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Rural Municipality of Daly


Information Bulletin 96-12

Soils and Terrain

An introduction
to the land resource

Land Resource Unit
Brandon Research Centre



Canada 

Rural Municipality of Daly

Information Bulletin 96-12

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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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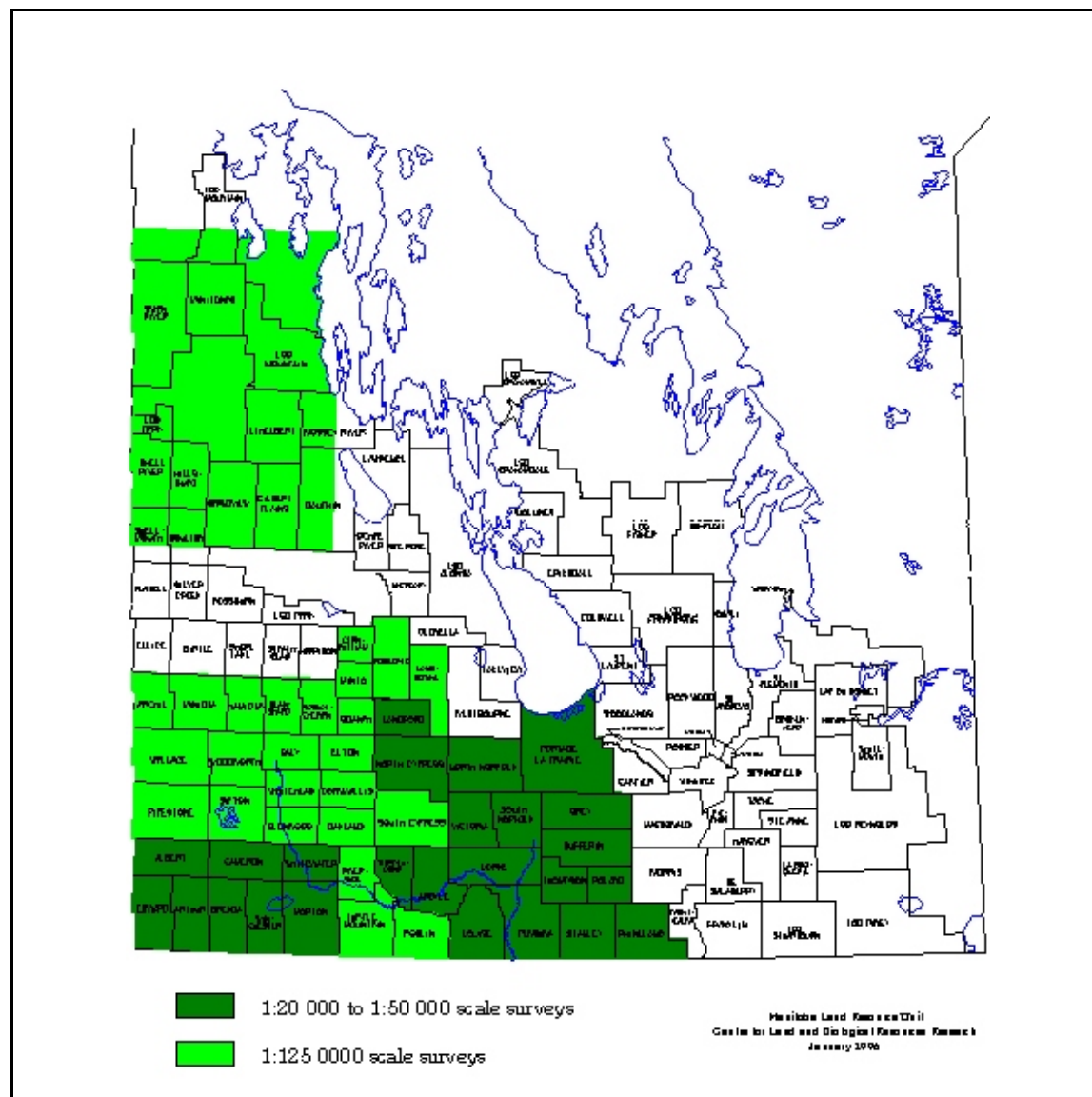


Figure 3. Rural municipalities in southern Manitoba with digital soil and terrain map information (1996).

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.

