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Rural Municipality of Riverside


Information Bulletin 96-4

Soils and Terrain

An introduction
to the land resource

Land Resource Unit
Brandon Research Centre



Canada 

Rural Municipality of Riverside

Information Bulletin 96-4

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

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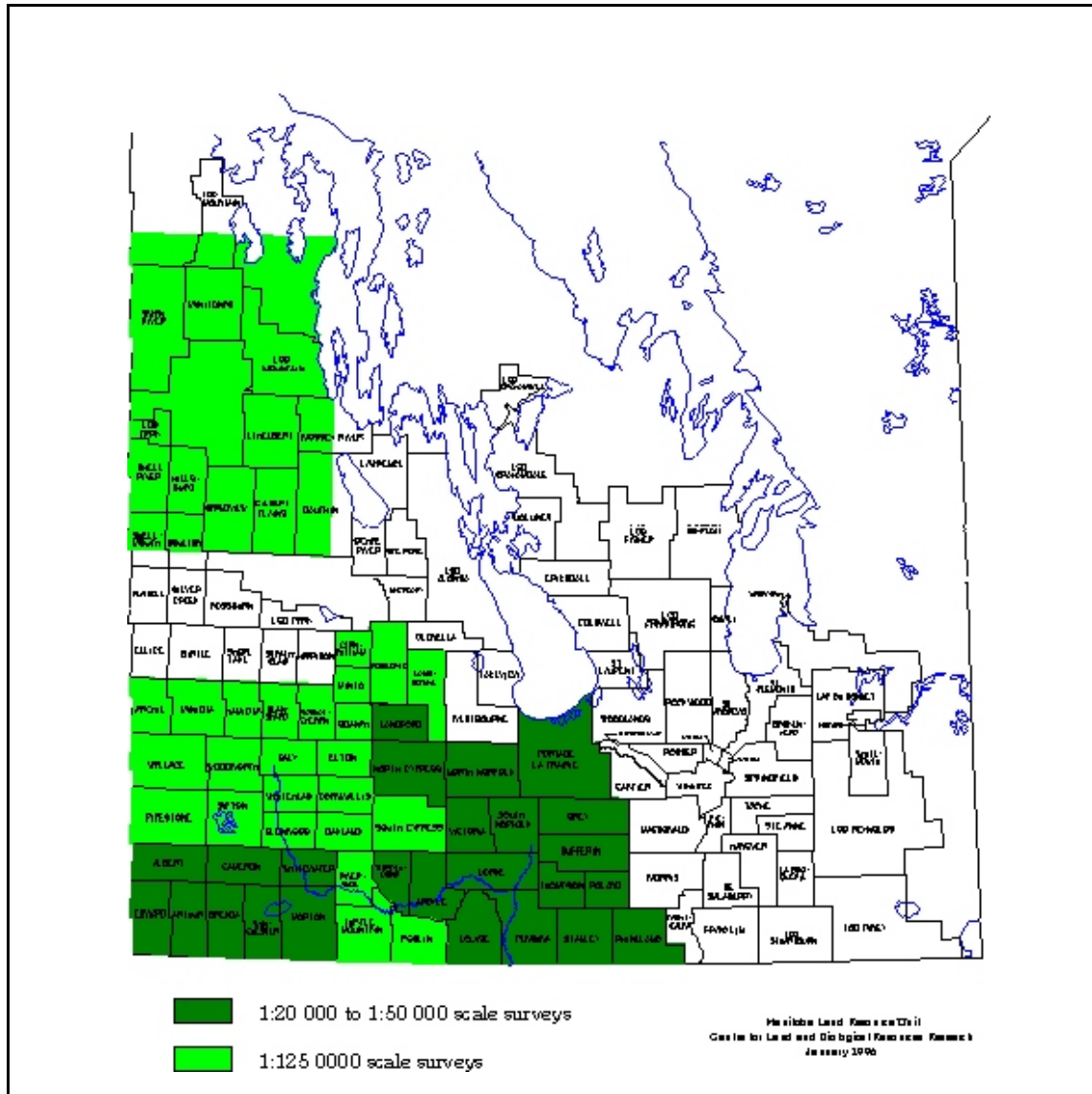


Figure 3. Rural municipalities in southern Manitoba with digital soil and terrain map information (1996).

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.

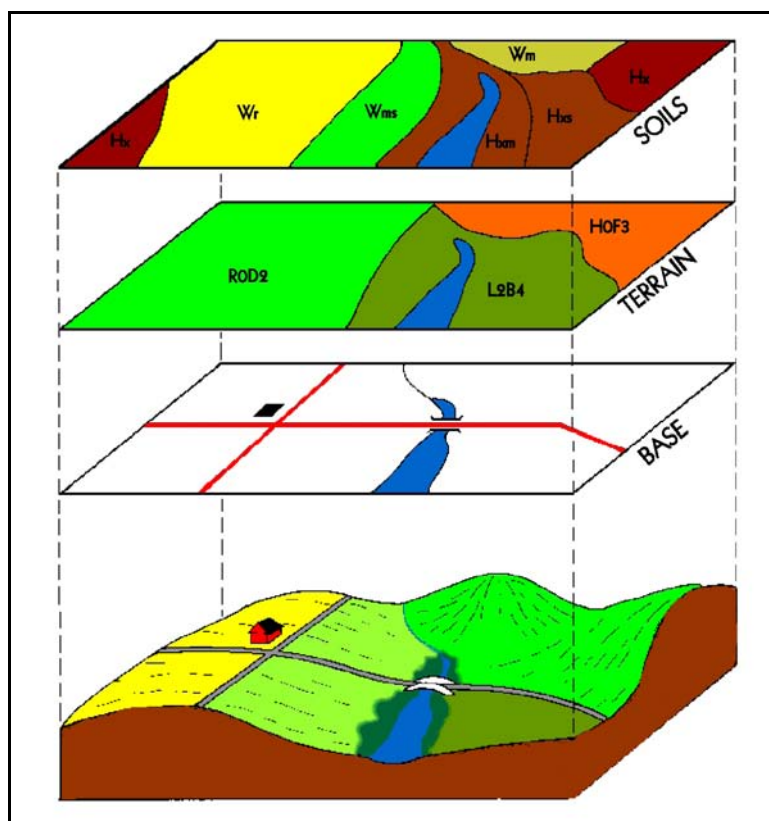


Figure 2. Soil, Terrain, and Base Map data.

