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Rural Municipality of Roland

Information Bulletin 97-13

Soils and Terrain

An introduction
to the land resource

Land Resource Unit
Brandon Research Centre

Canada

Rural Municipality of Roland

Information Bulletin 97-13

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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 soil databases and illustrate several typical derived and interpretive map products for agricultural land use planning applications. The bulletins will also be available in diskette format for each rural municipality.

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 soil and terrain maps at larger scales, may be obtained by contacting

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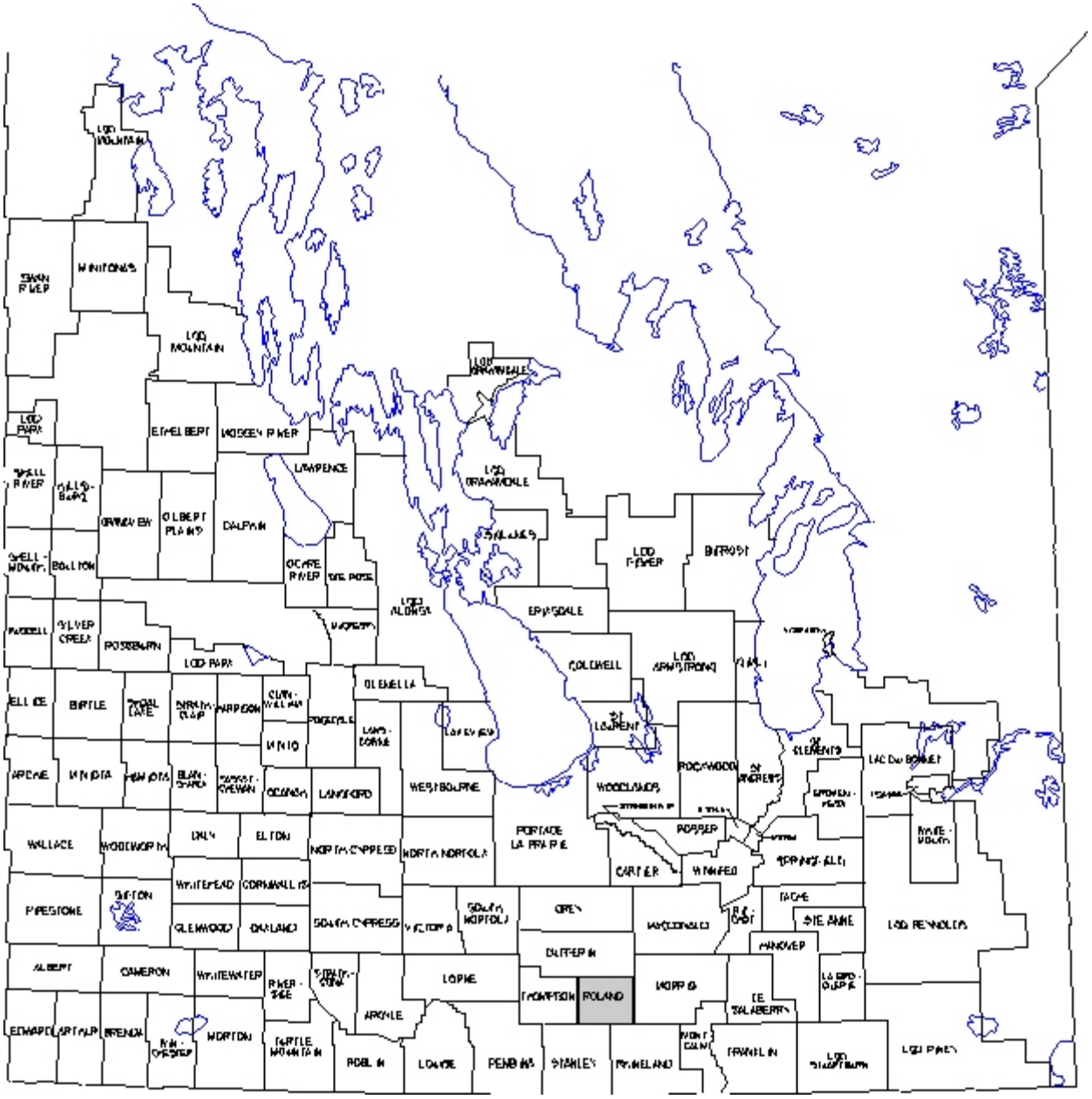


Figure 1. Rural municipalities of southern Manitoba.

INTRODUCTION

The location of the Rural Municipality of Roland is shown in Figure 1. A brief overview of the database information assembled, and general environmental conditions for the municipality are presented. A set of maps derived from the data for typical agricultural land use and planning applications are also included.

The soil map and database were compiled and registered using the computerized Geographic Information System (PAMAP GIS) facilities of the Land Resource Unit. These databases were used in GIS to create the generalized, derived and interpretive maps and statistics contained in this report. The final maps were compiled and printed using Coreldraw.

This bulletin is available in printed or digital format. The digital bulletin is a Windows based executable file which offers additional display options, including the capability to print any portion of the bulletin.

LAND RESOURCE DATA

The soil and terrain information presented in this bulletin was compiled 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 analysed in two distinct layers as shown in Figure 2.

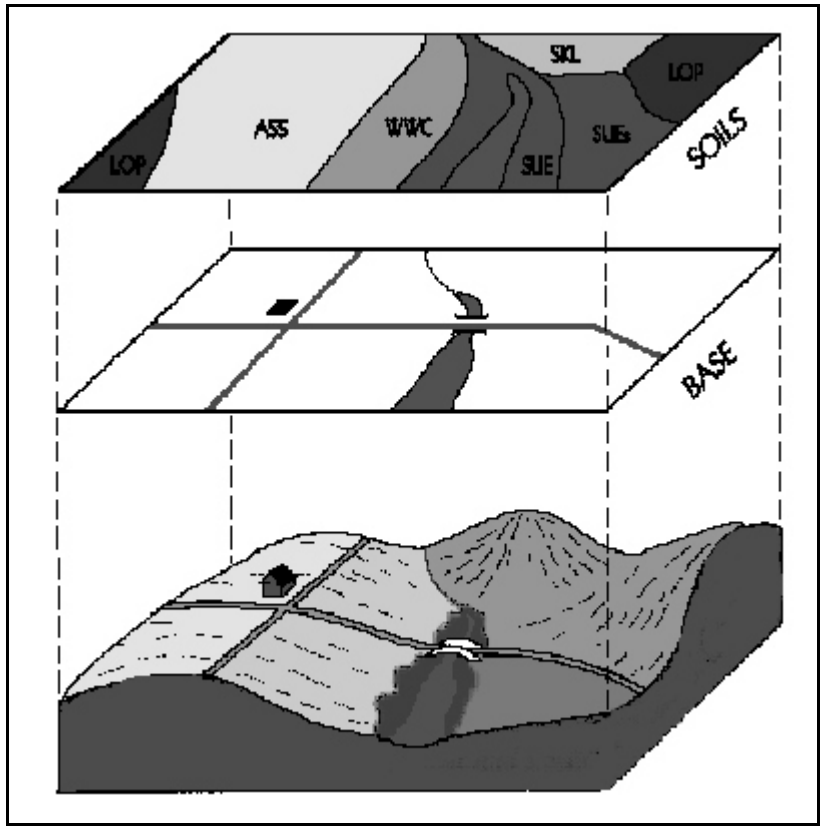


Figure 2. Soil and Base Map data.

Base Layer

Digital base map information includes the municipality and township boundaries, along with major streams, roads and highways. Major rivers and lakes from the base layer were also used as common boundaries for the soil map layer. Water bodies larger than 25 ha in size were digitized as separate polygons.

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. Modern soil series that best represent the soil association were identified for each soil polygon. The soil and modifier codes provide 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. Slope length classes were also added, based on photo-interpretation.