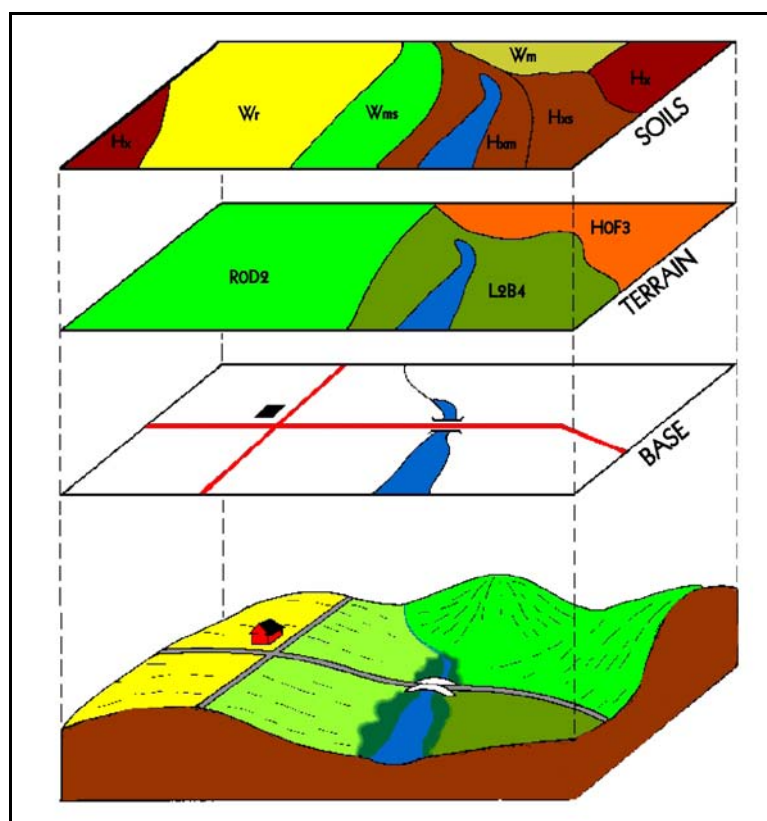


Figure 2. Soil, Terrain, and Base Map data.

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 airphoto 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 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.

SOIL AND TERRAIN OVERVIEW

The Rural Municipality (RM) of Daly covers 6 Townships (approximately 58 000 ha) in southwestern Manitoba. The Town of Rivers is the largest population centre. Land use is predominantly agriculture.

Soils in the Rural Municipality of Daly have been previously mapped (at 1:126 720 scale) in the Reconnaissance Soil Survey of the Rosburn and Virden Map Sheet Areas (Ehrlich et al., 1956).

Based on climatic data from Hamiota (Environment Canada, 1982), the mean annual temperature is 1.6°C; mean annual precipitation is 426 mm; frost-free period is 110 days; and degree days above 5°C is 1626. The seasonal moisture deficit for the period May to September is 250 to 300 mm; effective growing degree days (EGDD) above 5°C for the same period is approximately 1400. This parameter provides an indication of heat energy available for crop growth (Agronomic Interpretations Working Group, 1995). These conditions are generally adequate for cereal crop production.

The municipality is situated within the Antler River-Lake Souris Plain (Lake Souris Basin in published soil reports) and the southern portion of the Newdale Plain (Newdale Till Plain in published soil reports). The Assiniboine and Little Saskatchewan River valleys, both former glacial meltwater channels, are prominent features in the landscape. The Assiniboine valley, the larger of the two, varies from 2 to 4.3 km in width and has a depth of about 50 m. The Newdale Plain occupies the northern portion of the RM, generally at elevations above 470 masl. This hummocky to undulating landscape is characterized by local relief of 3 m and slopes up to 9%. Surface deposits consist of strongly calcareous, loam to clay loam till derived from shale, limestone and granitic rock material. A major portion of the RM consists of fluvial and lacustrine materials characterized by less than 3 m local relief with slopes generally less than 5%; steeply sloping areas are associated with ridged and inclined surface forms along the major river valleys. Finer textured lacustrine sediments occur in both the western and eastern portions of the RM whereas sand and gravel deposits and recent alluvial materials are associated with the river valleys.

The soils in the RM are dominantly Orthic Black Chernozems, with Gleyed Black Chernozems in imperfectly drained level and lower slope positions. Depressional areas of poorly drained soils with high water tables are classified as Humic Gleysols. Cumulic Regosol soils are associated with recent alluvial deposits in the river valleys.

Soils of the Newdale Till Plain are described as the Newdale Smooth phase. The dominant soils are well drained with minor inclusions of imperfectly drained soil in the lower slopes and poorly drained soils in depressional areas (Ehrlich et al., 1956). Local areas of saline soils, often associated with small waterways, occur in this portion of the RM. Well drained Newdale soils generally range in agricultural capability from class 2 to 3, with topography being the most common limiting factor. Localized areas of class 5 to 7 soils are restricted to landscapes with severe soil erosion or wetness. Irrigation suitability of this area is good to fair due to the uneven terrain and the occurrence of salts within the soil profile. The potential for environmental impact under irrigation is low to moderate. Risk of water erosion on the Newdale soils varies from moderate to severe depending upon slope gradient.

Lacustrine soils in the Lake Souris Basin and glaciofluvial soils associated with the river valleys are described according to major parent material and textural characteristics for each soil association.

Soils of the Carroll Association developed on loam to clay loam lacustrine deposits are dominantly well drained. Beresford soils are similar, but have glacial till within one meter of the surface. Agriculture capability on these soils is class 2 to 3, with the main limitations being topography on the better drained soils and wetness and salinity on imperfectly drained soils. Poorly drained soils are rated in class 5WI. Irrigation suitability is good to fair and the potential for environmental impact is low to moderate. Risk of water erosion is moderate to severe on well drained sites, depending upon topography.

