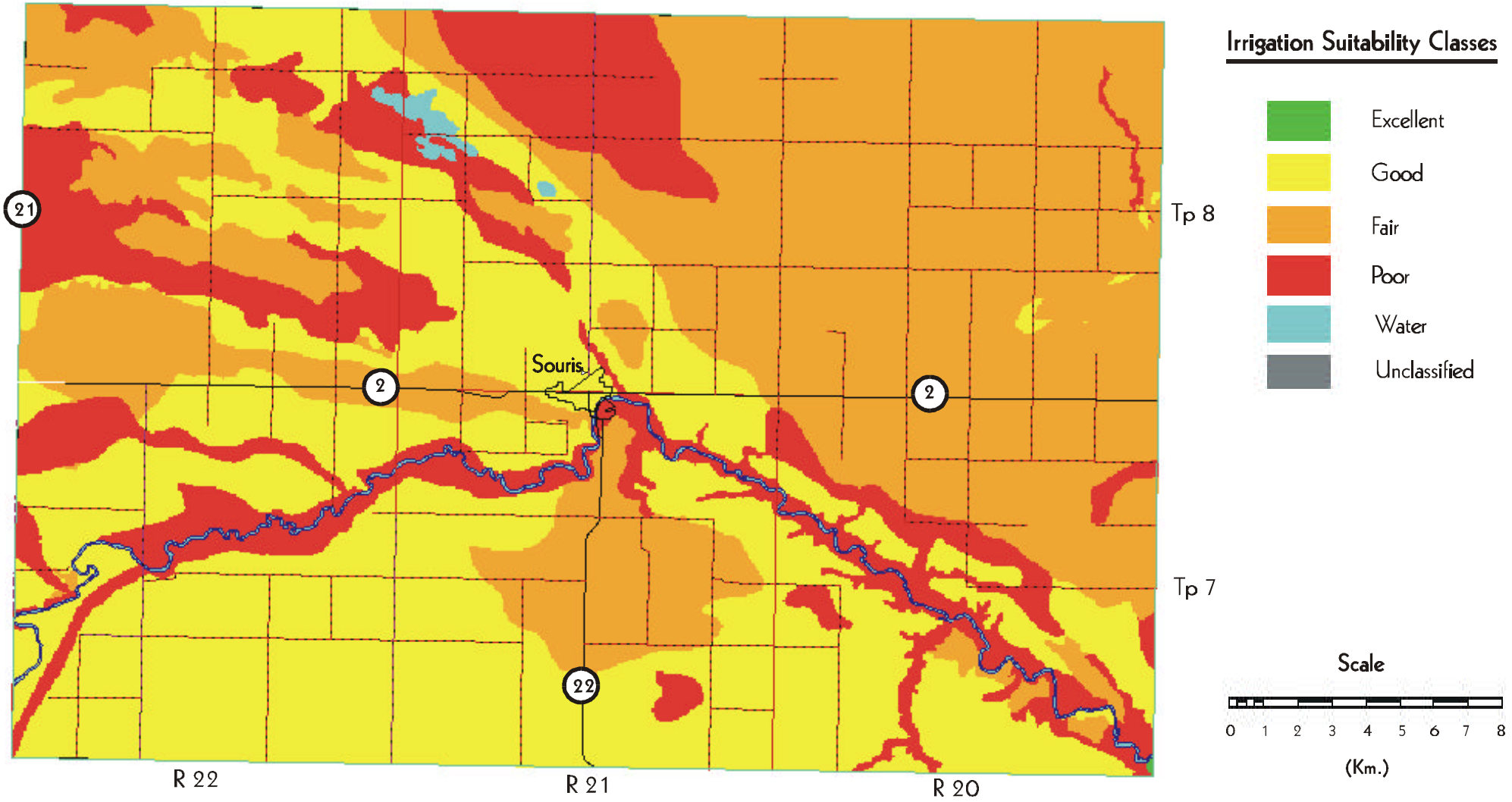
This generalized interpretive map is based on the dominant soil series for each soil polygon, in combination with the dominant slope class from the terrain layer database. The nature of the subclass limitations, and the classification of subdominant components is not shown at this generalized map scale.