LAND RESOURCE OVERVIEW

The Rural Municipality (RM) of Roland covers 5.5 Townships (approximately 53 000 ha) in south-central Manitoba. The town of Roland is the largest population centre. Land use within the rural municipality is predominantly agriculture.

Soils in the municipality have been mapped (1:20 000 scale) previously and published in report D60, Soils of the Rural Municipalities of Grey, Dufferin, Roland, Thompson, and part of Stanley (Michalyna et al, 1988).

Based on climatic data from Graysville (Environment Canada, 1993), mean annual temperature is 2.7˚C; mean annual precipitation is 538.7 mm; average frost-free period is 116 days (Environment Canada, 1982) and growing degree days above 5˚C are 1647. The calculated seasonal moisture deficit between May to September period is 250 to 300 mm; effective growing degree days (EGDD) above 5˚C accumulated from May to September are 1500 to 1600. This parameter provides an indication of heat energy available for crop growth (Agronomic Interpretations Working Group, 1992).

The RM of Roland is found completely within the Red River Valley physiographic subsection (Canada-Manitoba Soil Survey, 1980). The Red River Valley is a level to very gently sloping, lacustrine plain characterized by nearly level fluvial lacustrine loams, alluvium and lacustrine clays. Elevation ranges from 305 m.a.s.l in the western portion to a low of 260 in the east. Low relief and medium to fine textured deposits at or near the surface have resulted in imperfect drainage over much of this area. The soils in this area can be desribed by two general groupings based upon surface texture. Areas where the dominant surface texture is clayey are represented by the imperfectly drained Red River, Scanterbury, and the moderately well drained Myrtle series (Black Chernozems) . Poorly drained sites have been mapped as Osborne series (Rego Humic Gleysol). Included with this group are the imperfectly drained Blumengart (Cumulic Regosol) and Gretna (Solonetzic Black Chernozem) series which are developed on fine textured shaly alluvium. Soils developed on a thin medium to moderately fine sediment layer overlying fine textured lacustrine sediments are commonly mapped as the imperfectly drained Graysville and Rignold and the moderately well drained Denham series (Black Chernozems).

The finer textured soils in this area have been rated as class 2 and 3 for agricultural capability and fair for irrigation suitability. Excess moisture and the occurence of salinity are generally the main limitations. Soils with a coarser surface texture have slightly improved drainage and are generally rated class 1 and 2 for agricultural capability and good for irrigation suitability.

Land use in the RM of Roland is primarily agricultural with small areas of woodland, pasture, urban development and recreation. Annual crops occupy about 90% of the land inrough the RM. The remaining areas are in forest (1.3%), grassland (4.0%) and forage production (0.2%) most of which are used for livestock production. The remainder (4.5%) is being utilized for various non-agricultural applications.

While most of the soils in the R.M. of Roland are judged to be free of, or only slightly affected by limitations for arable agriculture, fine and moderately fine textured soils require the maintenance of adequate surface drainage, soil structure and tilth. The sandy moderately coarse textured soils require careful management to reduce the risk of wind erosion; this includes leaving crop residues to provide sufficient trash cover, the provision of shelter belts, minimum tillage practices, and crop rotation including a forage crop to maintain productivity.

Clayey soils have slow to very slow permeability, high shrink-swell properties and are very plastic. They are subject to surface ponding and slow runoff unless adequate drainage is provided. The moderately coarse to moderately fine textured soils have moderate to moderately rapid permeability, seasonal high water table or a saturation zone above the clay subsoil particularly in spring or following heavy rains.

DERIVED AND INTERPRETIVE MAPS

A large variety of computer derived and interpretive maps can be generated from the digital soil and landscape databases. 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 drainage, soil salinity, or slope class).

Interpretive maps portray more complex land evaluations based on a combination of soil and landscape information. Interpretations are based on soil and landscape conditions in each polygon. Interpretative maps typically show land capabilities, suitabilities, or risks related to sustainability.

Several examples of derived and interpretive maps are included in this information bulletin:

Derived Maps
Slope Classes
Surface Texture
Drainage
Salinity
Management Consideration

Interpretative Maps
Agricultural Capabilities
Irrigation Suitability
Potential Environmental Impact
Water Erosion Risk
Land Use.

The maps have all been reduced in size and generalized (simplified) in order to portray conditions for an entire rural municipality on one page. These generalized maps provide a useful overview of conditions within a municipality, but are not intended to apply to site specific land parcels. On-site evaluations are recommended for localized site specific land use suitability requirements.

Digital databases derived from recent detailed soil inventories contain additional detailed information about significant inclusions of differing soil and slope conditions in each map polygon. This information can be portrayed at larger map scale than shown in this bulletin.

Information concerning particular interpretive maps, and the primary soil and terrain map data, can be obtained by contacting the Manitoba Soil Resource Section of Manitoba Agriculture, the local PFRA office, or the Land Resource Unit.

Slope Map.

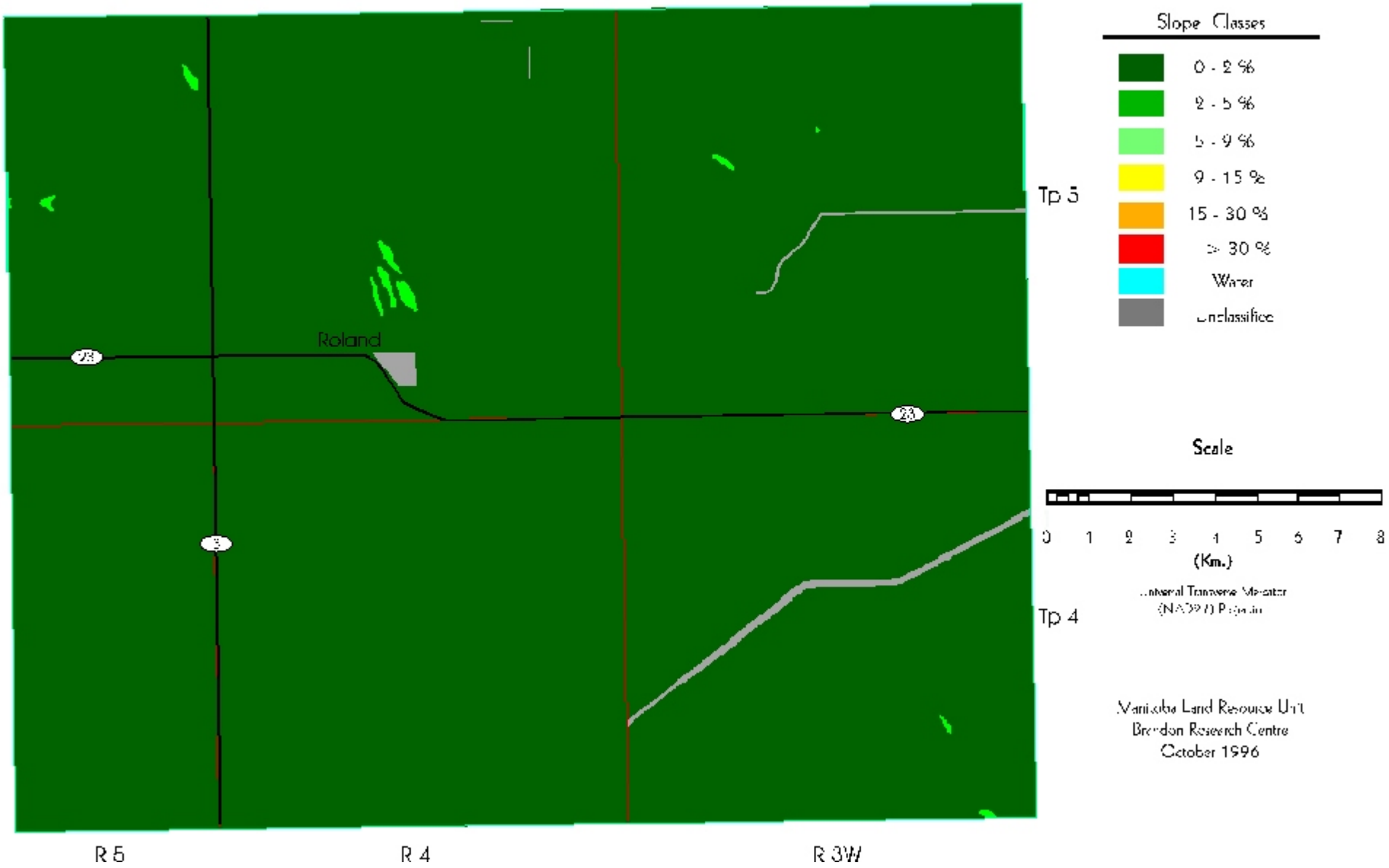
Slope describes the steepness of the landscape surface. The slope classes shown on this map are derived from the digital soil layer database. Specific colours are used to indicate the dominant slope class for each soil polygon in the RM. Additional slope classes may occur in each polygon area, but cannot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