Soils of the Miniota and Marringhurst associations occur in the western portion of the RM. They are dominantly well drained soils developed on a variable mantle of sandy sediments over coarse

sandy and gravelly glaciofluvial deposits. They have rapid permeability and low water retention capacity. Agriculture capability of the Miniota soils is dominantly 4M to 5M. Irrigation suitability is good where sufficient fine textured soil occurs at the surface. Agriculture capability of the Marringhurst soils is 5M. Irrigation suitability is poor due to rapid permeability and very low water retention capacity of the subsoil. Both soil associations have a high potential for environmental impact under irrigation. Risk of water erosion is low but the risk of erosion by wind is high if the surface cover is minimal. Land use is mainly forage production and grazing.

Soils of the Eroded Slopes Complex occur on the steeply sloping valley walls of the Assiniboine and Little Saskatchewan Rivers. Agriculture capability is class 6 and 7T. The soils in the valley bottom are mapped as the Assiniboine Association developed on sandy loam to clay textured recent alluvial deposits. Agriculture capability varies from class 2 to 4 depending on elevation of the terraces and frequency of flooding. Irrigation suitability ranges from good to poor depending on the texture and frequency of inundation. Land use is mainly cereal and forage production.

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 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 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.

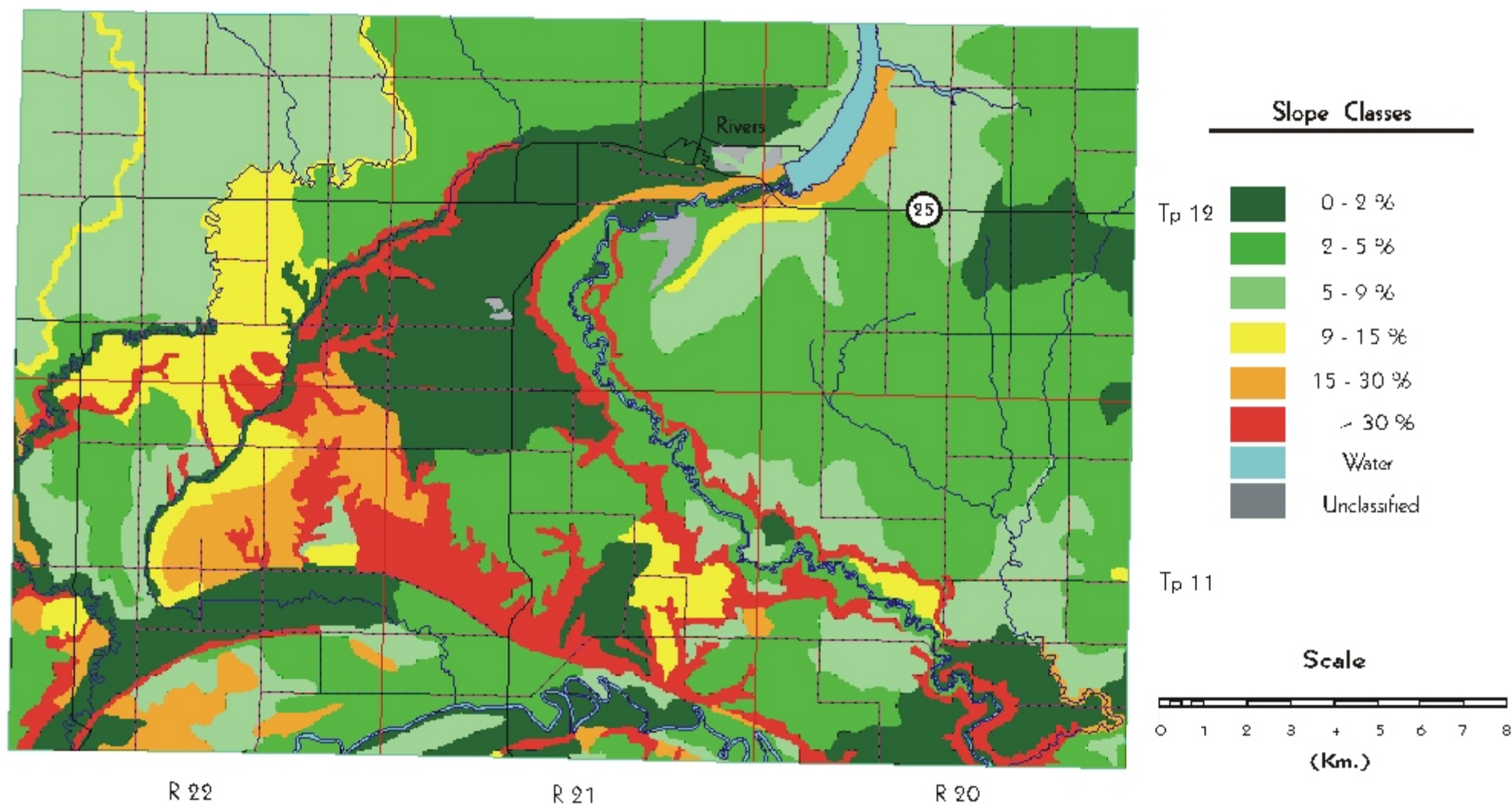
Table 1. Slope Classes¹

Slope Class	Area (ha)	Percent of RM
0 - 2 %	10570	18.2
2 - 5 %	21856	37.6
5 - 9 %	13102	22.6
9 - 15 %	3728	6.4
15 - 30 %	2978	5.1
> 30 %	4835	8.3
Water	784	1.4
Unclassified	227	0.4
Total	58079	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 Daly

Slope Map



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March 1996

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 surface forms 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

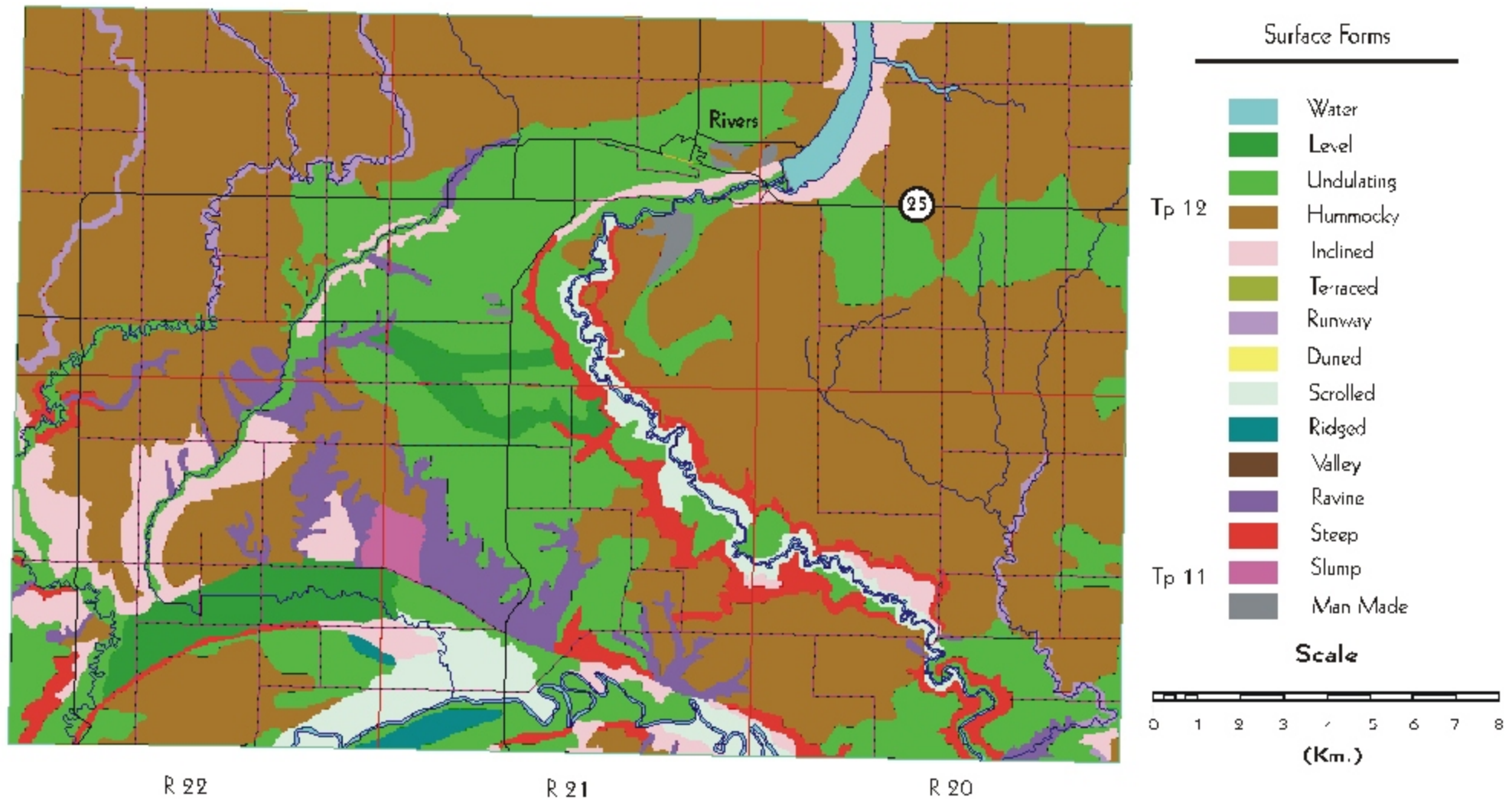
Surface Form Slope Class	Area (ha)	Percent of RM
Scrolled	2066	3.6
C (2.0 to 5.0%)	2066	3.6
Hummocky	30484	52.5
C (2.0 to 5.0%)	15028	25.9
D (6.0 to 9.0%)	10992	18.9
E (10.0 to 15.0%)	2429	4.2
F (16.0 to 30.0%)	2035	3.5
Inclined	3247	5.6
D (6.0 to 9.0%)	1536	2.6
E (10.0 to 15.0%)	733	1.3
F (16.0 to 30.0%)	794	1.4
H (31.0 to 70.0%)	184	0.3
Level	1797	3.1
B (0.5 to 2.0%)	1797	3.1