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:

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

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 Riverside covers 6.1 Townships (approximately 58,800 ha) in south-western Manitoba. The town of Ninette is the largest population centre in the municipality. Land use within the municipality is predominantly cereal production in the area south of the Pembina River, and mainly livestock production, forage and woodland north of the river.

Soils in the municipality have been mapped previously in the Reconnaissance Soil Survey of South-Central Manitoba (Ellis and Shafer, 1943).

Based on climatic data from Boissevain (Environment Canada, 1982), mean annual temperature is 2.7°C; mean annual precipitation is 502 mm; frost-free period is 121 days; and degree days above 5°C is 1756. Average seasonal moisture deficit for the period May to September is 200 to 250 mm and effective growing degree days (EGDD) above 5°C are above 1500 for the same period (Agronomic Interpretations Working Group, 1995).

The area can be divided into two significant eco-climatic regions. The southern portion of the RM (70 %) in the Boissevain Plain (referred to as the Waskada Till Plain in published soil reports) has an average elevation of 450 to 480 masl. Relief in this area is generally less than 3 m with slopes usually less than 9 % in hummocky, undulating, and ridged terrain. The area north of the Pembina River Valley is represented by the Tiger Hills Upland at elevations ranging from 450 to 470 masl; relief is greater in this upland characterized by undulating and sharply hummocky surface forms with slopes up to 30 %. The dominant soils in the Boissevain Plain are Black Chernozems in well to imperfectly drained areas and Humic Gleysols in poorly drained depressions. Higher elevations in the Tiger Hills are characterized by Orthic Dark Gray and Orthic Black Chernozems in well drained upper and mid slope positions and Gleyed Dark Gray and Black soils on imperfectly drained lower slopes. Gleysolic soils occur in depressional sites with poor drainage.

Soils of the Boissevain Plain are developed on strongly calcareous loam to clay loam glacial till derived from local bedrock (shale), limestone, and granitic sources (Waskada Association), as well as on water-modified till deposits (Heaslip Complex) in the area adjacent to the Pembina Valley. Soils of the Waskada Association, undulating phase are dominant (38% of RM), generally ranging in agricultural capability from 2 to 3 with topography being the most common limiting factor. Localized areas of class 5 to 7 soils occur within this area but are restricted to areas of high soil erosion or wetness. Due to the uneven terrain and the occurrence of salts within the soil profile much of this area is rated as good to fair for irrigation; the potential for environmental impact under irrigation is low to moderate. Risk of water erosion on the Waskada soils varies from moderate to severe depending on the slope gradient.

Soils of the Heaslip Complex occupy 24 % of the RM area. These soils are mainly imperfectly drained and vary in surface texture from sandy loam to clay loam due to water-modification of the soil surface. A thin gravel layer commonly occurs in the water-worked surface above the contact with the underlying till. Agricultural capability of the Heaslip Association is generally class 3 due to a low water retention capacity. Suitability for irrigation is good to fair but the potential for environmental impact is high due to the permeable nature of the surface soil. However, the rapid permeability and low relief common to these soils decreases the risk of water erosion when compared to the adjacent Waskada soils.

Soils in the Tiger Hills Upland cover 22% of the municipality and are developed on very strongly to extremely calcareous glacial till derived from dominantly limestone and granitic rock. The Tiger Hills Association occurs mainly at higher elevations on wooded portions of the upland whereas soils of the Hilton Association occur at slightly lower elevations. Generally, the Tiger Hills and the Hilton soils range in agricultural capability from class 2 to 5 depending on the topography and degree of soil erosion. Localized areas of class 6 and 7 land occur within the area. Due to the uneven terrain, irrigation suitability is fair to poor with a high potential for environmental impact. These soils have a high risk of water erosion due to the complex, steeply sloping topography and generally thin

soil profiles. Land use is dominantly native pasture, woodland grazing and forage production for livestock.

The Pembina River Valley crossing the northern part of the RM is a glacial meltwater channel varying in width from 1.7 to 3.2 km. The valley has cut some 60 m below the land surface of the municipality. The soils in the valley are mapped as the Eroded Slopes Complex with dominantly Regosolic soils on the steep slopes and Gleyed Cumulic Regosol soils on the river bottom alluvial deposits. The side slopes remain under natural vegetation of grass and woodland, and have an agricultural capability of 6 and 7T. Some of the undulating alluvial bottom lands are suitable for agriculture and have been given a general rating of class 3. The irrigation suitability of the bottom lands is fair to poor. Land use is mainly cereal and forage production with some livestock grazing.

The Souris River flows north from the Pembina River Valley in a broad meltwater channel with a width of 1.1 to 3.1 km and a depth of 65 to 70 m. The soils are mapped as the Eroded Slopes Complex and are similar to the soils along the Pembina Valley. The valley sidewalls are steep and have an agricultural capability of class 7T. There is relatively little alluvial floodplain in this valley. Land use is dominantly native grass and woodland providing limited pasture for livestock.

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 combined which was 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 interpretive maps, and the primary soil and terrain map data, can be obtained by contacting the Manitoba Land Resource Unit.

Slope Map.