Table 1. Slope Classes[1]

Slope Class	Area (ha)	Percent of RM
0 - 2 %	48127	99.2
2 - 5 %	100	0.2
5 - 9 %	0	0.0
9 - 15 %	0	0.0
15 - 30 %	0	0.0
> 30 %	0	0.0
Unclassified	302	0.6
Water	0	0.0
Total	48529	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.

Slope Map


Slope Classes
0 - 2 %
2 - 5 %
5 - 9 %
9 - 15 %
15 - 30 %
> 30 %
Water
Unclassified
Roland
Tp 5
Tp 4
R 5
R 4
R 3W
Scale
0 1 2 3 4 5 6 7 8
(Km.)
Manitoba Land Resource Unit
Brandon Research Centre
October 1996

Surface Texture Map.

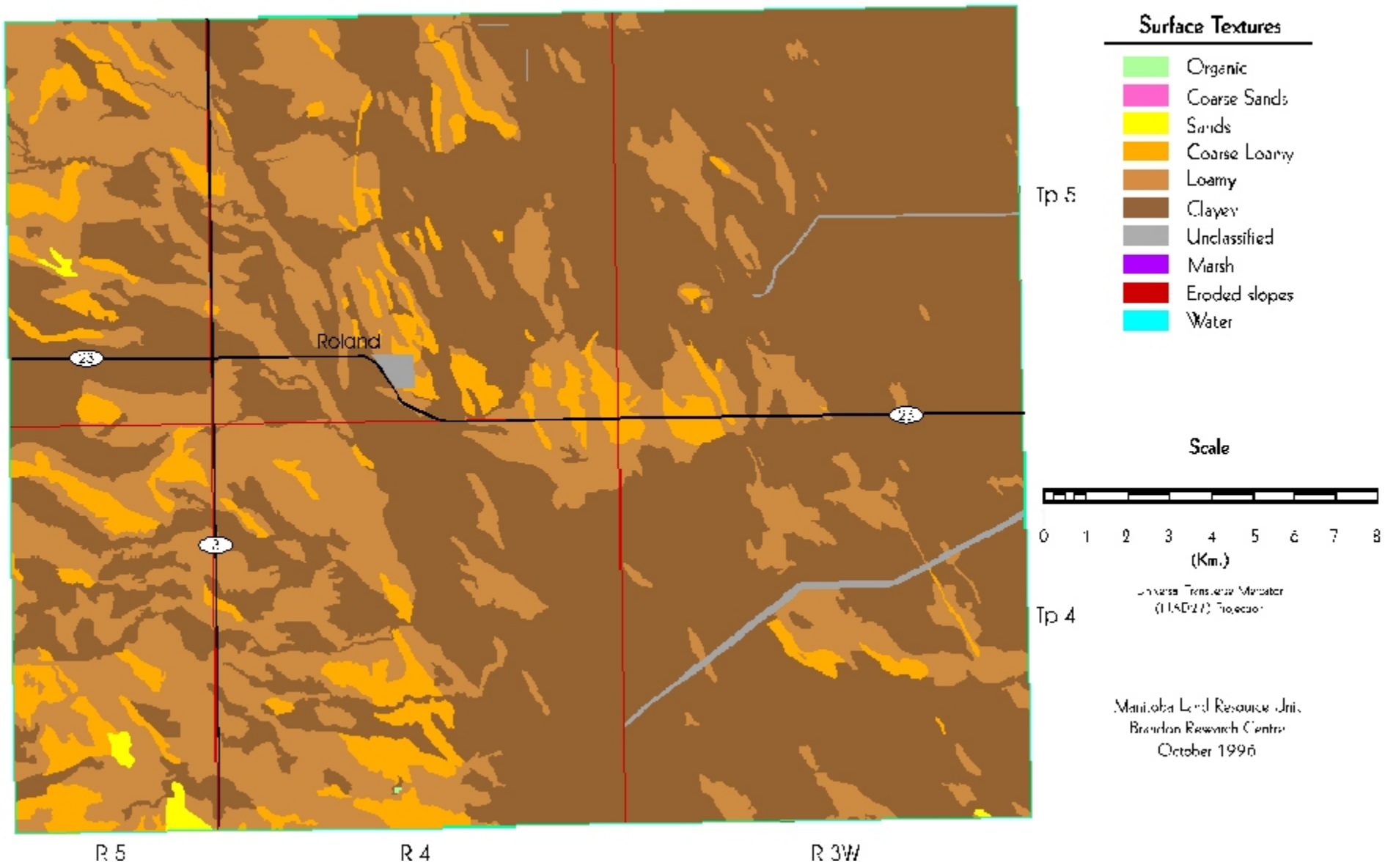
The soil textural class for the upper most soil horizon of the dominant soil series within a soil polygon was utilized for classification. Texture may vary from that shown with soil depth and location within the polygon.

Table 2. Surface Texture[1]

Surface Texture	Area (ha)	Percent of RM
Organics	**1**	**0.0**
Coarse Sands	**0**	**0.0**
Sands	**134**	**0.3**
Coarse Loamy	**3483**	**7.2**
Loamy	**13903**	**28.6**
Clayey	**30706**	**63.3**
Eroded Slopes	**0**	**0.0**
Marsh	**0**	**0.0**
Unclassified	**302**	**0.6**
Water	**0**	**0.0**
Total	**48529**	**100.0**

[1] Based on the **dominant** soil series for each soil polygon.

Surface Texure Map



Soil Drainage Map.

Drainage is described on the basis of actual moisture content in excess of field capacity, and the length of the saturation period within the plant root zone. Six drainage classes plus four land classes are shown on this map.

Very Poor - Water is removed from the soil so slowly that the water table remains at or on the soil surface for the greater part of the time the soil is not frozen. Excess water is present in the soil throughout most of the year.

Poor - Water is removed so slowly in relation to supply that the soil remains wet for a large part of the time the soil is not frozen. Excess water is available within the soil for a large part of the time.

Imperfect - Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly down the profile if precipitation is the major source.

Moderately Well - Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to low perviousness, shallow water table, lack of hydaulic gradient, or some combination of these.

Well - Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying materials or laterally as subsurface flow.

Rapid - Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep slopes during heavy rainfall.