Table 5. Irrigation Suitability[1]

Class	Area (ha)	Percent of RM
Excellent	**7**	**0.0**
Good	**23420**	**40.3**
Fair	**23902**	**41.2**
Poor	**10221**	**17.6**
Organic	**0**	**0.0**
Water	**528**	**0.9**
Unclassified	**0**	**0.0**
Total	**58077**	**100.0**

[1] Based on **dominant** soil and slope of the respective soil and terrain maps.

Rural Municipality of Glenwood Irrigation Suitability Map



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Potential Environmental Impact Under Irrigation.

A major concern for land under irrigated crop production is the possibility that surface and/or groundwater may be impacted. The potential environmental impact assessment provides a relative rating of land into 4 classes (minimal, low, moderate and high) based on an evaluation of specific soil factors and landscape conditions that determine the impact potential.

Soil factors considered are those properties that determine water retention and movement through the soil; topographic features are those that affect runoff and redistribution of moisture in the landscape. Specifically considered are: soil texture, hydraulic conductivity, salinity, geological uniformity, depth to watertable and topography. The risk of altering surface and subsurface soil drainage regimes, soil salinity or the potential for runoff, erosion or flooding is determined by specific criteria for each property.

Use of this rating is intended to serve as a warning of potential environmental concern. It may be possible to design and/or give special consideration to soil-water-crop management practices that will mitigate any adverse impact.

This generalized interpretive map is based on the dominant soil series for each soil polygon, in combination with the dominant slope class from the terrain layer database. The nature of the subclass limitations, and the classification of subdominant components is not shown at this generalized map scale.

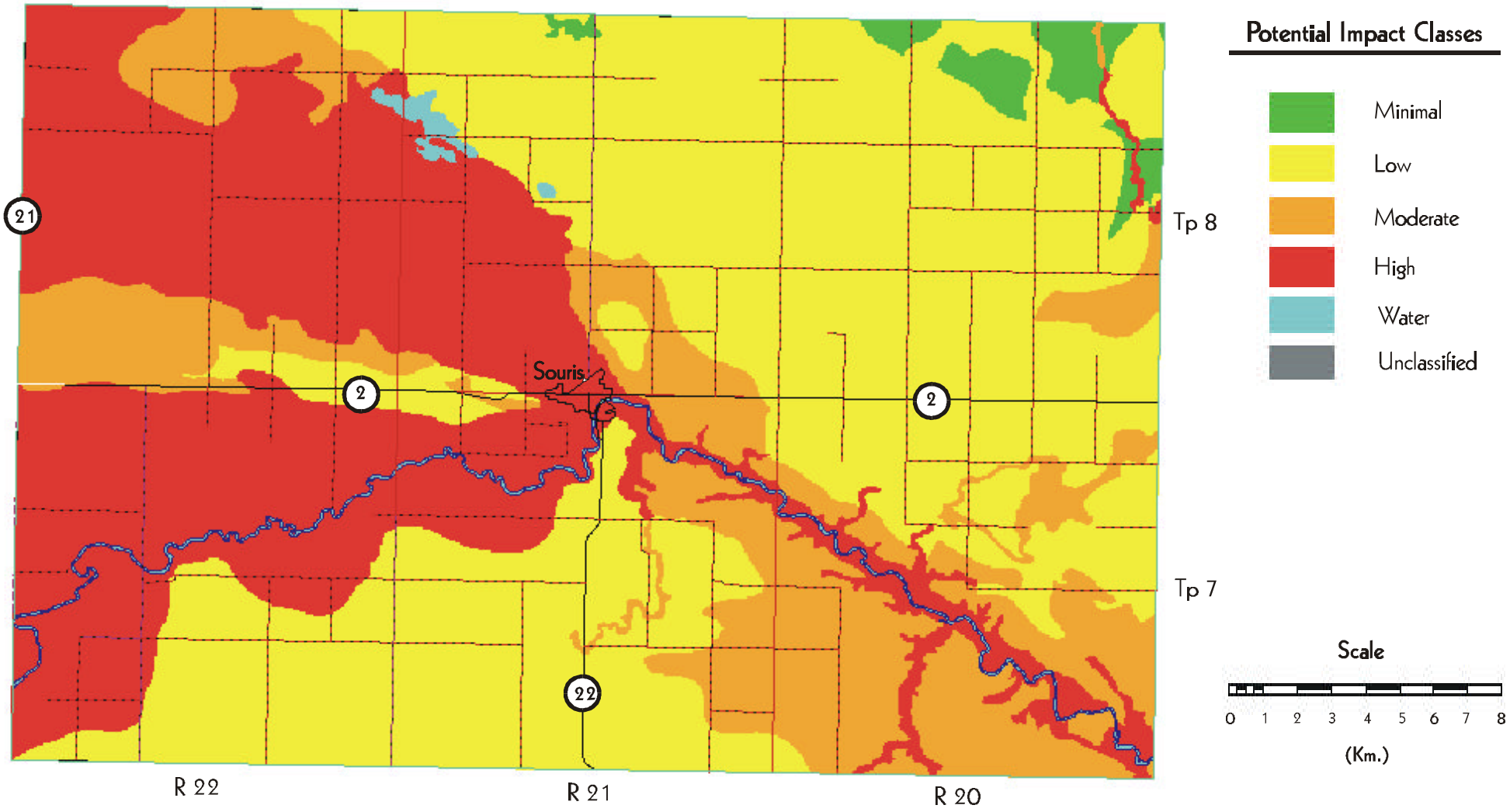
Table 6. Potential Environmental Impact Under Irrigation[1]