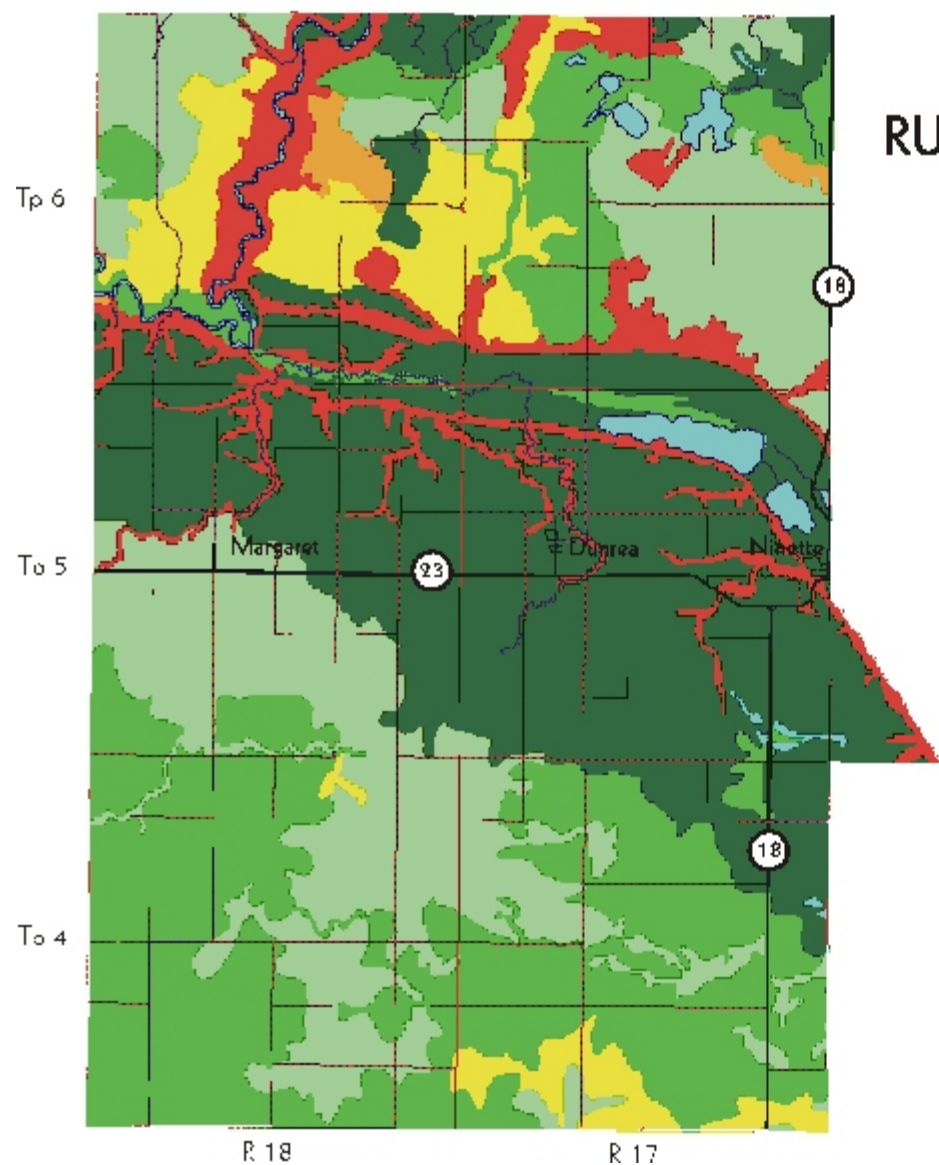
Slope describes the steepness of the landscape surface. The slope classes shown on this map are derived from the digital terrain layer database. Specific colours are used to indicate the most significant, limiting slope class for each terrain polygon in the RM. Additional slope classes can occur in each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

Table 1. Slope Classes¹

Slope Class	Area (ha)	Percent of RM
Water	965	1.6
0 - 2 %	17639	30.0
2 - 5 %	16403	27.9
5 - 9 %	14033	23.9
9 - 15 %	4389	7.5
15 - 30 %	545	0.9
> 30 %	4843	8.2
Total	58816	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.

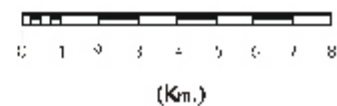
SLOPE MAP for RURAL MUNICIPALITY of RIVERSIDE



Slope Classes

	0 - 2 %
	2 - 5 %
	5 - 9 %
	9 - 15 %
	15 - 30 %
	> 30 %
	Water
	Unclassified

Scale



Manitoba Land Resources Unit
Centre for Land and Biological Resources Research
November 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).