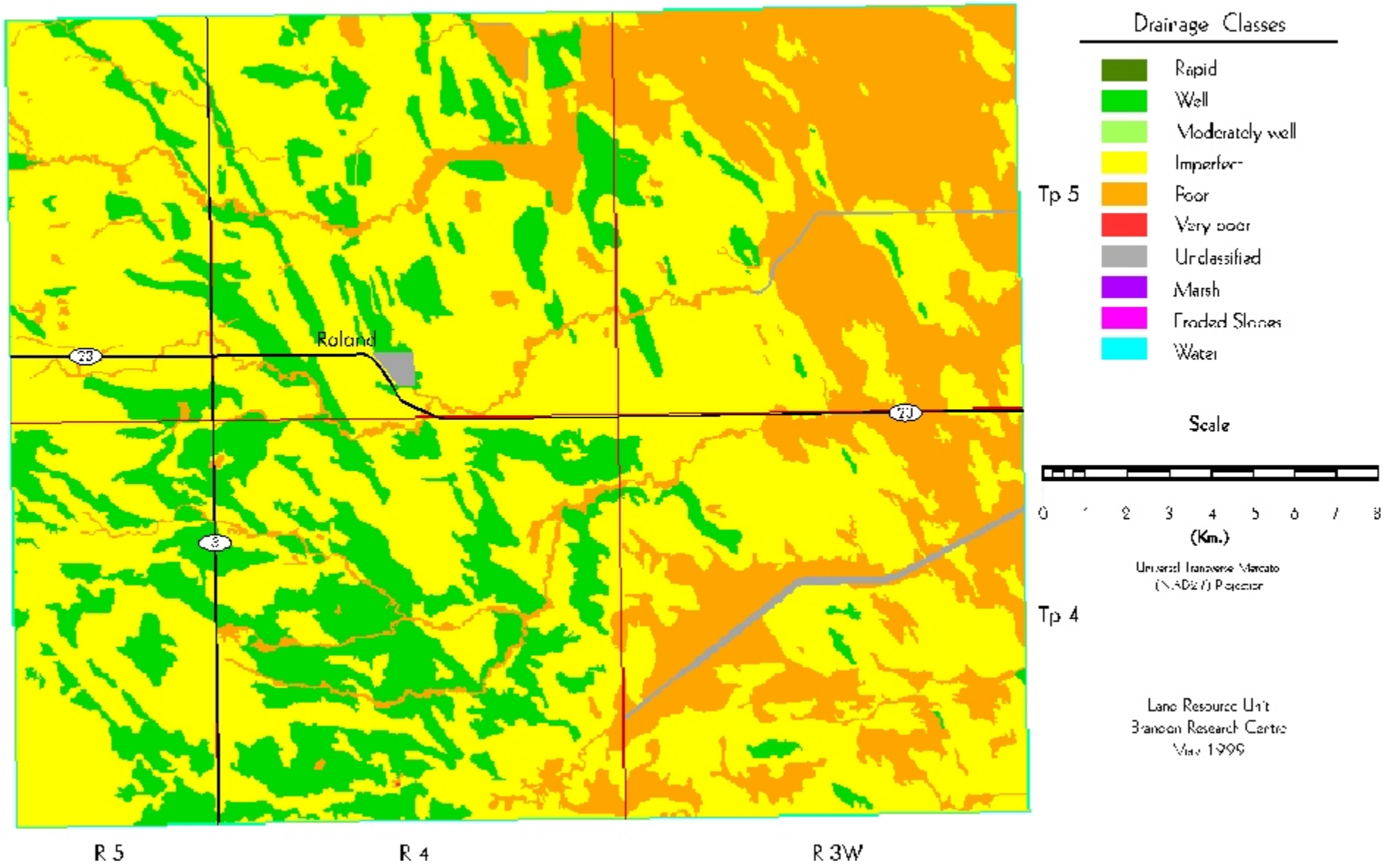
Drainage classification is based on the dominant soil series within each individual soil polygon.

Table 3. Drainage Classes[1]

Drainage Class	Area (ha)	Percent of RM
Very Poor	**1**	**0.0**
Poor	**11018**	**22.7**
Imperfect	**28366**	**58.5**
Well	**8842**	**18.2**
Rapid	**0**	**0.0**
Marsh	**0**	**0.0**
Unclassified	**302**	**0.6**
Water	**0**	**0.0**
Total	**48529**	**100.0**

[1] Area has been assigned to the dominant drainage class for each soil polygon. Salinity may be present in localized areas too small to present at this generalized scale.

Soil Drainage Map



Soil Salinity Map.

A saline soil contains soluble salts in such quantities that they interfere with the growth of most crops. Soil salinity is determined by the electrical conductivity of the saturation extract in decisiemens per metre (dS/m). Approximate limits of salinity classes are:

non-saline	< 4 dS/m
slightly saline	4 to 8 dS/m
moderately saline	8 to 16 dS/m
strongly saline	> 16 dS/m.

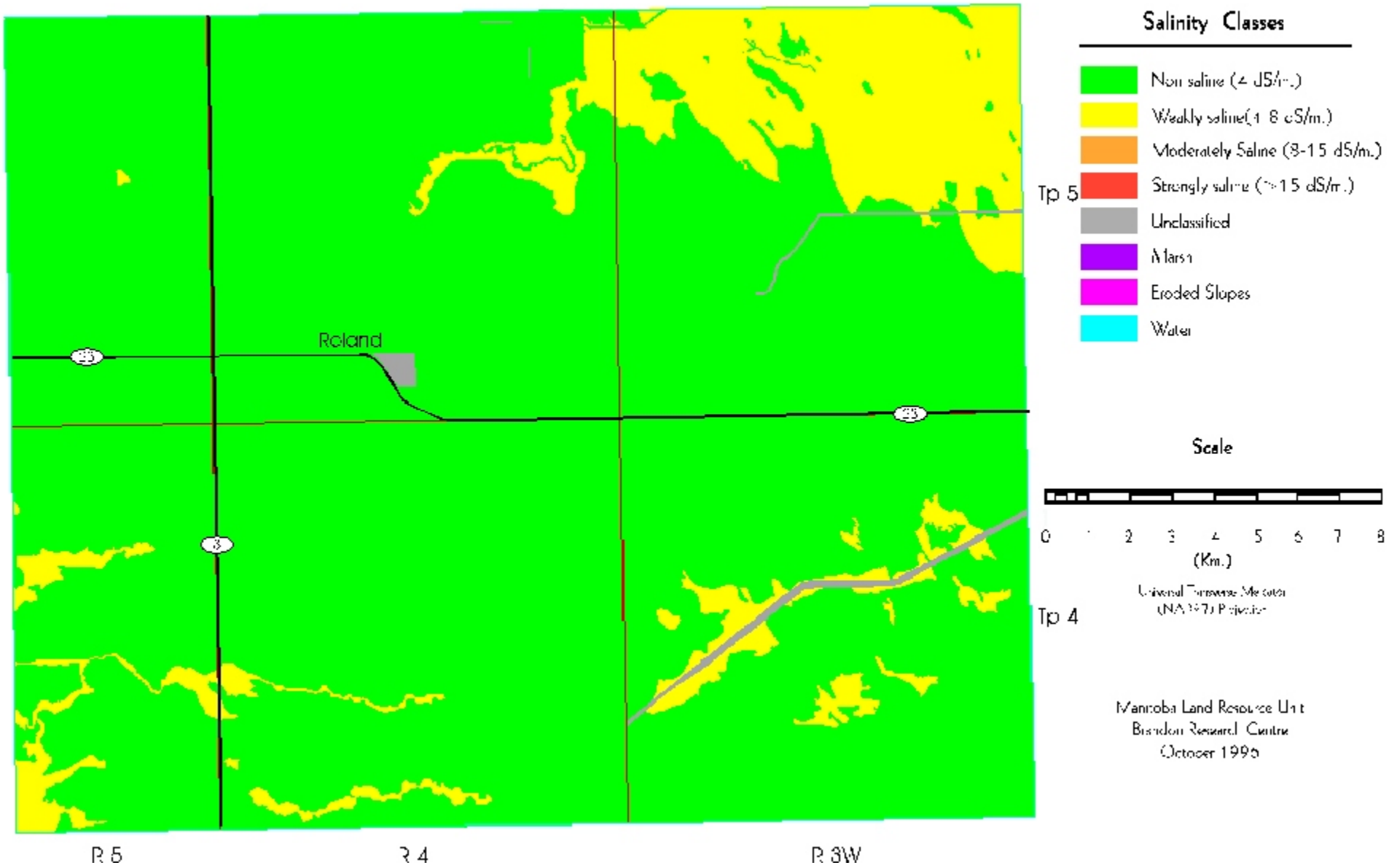
The salinity classification of each individual soil polygon was determined by the most severe salinity classification present within that polygon.