Class	Area (ha)	Percent of RM
Minimal	**973**	**1.7**
Low	**27463**	**47.3**
Moderate	**10743**	**18.5**
High	**18371**	**31.6**
Organic	**0**	**0.0**
Water	**528**	**0.9**
Unclassified	**0**	**0.0**
Total	**58077**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of the respective soil and terrain maps.

Rural Municipality of Glenwood

Potential Environmental Impact Under Irrigation



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March 1996

Water Erosion Risk Map.

The risk of water erosion was estimated using the universal soil loss equation (USLE) developed by Wischmeier and Smith (1965). The map shows 5 classes of soil erosion risk based on bare unprotected soil:

negligible
low
moderate
high
severe

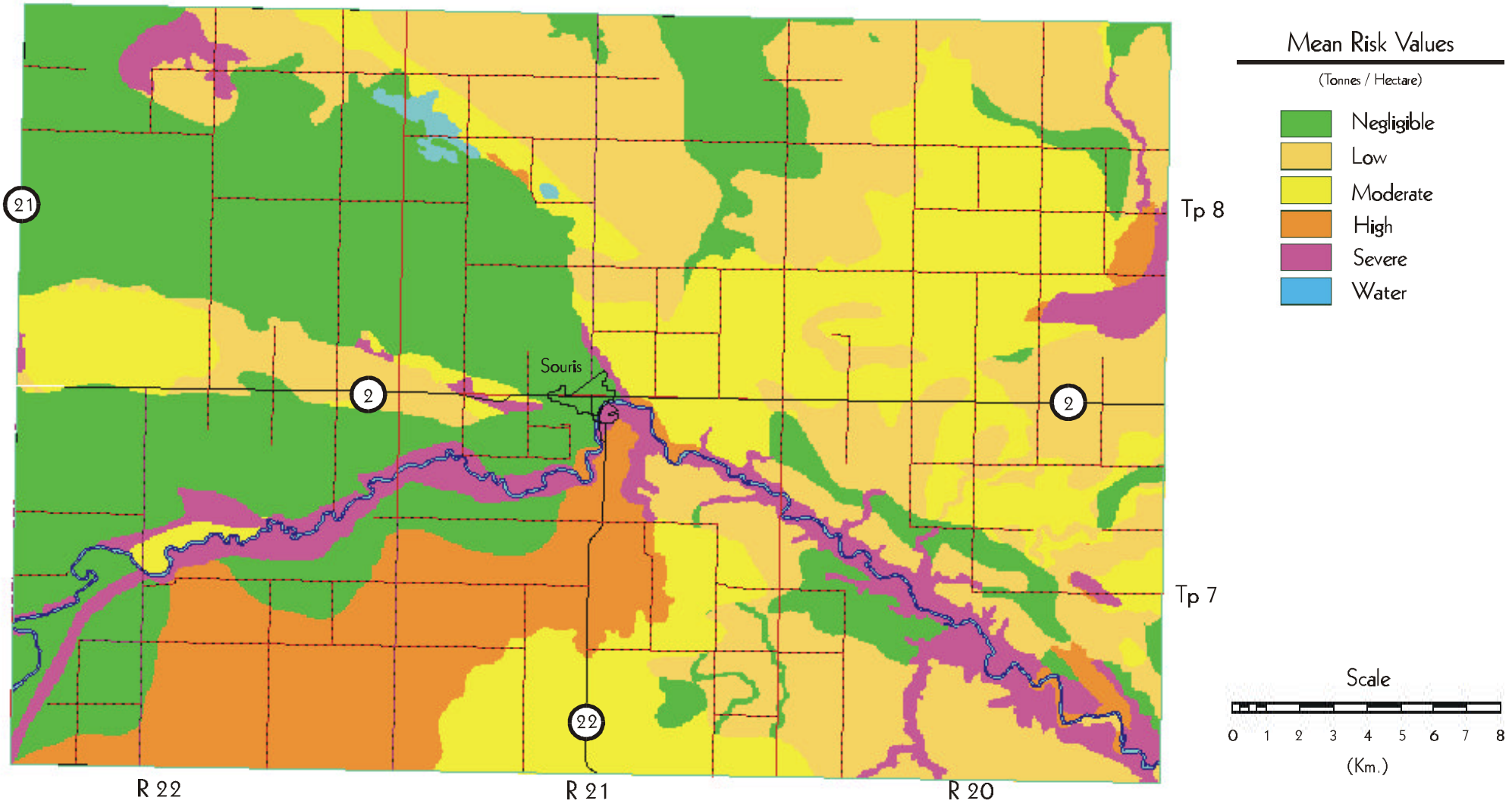
Cropping and management practices will significantly reduce this risk depending on crop rotation program, soil type, and landscape features.