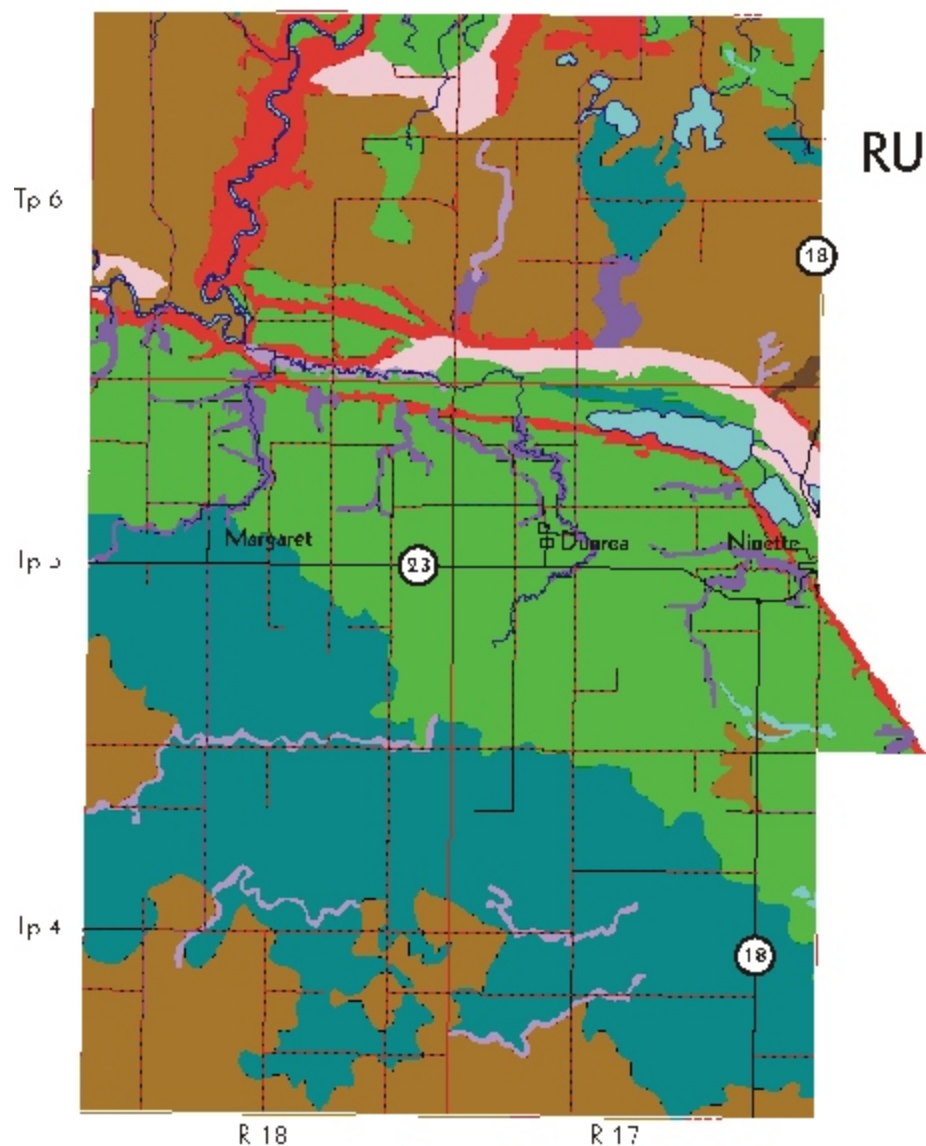
Surface form and slope class are two key features of the digital terrain map layer. Both of these characteristics are important controlling and influencing factors to consider for sustainable land use planning and management.

Table 2. Surface Form and Slope Classes¹

Surface Form Slope Class	Area (ha)	Percent of RM
Hummocky	17731	30.1
C (2.0 to 5.0%)	7793	13.2
D (6.0 to 9.0%)	4823	8.2
E (10.0 to 15.0%)	4217	7.2
F (16.0 to 30.0%)	532	0.9
H (31.0 to 70.0%)	98	0.2
J (> 70.0%)	268	0.5
Inclined	1633	2.8
B (0.5 to 2.0%)	910	1.5
C (2.0 to 5.0%)	409	0.7
D (6.0 to 9.0%)	193	0.3
E (10.0 to 15.0%)	112	0.2
F (16.0 to 30.0%)	9	< 0.1
Ravine	1516	2.6
J (> 70.0%)	1516	2.6
Ridged	16507	28.1
C (2.0 to 5.0%)	7598	12.9
D (6.0 to 9.0%)	8746	14.9
E (10.0 to 15.0%)	60	0.1
H (31.0 to 70.0%)	104	0.2
Steep	2788	4.7
J (> 70.0%)	2788	4.7
Undulating	16729	28.4
B (0.5 to 2.0%)	16729	28.4
Runway	879	1.5
C (2.0 to 5.0%)	604	1.0
D (6.0 to 9.0%)	271	0.5
F (16.0 to 30.0%)	4	< 0.1
Valley	70	0.1
H (31.0 to 70.0%)	70	0.1
Water	965	1.6
Total	58816	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.

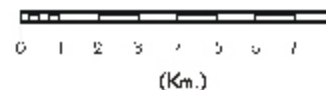
SURFACE FORM MAP for RURAL MUNICIPALITY of RIVERSIDE



Surface Forms

- Water
- Level
- Undulating
- Hummocky
- Inclined
- Terraced
- Runway
- Diked
- Scalloped
- Ridged
- Valley
- Ravine
- Steep
- Slump
- Man Made

Scale



Manitoba Land Resource Unit
Centre for Land and Biological Resources Research
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.