Table 4. Salinity Classes[1]

Salinity Class	Area (ha)	Percent of RM
Non Saline	**42277**	**87.1**
Weakly Saline	**5949**	**12.3**
Moderately Saline	**0**	**0.0**
Strongly Saline	**0**	**0.0**
Eroded Slopes	**0**	**0.0**
Marsh	**0**	**0.0**
Unclassified	**302**	**0.6**
Water	**0**	**0.0**
Total	**48529**	**100.0**

[1] Area has been assigned to the most severe salinity class for each soil polygon.

Soil Salinity Map



Management Considerations Map.

Management consideration maps are provided to focus on awareness of land resource characteristics important to land use. This map does not presume a specific land use. Rather it portrays the most common and wide spread attributes that apply to most soil landscapes in the province.

These maps **highlight attributes** of soil-landscapes that the land manager must consider for any intended land use.

- **Topography**
- **Wetness**
- **Coarse texture**
- **Medium texture**
- **Fine texture**
- **Organic**
- **Bedrock**

F = Fine texture - soil landscapes that have **fine textured soils (clays and silty clays)**, and thus low infiltration and internal permeability, require special considerations to mitigate surface ponding (water logging), runoff, trafficability. Timing and type of tillage practices used may be restricted.

C = Coarse texture - soil landscapes that have **coarse to very coarse textured soils (loamy sands, sands and gravels)**, and hence a high permeability throughout the profile, require special management practices related to application of agricultural chemicals, animal wastes, and municipal effluent to protect and sustain the long term quality of the soil and water resources. The risk of soil erosion can be minimized through the use of shelterbelts and maintenance of crop residues.

M = Medium texture - soil landscapes that have medium to moderately fine texture **(loams to clay loams)**, and hence have good water and nutrient retention properties, require good management and cropping practices to minimize leaching and the risk of erosion.

T = Topography - soil landscapes with **slopes greater than 5 %** are steep enough to require special management practices to minimize the risk of erosion.

W = Wetness - soil landscapes that have **poorly drained soils and/or >50 % wetlands** (due to seasonal and annual flooding, surface ponding, permanent water bodies (sloughs), and/or high water tables), require special management practices to mitigate adverse impact on water quality, protect subsurface aquifers, and sustain crop production during periods of high risk of water logging.

O = Organic - soil landscapes that have organic soils, require special management considerations of drainage, tillage, and cropping to sustain productivity and minimize subsidence and erosion.

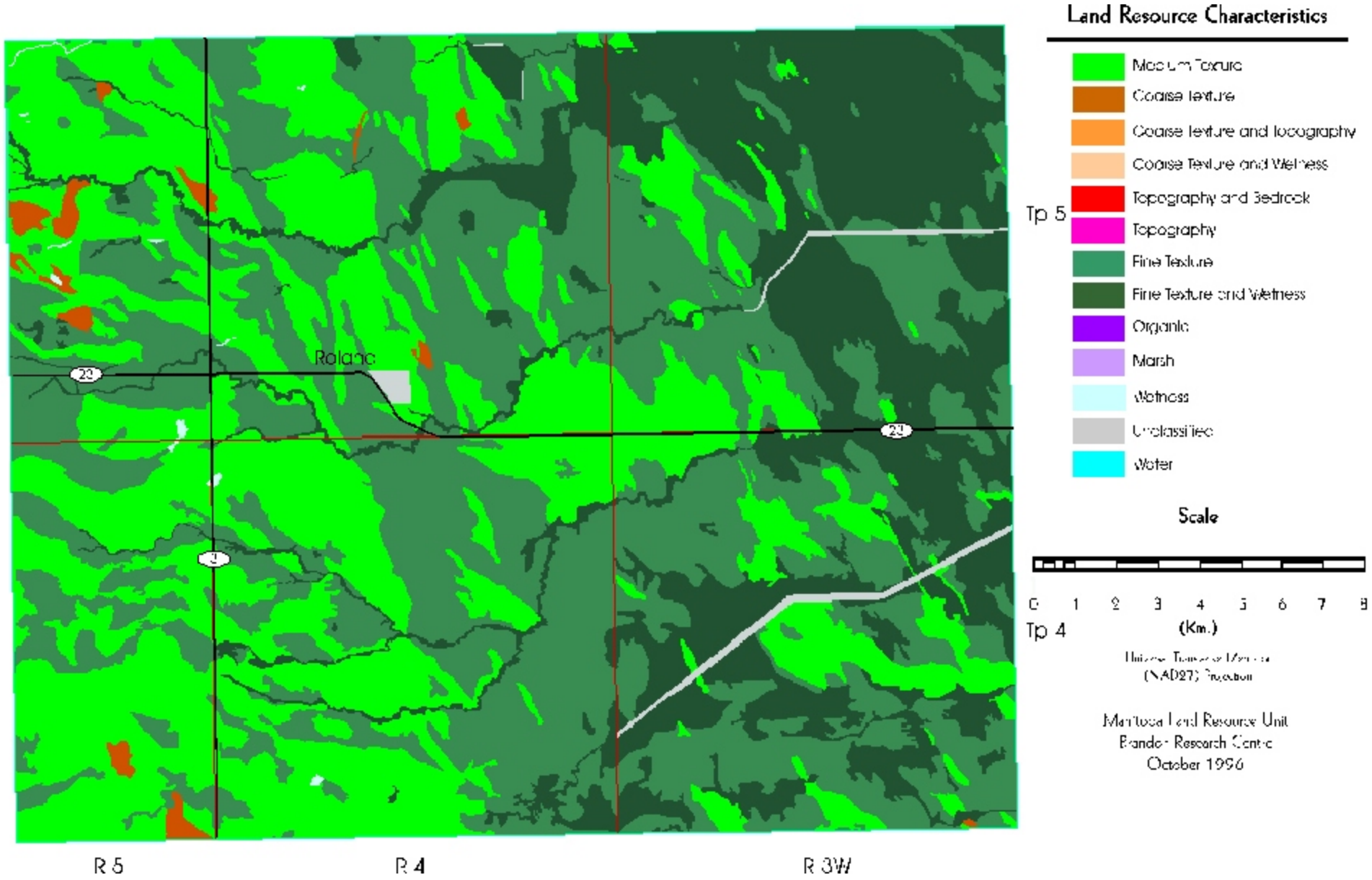
R = Bedrock - soil landscapes that have shallow depth to bedrock (≤ 50 cm) and/or exposed bedrock which may prevent the use of some or all tillage practices as well as the range of potential crop. They require special cropping and management practices to sustain agricultural production.

Table 5. Management Considerations[1]

Land Resource Characteristics	Area (ha)	Percent of RM
Fine Texture	**19773**	**40.7**
Fine Texture and Wetness	**10940**	**22.5**
Fine Texture and Topography	**0**	**0.0**
Medium Texture	**17051**	**35.1**
Coarse Texture	**408**	**0.8**
Coarse Texture and Wetness	**0**	**0.0**
Coarse Texture and Topography	**0**	**0.0**
Topography	**0**	**0.0**
Bedrock	**0**	**0.0**
Wetness	**55**	**0.1**
Organic	**0**	**0.0**
Marsh	**0**	**0.0**
Unclassified	**302**	**0.6**
Water	**0**	**0.0**
Total	**48529**	**100.0**

[1] Based on **dominant** soil series for each soil polygon.

Management Considerations Map



Agricultural Capability Map.