Surface Form Slope Class	Area (ha)	Percent of RM
Ravine	2350	4.0
H (31.0 to 70.0%)	144	0.2
J (> 70.0%)	2206	3.8
Slumped	240	0.4
J (> 70.0%)	240	0.4
Man Made	227	0.4
Ridged	241	0.4
D (6.0 to 9.0%)	197	0.3
F (16.0 to 30.0%)	44	0.1
Steep	2061	3.5
J (> 70.0%)	2061	3.5
Undulating	13736	23.7
B (0.5 to 2.0%)	8775	15.1
C (2.0 to 5.0%)	4755	8.2
D (6.0 to 9.0%)	206	0.4
Runway	849	1.5
C (2.0 to 5.0%)	8	0.0
D (6.0 to 9.0%)	171	0.3
E (10.0 to 15.0%)	566	1.0
F (16.0 to 30.0%)	105	0.2
Water	781	1.3
Total	58079	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 Daly

Surface Form Map



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March 1996

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.

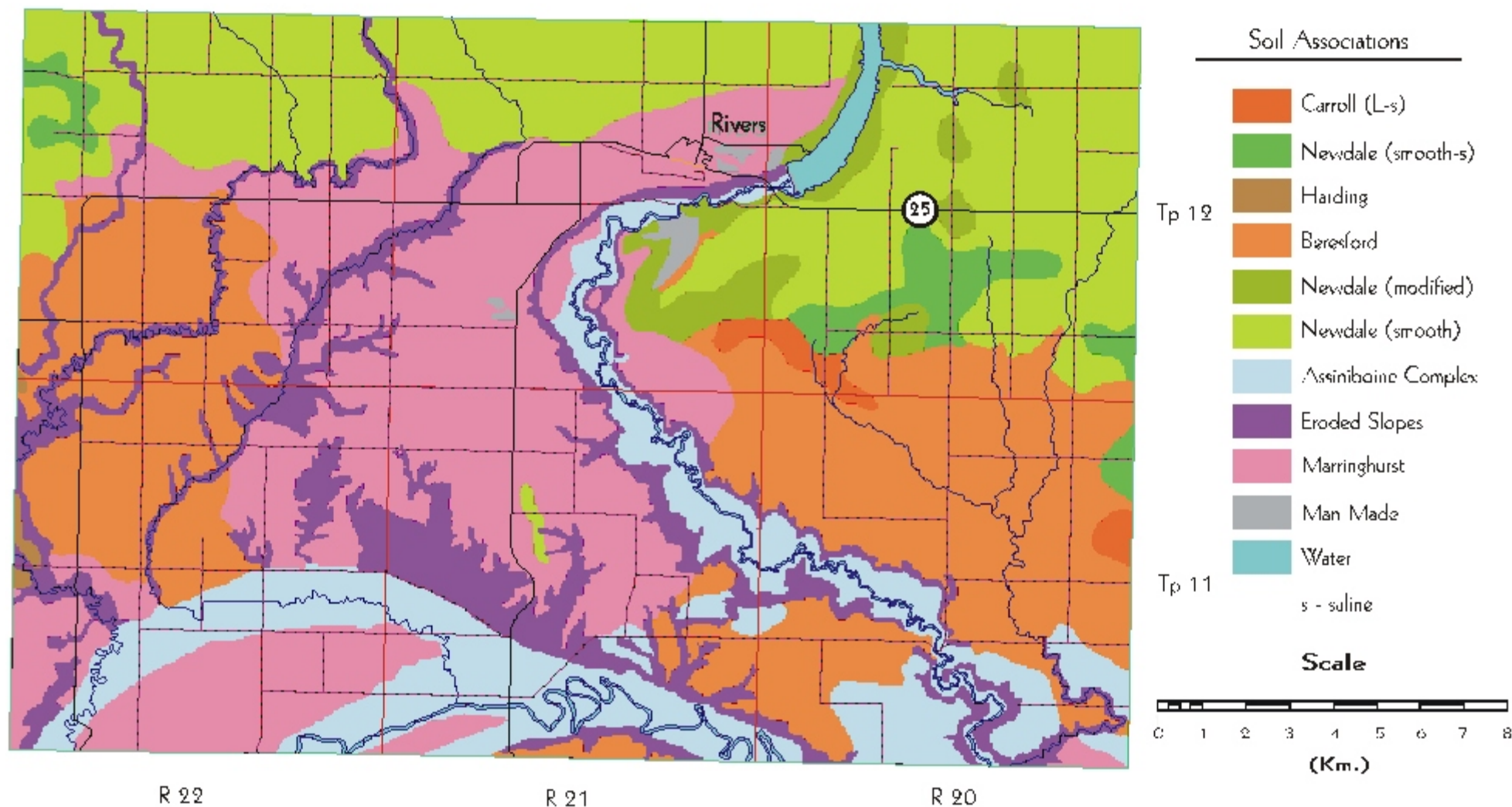
The groups have been named after the dominant soil association, and the statistics for each the groups have been summarized (in bold). The original reconnaissance map symbol types and their areal extent in the municipality are shown within each group.