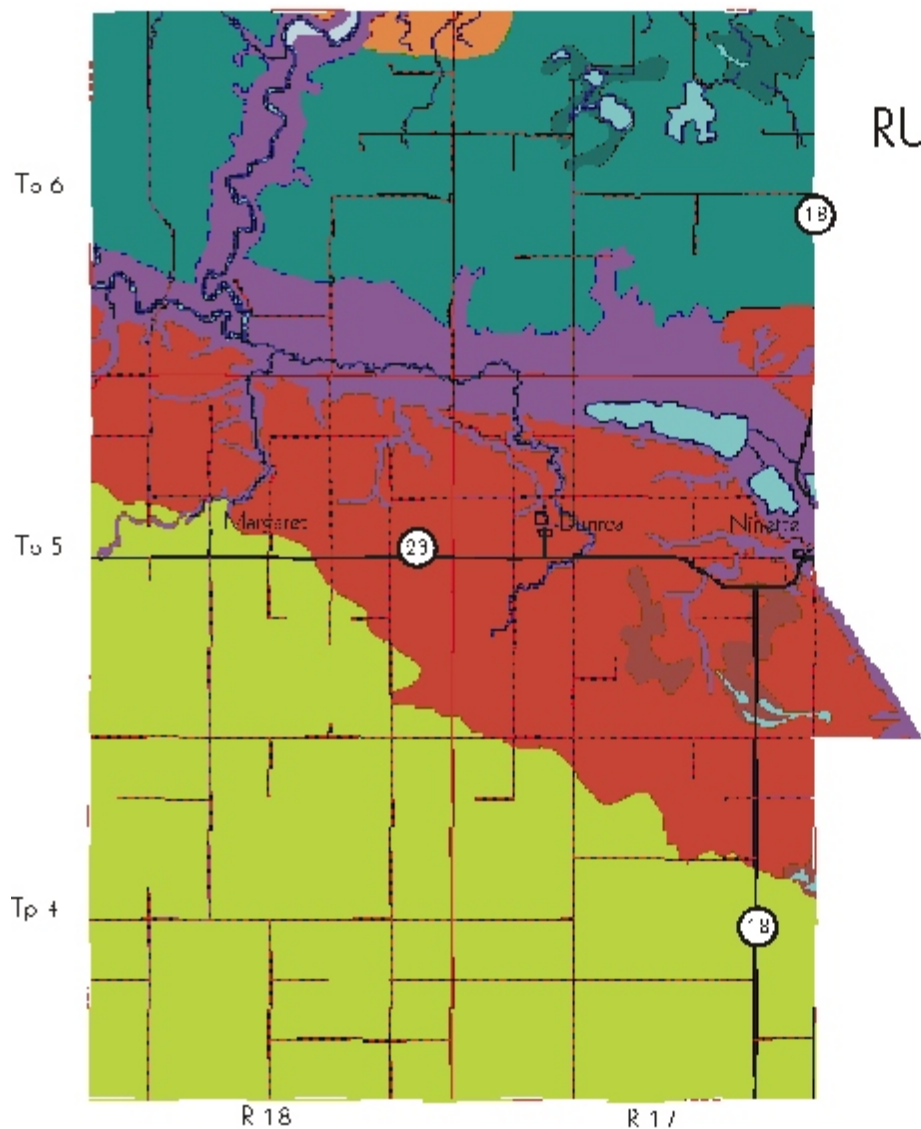
This generalized soil map has been reduced in size and simplified by grouping the original soil association polygons. The groups have been colour themed according to similar modes of origin, texture, and soil drainage. Soils derived from glacial till deposits (typically loam to clay loam in texture) 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 group 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	965	1.6
Eroded Slopes	7709	13.1
Er	7709	13.1
Assiniboine	68	0.1
As	68	0.1
Hilton	12400	21.1
Hn	1662	2.8
Th	10739	18.3
Hilton (s)	691	1.2
Hn (saline)	345	0.6
Th (meadow)	347	0.6
Waskada (undulating)	22079	37.5
Ws	80	0.1
Wu	22000	37.4
Carroll	447	0.8
C	447	0.8
Heaslip Complex	13796	23.5
Hx	12388	21.1
Hx (gravel)	1408	2.4
Heaslip Complex (s)	662	1.1
Hx (meadow)	43	0.1
Hx (saline)	619	1.1
Total	58816	100.0

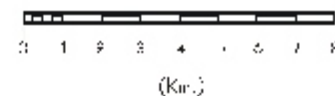
SOIL ASSOCIATION MAP for RURAL MUNICIPALITY of RIVERSIDE



Soil Associations



Scale



Manitoba Land Resource Unit
Centre for Land and Biological Resources Research
November 1994

Agricultural Capability Map.

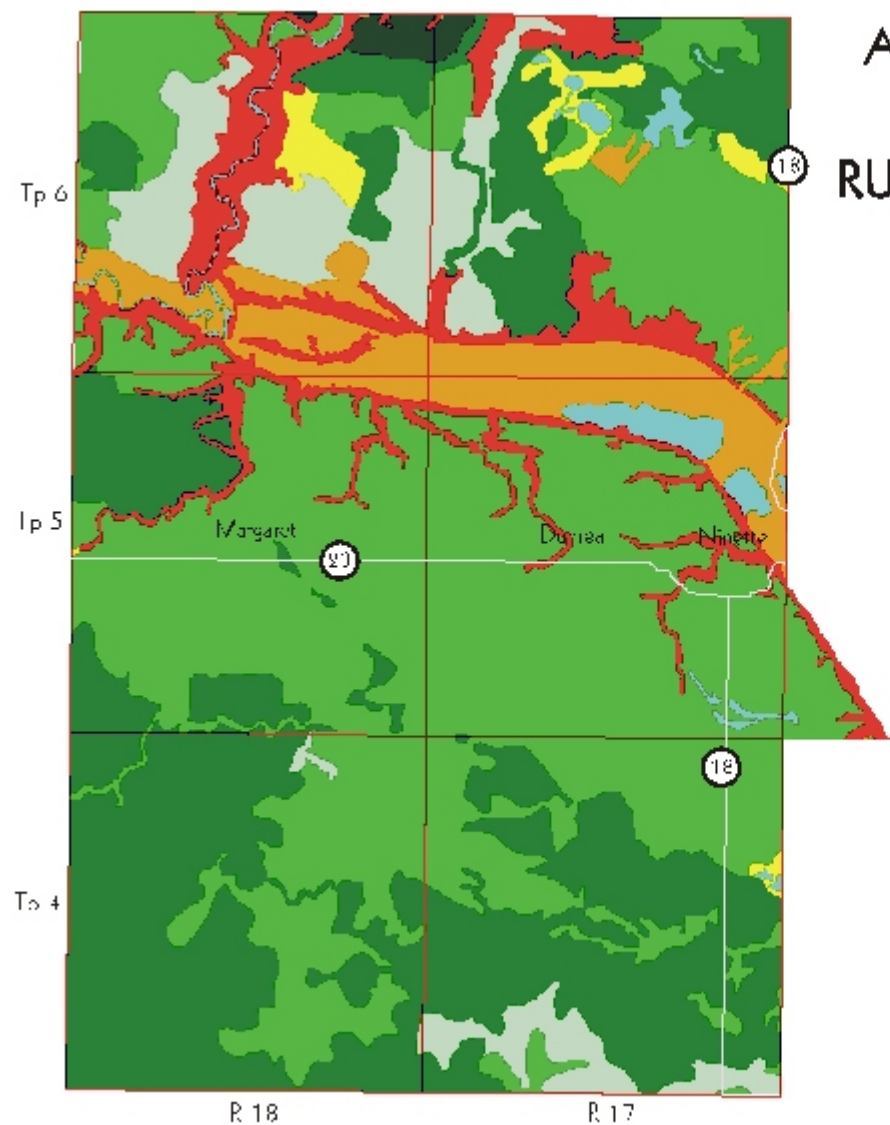
This evaluation utilizes the 7 class Canada Land Inventory system (CLI, 1965). Classes 1 to 3 represent the prime agricultural land, classes 4 and 5 represent marginal lands, and classes 6 and 7 are considered unsuitable for dryland agriculture.