This evaluation utilizes the 7 class Canada Land Inventory system (CLI, 1965). Classes 1 to 3 represent the prime agricultural land, class 4 land is marginal for sustained cultivation, class 5 land is capable of perennial forages and improvement is feasible, class 6 land is capable of producing native forages and pasture but improvement is not feasible, and class 7 land is considered unsuitable for dryland agriculture. Subclass modifers include structure and/or permeability (D), erosion (E), inundation (I), moisture limitation (M), salinity (N), stoniness (P), consolidated bedrock (R), topography (T), excess water (W) and cumulative minor adverse characteristics (X).

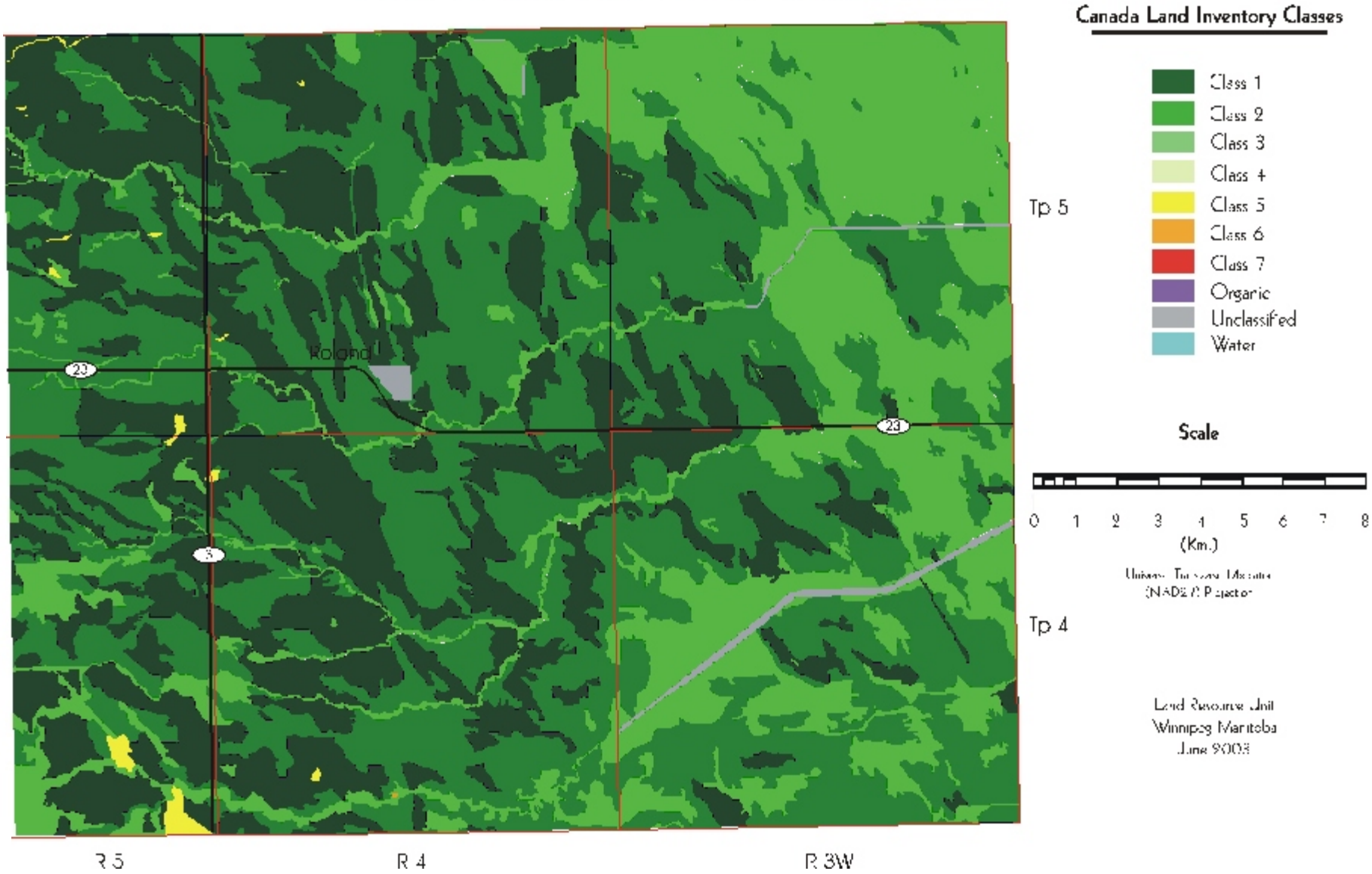
This generalized interpretive map is based on the dominant soil series and phases for each soil polygon. The CLI subclass limitations cannot be portrayed at this generalized map scale.

Table 6. Agricultural Capability[1]

Class Subclass	Area (ha)	Percent of RM
1	**14147**	**29.1**
2	**21535**	**44.3**
2D	17	0.0
2DW	117	0.2
2M	1633	3.4
2MT	26	0.1
2T	22	0.0
2W	19687	40.5
2X	32	0.1
3	**12431**	**25.6**
3D	100	0.2
3I	121	0.2
3M	263	0.5
3N	603	1.2
3NI	366	0.8
3NW	1252	2.6
3W	9726	20.0
5	**157**	**0.3**
5M	103	0.2
5W	44	0.1
5WI	11	0.0
6	**1**	**0.0**
6W	1	0.0
Unclassified	**302**	**0.6**
Organic	**0**	**0.0**
Total	**48573**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of each soil polygon.

Agriculture Capability Map



Irrigation Suitability Map.

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.

Irrigation suitability is a four class rating system. Areas with no or slight soil and/or landscape limitations are rated **Excellent** to **Good** and can be considered irrigable. Areas with moderate soil and/or landscape limitations are rated as **Fair** and considered marginal for irrigation providing adequate management exists so that the soil and adjacent areas are not adversely affected by water application. Soil and landscape areas rated as **Poor** have severe limitations for irrigation.

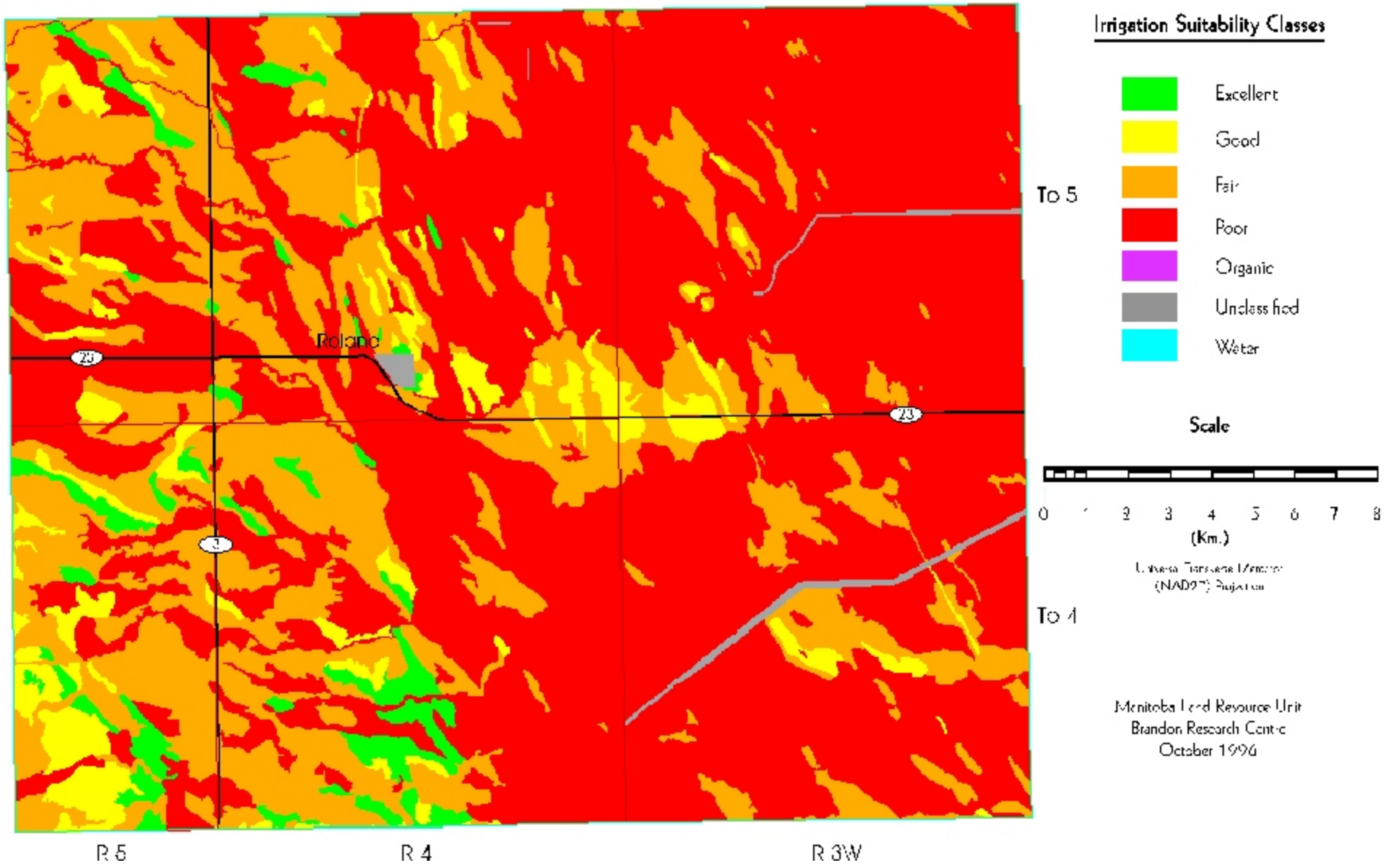
This generalized interpretive map is based on the dominant soil series for each soil polygon, in combination with the dominant slope class. The nature of the subclass limitations and the classification of subdominant components is not shown at this generalized map scale.