Table 3. Generalized Soil Association Groups

Association Group Associate	Area (ha)	Percent of RM
Carroll (L - s)	442	0.8
Ccl (saline)	442	0.8
Newdale (smooth - s)	1407	2.4
Nsp (saline)	1407	2.4
Newdale (smooth)	12631	21.7
N	64	0.1
Nsp	12567	21.6
Newdale (modified)	1557	2.7
Nm	725	1.2
Nsp (wooded)	832	1.4
Harding	86	0.1
Hc	86	0.1
Beresford	13228	22.8
Bd	2369	4.1
Ccl	9982	17.2
Ccl (saline)	720	1.2
Ccl/T	157	0.3
Assiniboine Complex	7118	12.3
As	4899	8.4
As (meadow)	629	1.1
Bcx	1589	2.7
Eroded Slopes	6527	11.2
Er	6527	11.2
Marringhurst	14073	24.2
M	7509	12.9
Ma	6564	11.3
Man Made	227	0.4
Water	784	1.4
Total	58079	100.0

Rural Municipality of Daly

Generalized Soil Map



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 March 1996

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.

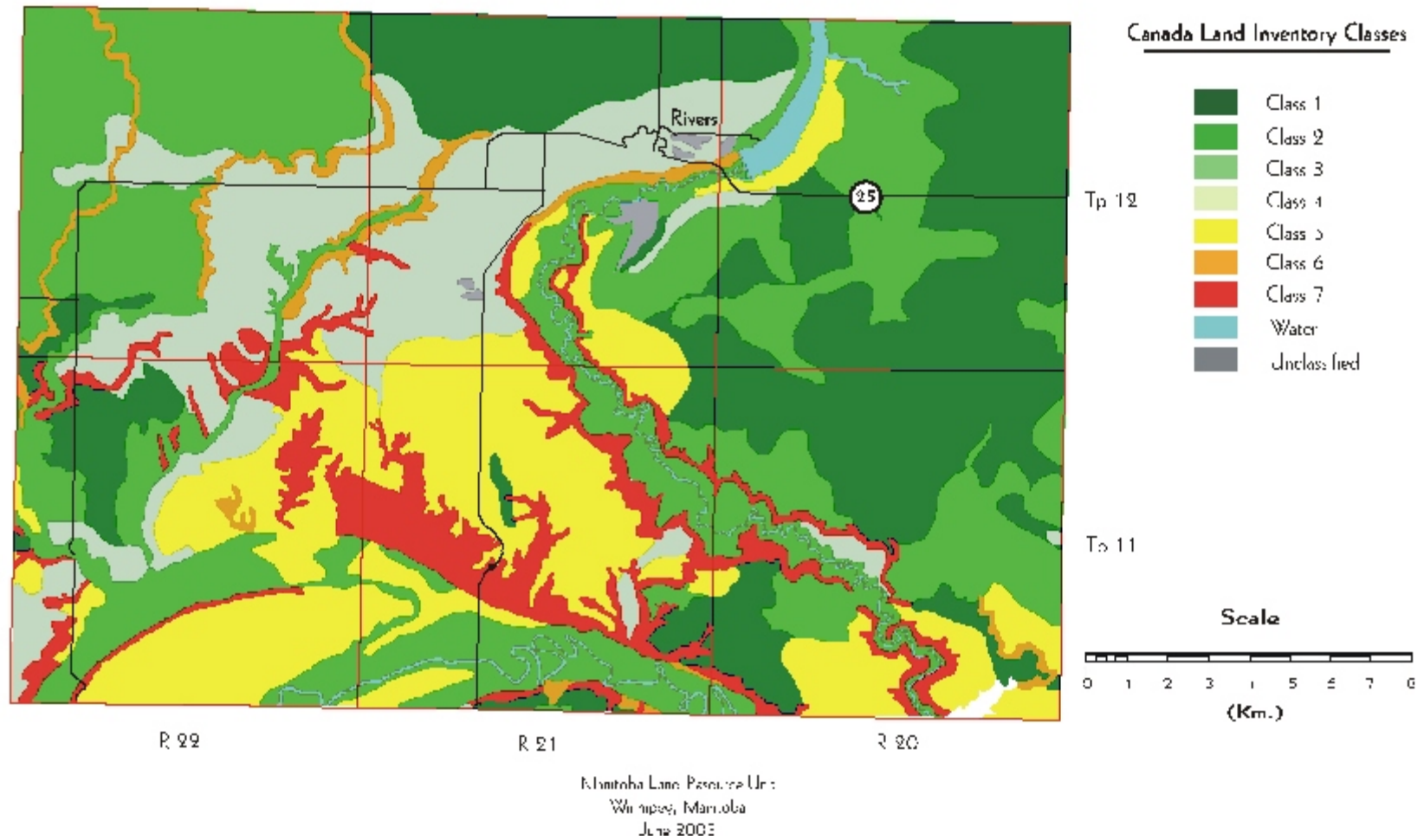