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 Capability¹

Class Subclass	Area (ha)	Percent of RM
1	355	0.6
2	17334	29.4
2T	14904	25.3
2TW	29	0.0
2W	1490	2.5
2X	910	1.5
3	26699	45.3
3I	68	0.1
3M	12094	20.5
3MT	519	0.9
3N	617	1.0
3T	13401	22.7
4	4310	7.3
4T	4310	7.3
5	932	1.6
5	89	0.2
5T	540	0.9
5W	303	0.5
6	3753	6.4
6T	3753	6.4
7	4581	7.8
7	35	0.1
7T	4546	7.7
Water	964	1.6
Total	58928	100.0

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

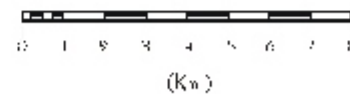


AGRICULTURE CAPABILITY MAP for RURAL MUNICIPALITY of RIVERSIDE

Canada Land Inventory Classes

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Water
- Unclassified

Scale



Manitoba Land Resource Unit
Winnipeg, Manitoba
June 2003

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.

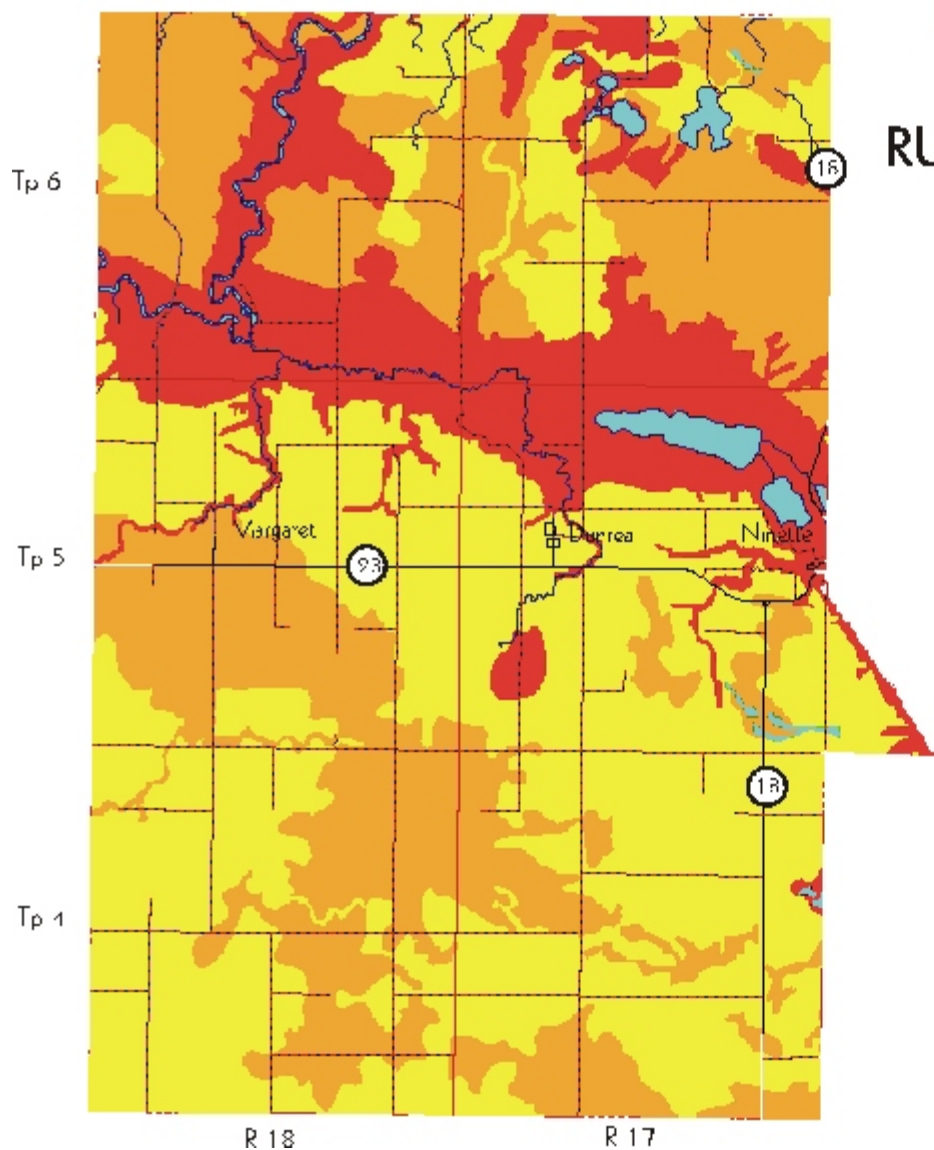
This generalized interpretive map is based on the dominant soil series for each soil polygon, in combination with the dominant slope class from the terrain layer database. The nature of the subclass limitations, and the classification of subdominant components is not shown at this generalized map scale.