Table 7. Irrigation Suitability[1]

Class	Area (ha)	Percent of RM
Excellent	**1392**	**2.9**
Good	**2536**	**5.2**
Fair	**14015**	**28.9**
Poor	**30284**	**62.4**
Organic	**0**	**0.0**
Unclassified	**302**	**0.6**
Water	**0**	**0.0**
Total	**48529**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of each soil polygon.

Irrigation Suitability Map



Potential Environmental Impact Under Irrigation Map.

A major concern for land under irrigated crop production is the possibility that surface and/or ground water 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. Several factors are specifically considered: soil texture, hydraulic conductivity, salinity, geological uniformity, depth to water table and topography. The risk of altering surface and subsurface soil drainage regimes, soil salinity, potential for runoff, erosion and 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.

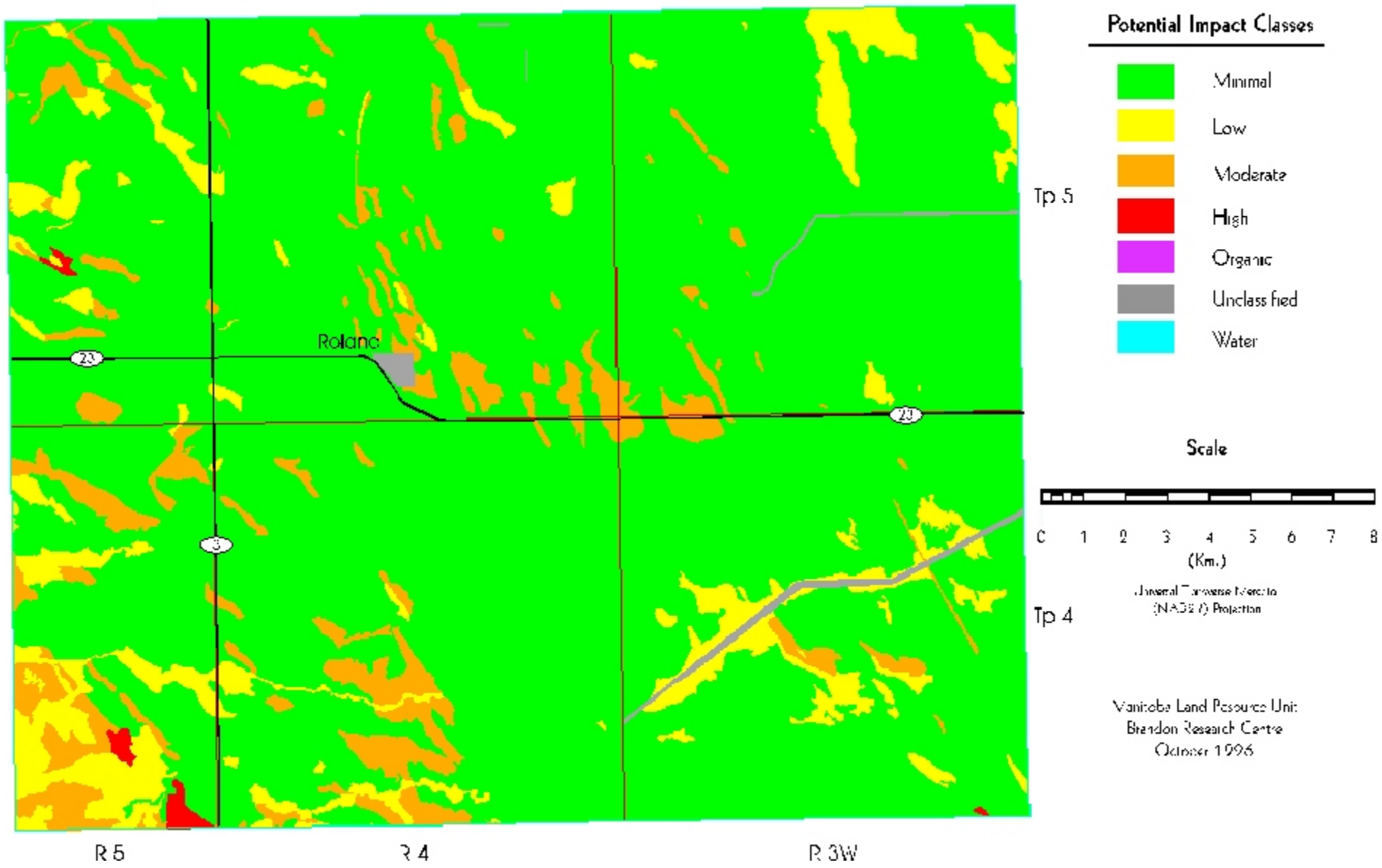
This generalized interpretive map is based on the dominant soil series and slope class for each soil polygon. The nature of the subclass limitations, and the classification of subdominant components is not shown at this generalized map scale.

Table 8. Potential Environmental Impact Under Irrigation[1]

Class	Area (ha)	Percent of RM
Minimal	**41251**	**85.0**
Low	**3615**	**7.5**
Moderate	**3227**	**6.6**
High	**134**	**0.3**
Organic	**0**	**0.0**
Unclassified	**302**	**0.6**
Water	**0**	**0.0**
Total	**48529**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of each soil polygon.

Potential Environmental Impact Under Irrigation



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.