Table 4. Agricultural Capability¹

Class Subclass	Area (ha)	Percent of RM
1	0	0.0
2	14011	24.1
2T	10738	18.5
2TW	2114	3.6
2W	90	0.2
2X	1069	1.8
3	18389	31.6
3	408	0.7
3I	5190	8.9
3M	269	0.5
3MT	220	0.4
3N	1871	3.2
3T	9711	16.7
3TN	720	1.2
4	8501	14.6
4	161	0.3
4M	5695	9.8
4MT	845	1.5
4T	1799	3.1
5	10425	17.9
5	420	0.7
5I	7227	12.4
5MT	810	1.4
5T	1343	2.3
5WI	625	1.1
6	1293	2.2
6T	1293	2.2
7	4505	7.7
7T	4505	7.7
Unclassified	226	0.4
Water	787	1.4
Total	58138	100.0

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

Rural Municipality of Daly

Agriculture Capability Map



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.

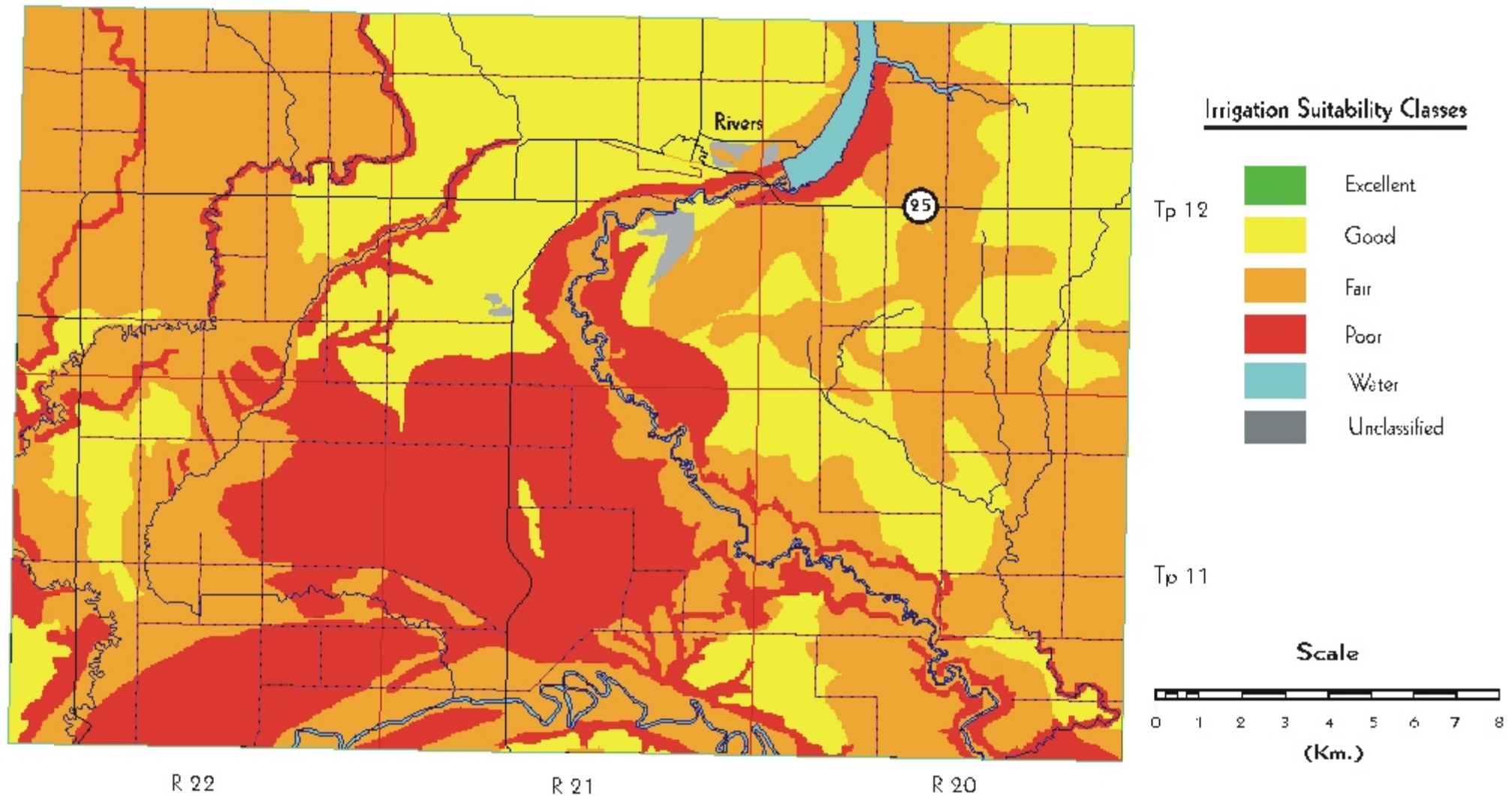
Table 5. Irrigation Suitability¹

Class	Area (ha)	Percent of RM
Excellent	0	0.0
Good	16957	29.2
Fair	25762	44.4
Poor	14348	24.7
Organic	0	0.0
Water	784	1.4
Unclassified	227	0.4
Total	58079	100.0