Table 5. Irrigation Suitability¹

Class	Area (ha)	Percent of RM
Excellent	0	0.0
Good	28063	47.7
Fair	19134	32.5
Poor	10655	18.1
Organic	0	0.0
Water	965	1.6
Unclassified	0	0.0
Total	58816	100.0

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

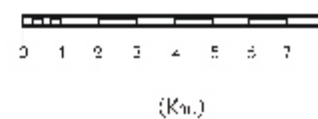
IRRIGATION SUITABILITY MAP for RURAL MUNICIPALITY of RIVERSIDE



Irrigation Suitability Classes

Green	Excellent
Yellow	Good
Orange	Fair
Red	Poor
Blue	Water
Grey	Unclassified

Scale



Manitoba Land Resource Unit
Centre for Land and Biological Resources Research
March 1996

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.

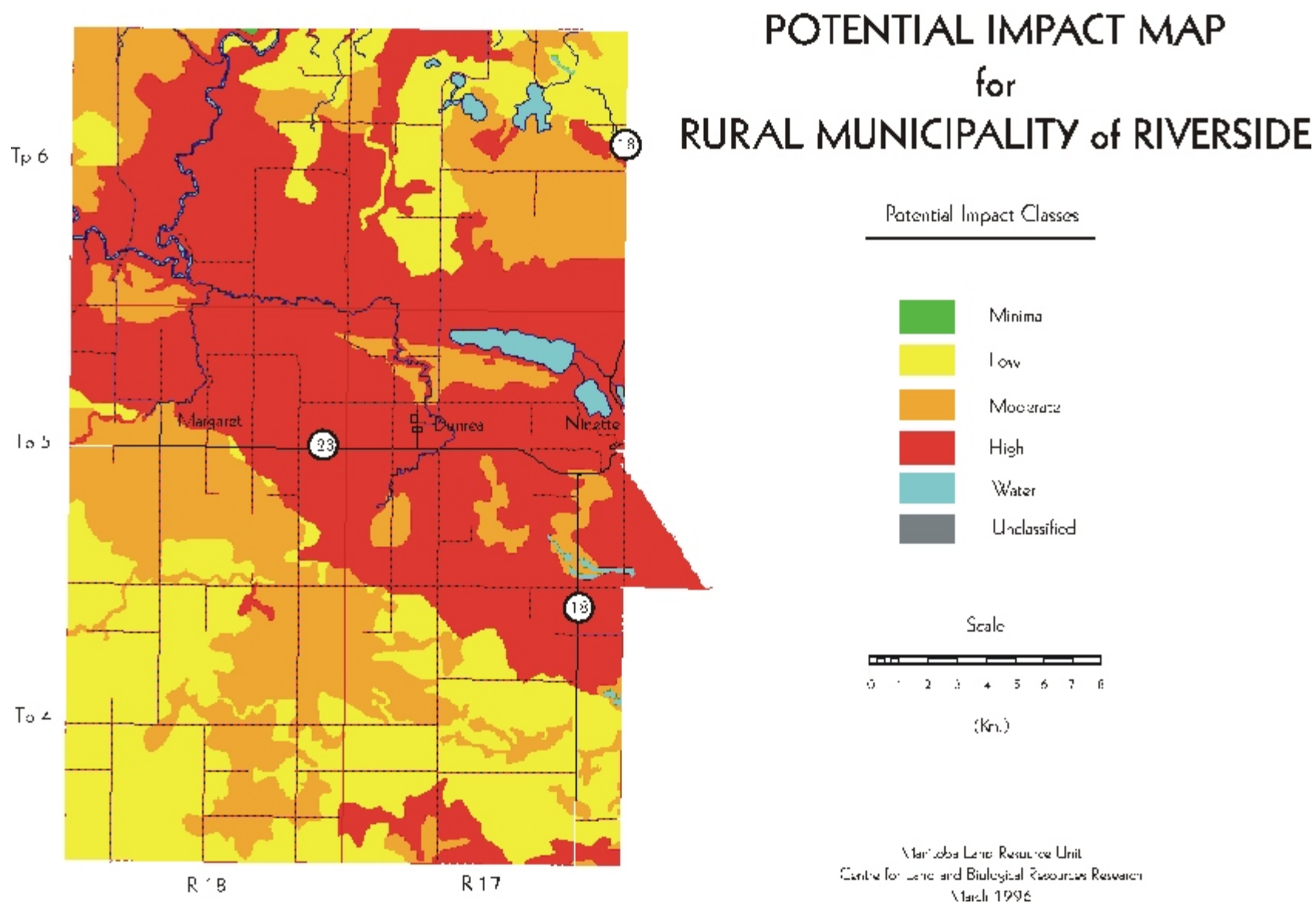
Use of this rating is intended to serve as a warning of potential environmental concern. It may be possible to design and/or give special consideration to soil-water-crop management practices that will mitigate any adverse impact.

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 Irrigation¹

Class	Area (ha)	Percent of RM
Minimal	13	0.0
Low	16857	28.7
Moderate	15461	26.3
High	25522	43.4
Organic	0	0.0
Water	965	1.6
Unclassified	0	0.0
Total	58816	100.0

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



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:

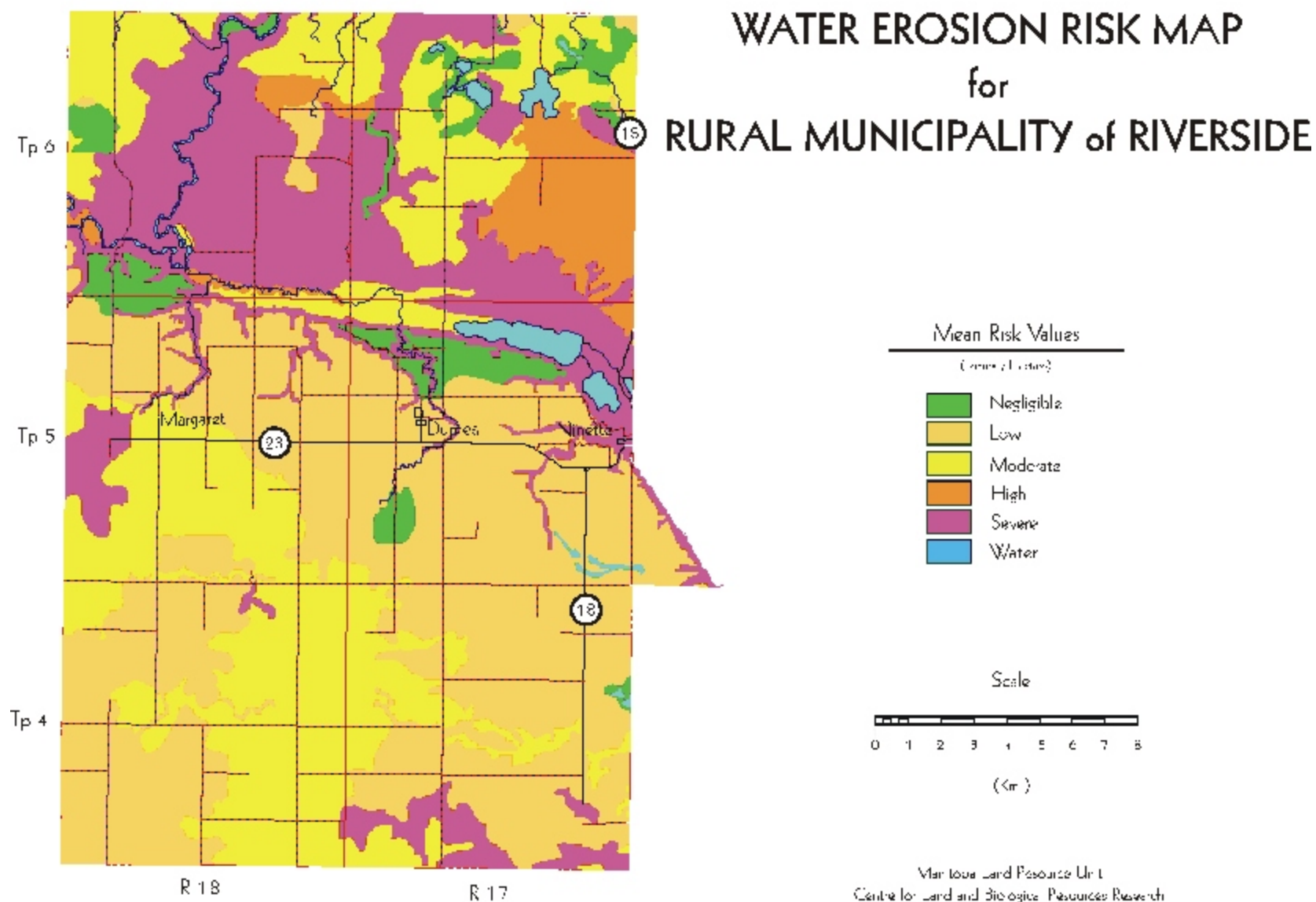
negligible
low
moderate
high
severe

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

Table 7. Water Erosion Risk¹

Class	Area (ha)	Percent of RM
Negligible	2578	4.4
Low	22878	38.9
Moderate	16537	28.1
High	2903	4.9
Severe	12956	22.0
Water	965	1.6
Unclassified	0	0.0
Total	58816	100.0

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



REFERENCES

Agronomic Interpretations Working Group. 1995. Land Suitability Rating System for Agricultural Crops: 1. Spring-seeded Small Grains. Edited by W.W. Pettapiece. Tech. Bull. 1995-6E. Centre for Land and Biological Resources Research, Agriculture and Agri-Food Canada, Ottawa. 90 pages, 2 maps.

Canada Land Inventory. 1965. Soil Capability Classification for Agriculture. Canada Land Inventory Report No. 2. ARDA, Dept. of Forestry, Canada, Ottawa.

Ellis, J.H., and Shafer, W.H. 1943. Reconnaissance Soil Survey of South-Central Manitoba. Soils Report No. 4. Manitoba Soil Survey. Published by Manitoba Dept. of Agriculture. 146pp and map.

Environment Canada. 1982. Canadian Climatic Normals 1951-1980. 1- Temperatures, Vol. 2; 2- Precipitation, Vol. 3; 3- Frost, Vol. 6; 4- Degree Days, Vol. 4. Atmospheric Environment, Downsview, Ontario.

Expert Committee on Soil Survey. 1987. The Canadian System of Soil Classification. Second Edition. Publ. No. 1646. Research Branch, Agriculture Canada.

MacDonald, K.B., and K.W.G. Valentine. 1992. CanSIS Manual 1 CanSIS/NSDB: A General Description. Land Resource Division, Centre for Land and Biological Resources Research, Research Branch, Agriculture Canada, Ottawa.

Manitoba Land Resource Unit. 1996. Soil and Terrain Classification System Manual. In preparation. Ellis Bldg. University of Manitoba. Winnipeg.

PFRA. 1964. Handbook for the Classification of Irrigated Land on the Prairie Provinces. PFRA, Regina, Saskatchewan.

Podolsky, G. 1985. Soils of the Souris, Virden and Wawanesa Townsites. Report No. D56. Canada-Manitoba Soil Survey. Winnipeg.

Wishmeier, W.H. and Smith, D.D. 1965. Predicting Rainfall-erosion Loss from Cropland East of the Rocky Mountains. U.S. Department of Agriculture, Agriculture Handbook No. 282, U.S. Government Printing Office, Washington, D.C.

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 Use¹

Class	Area (ha)	Percent of RM
Annual Crop Land	36148	60.9
Forage	1414	2.4
Grasslands	7725	13.0
Trees	6712	11.3
Wetlands	3057	5.1
Water	987	1.7
Urban and Transportation	3356	5.6
Total	59399	100.0

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