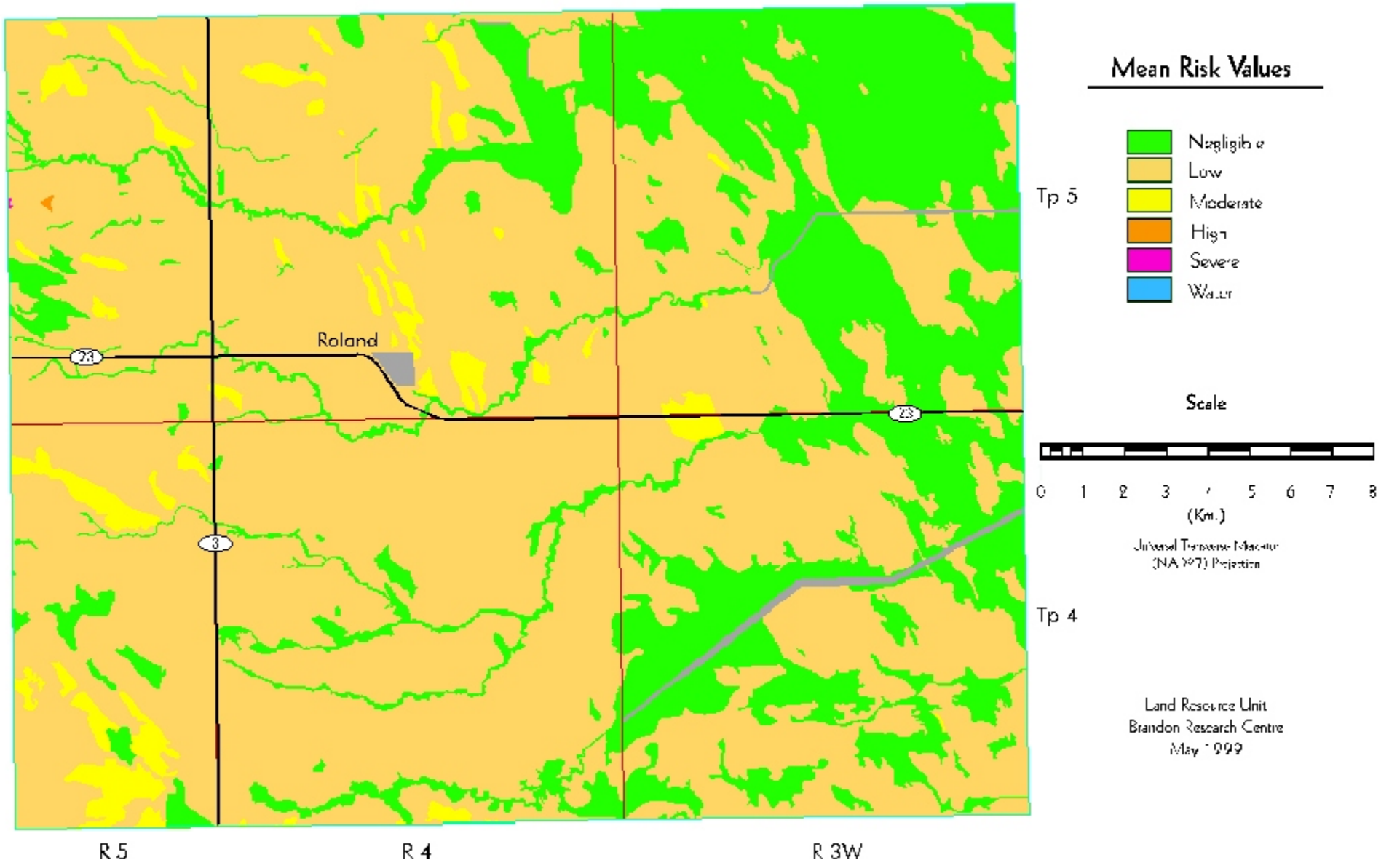
Cropping and residue management practices will significantly reduce this risk depending on crop rotation program, soil type, and landscape features.

Table 9. Water Erosion Risk[1]

Class	Area (ha)	Percent of RM
Negligible	**12154**	**25.0**
Low	**34427**	**70.9**
Moderate	**1636**	**3.4**
High	**7**	**0.0**
Severe	**3**	**0.0**
Unclassified	**302**	**0.6**
Water	**0**	**0.0**
Total	**48529**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of each soil polygon.

Water Erosion Risk Map



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:

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.

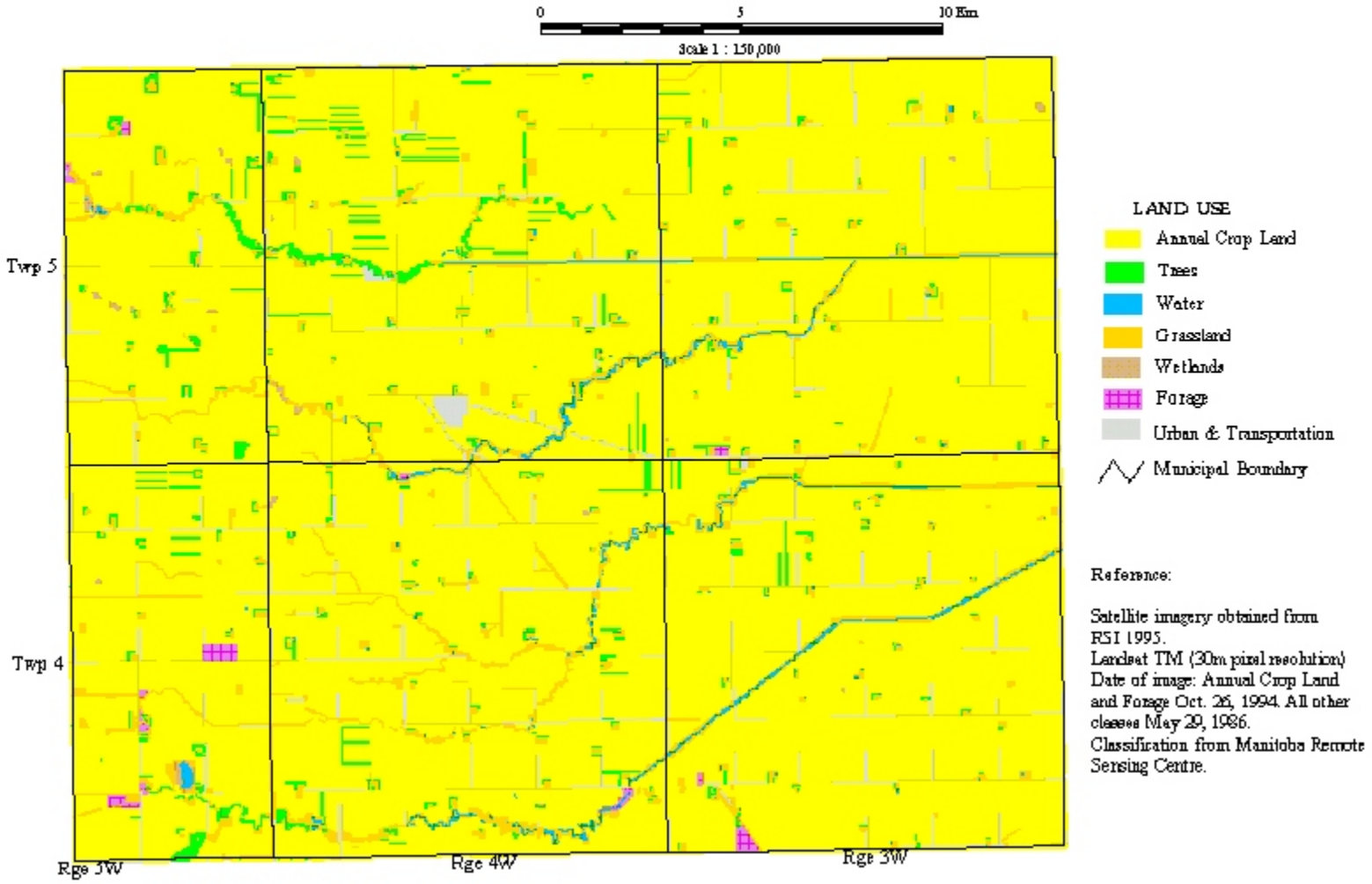
Urban and Transportation - towns, roads, railways, quarries.

Table 10. Land Use[1]

Class	Area (ha)	Percent of RM
Annual Crop Land	**44087**	**90.0**
Forage	**121**	**0.2**
Grasslands	**1951**	**4.0**
Trees	**633**	**1.3**
Wetlands	**44**	**0.1**
Water	**254**	**0.5**
Urban and Transportation	**1897**	**3.9**
Total	**48987**	**100.0**

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

RURAL MUNICIPALITY OF ROLAND
LAND USE



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