Table 7. Water Erosion Risk[1]

Class	Area (ha)	Percent of RM
Negligible	**18726**	**32.2**
Low	**15893**	**27.4**
Moderate	**12606**	**21.7**
High	**6279**	**10.8**
Severe	**4046**	**7.0**
Water	**528**	**0.9**
Unclassified	**0**	**0.0**
Total	**58077**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of the respective soil and terrain maps.

Rural Municipality of Glenwood Water Erosion Risk Map



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Centre for Land and Biological Resources Research
March 1996

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ADDENDUM

Land Use Map.

The land use classification of the RM has been interpreted from LANDSAT satellite imagery, using supervised computer classification techniques. Many individual spectral signatures were classified and grouped into the seven general land use classes shown here. Although land use changes over time, and some land use practices on individual parcels may occasionally result in similar spectral signatures, this map provides a general representation of the current land use in the RM.

The following is a brief description of the land use classes are:

Annual Crop Land - land that is normally cultivated on an annual basis.

Forage - perennial forages, generally alfalfa or clover with blends of tame grasses.

Grasslands - areas of native or tame grasses, may contain scattered stands of shrubs.

Trees - lands that are primarily in tree cover.

Wetlands - areas that are wet, often with sedges, cattails, and rushes.

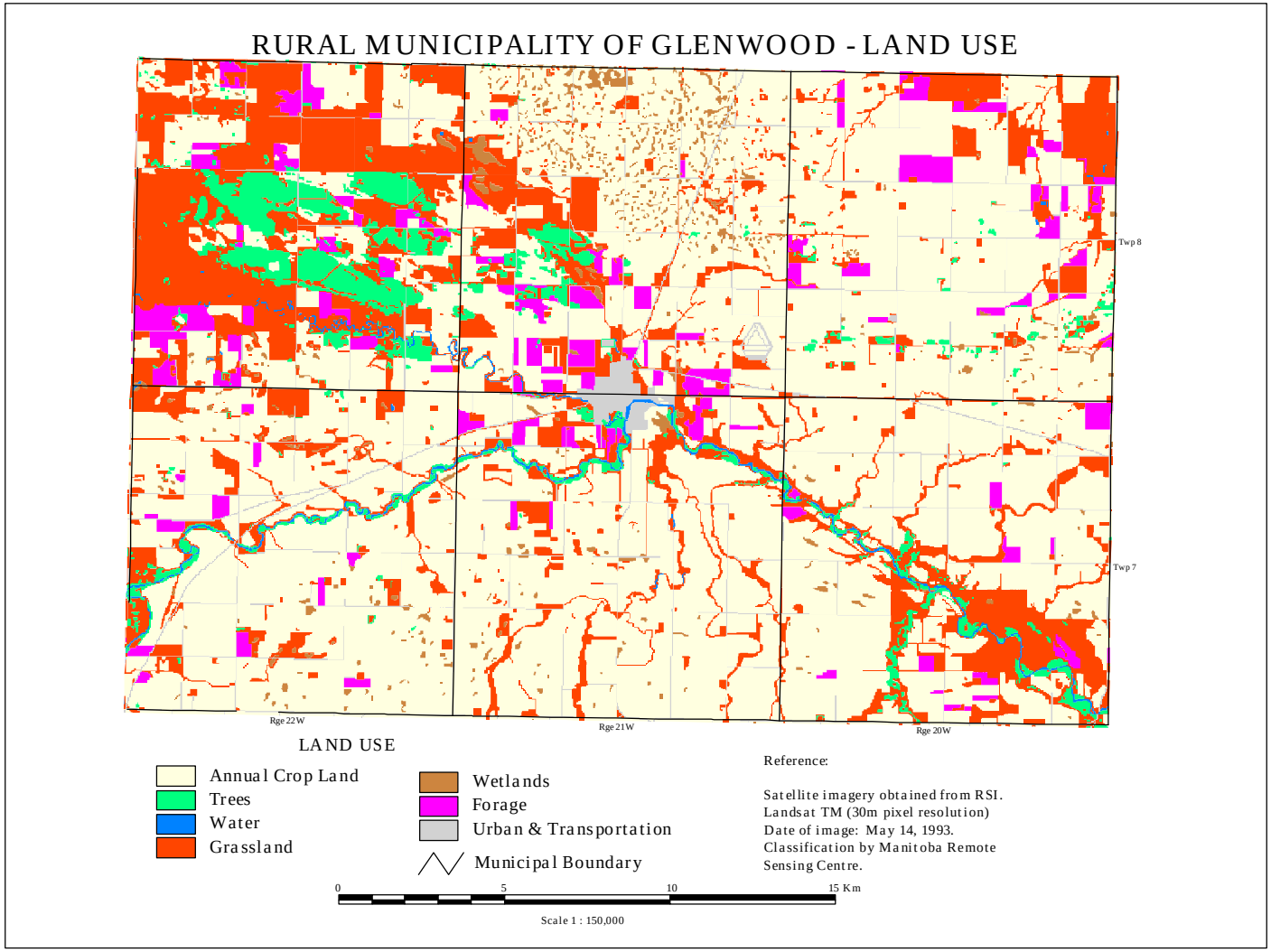
Water - open water-lakes, rivers streams, ponds, and lagoons.

Urban and Transportation - towns, roads, railways, quarries.

Table 10. Land Use[1]

Class	Area (ha)	Percent of RM
Annual Crop Land	**38152**	**64.9**
Forage	**2636**	**4.5**
Grasslands	**12080**	**20.5**
Trees	**2622**	**4.5**
Wetlands	**910**	**1.5**
Water	**358**	**0.6**
Urban and Transportation	**2059**	**3.5**
Total	**58817**	**100.0**

[1] Land use information (1995) and map supplied by Prairie Farm Rehabilitation Administration. Total area may vary from previous maps due to differences in analytical procedures.


RURAL MUNICIPALITY OF GLENWOOD - LAND USE
Twp 8
Twp 7
Rge 22W
Rge 21W
Rge 20W
LAND USE
Annual Crop Land
Trees
Water
Grassland
Wetlands
Forage
Urban & Transportation
Municipal Boundary
Reference:
Satellite imagery obtained from RSI.
Landsat TM (30m pixel resolution)
Date of image: May 14, 1993.
Classification by Manitoba Remote Sensing Centre.
0
5
10
15 Km
Scale 1 : 150,000