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

Rural Municipality of Daly

Irrigation Suitability Map



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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.

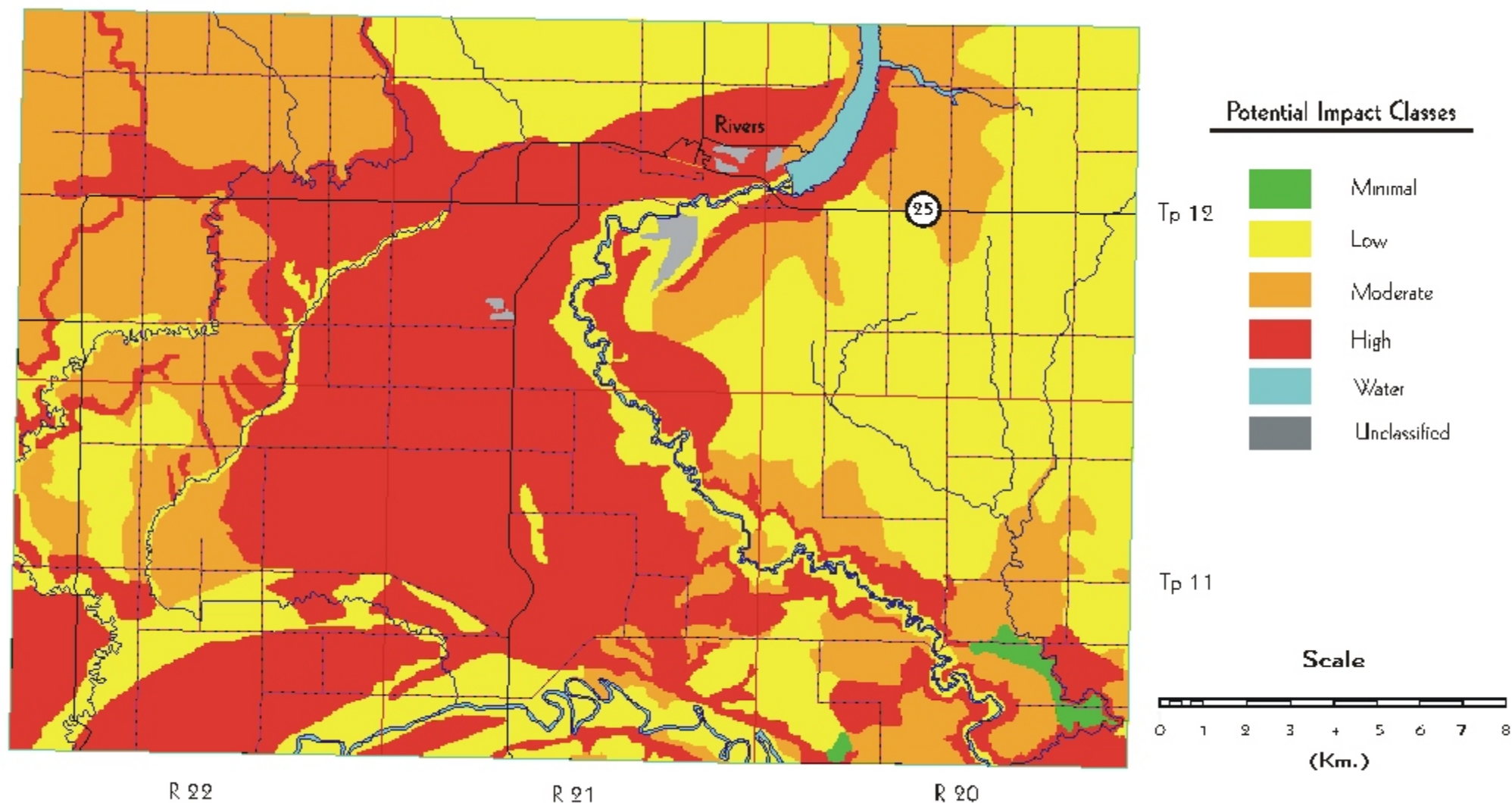
Use of this rating is intended to serve as a warning of potential environmental concern. It may be possible to design and/or give special consideration to soil-water-crop management practices that will mitigate any adverse impact.

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	6958	12.0
Low	36500	62.8
Moderate	12133	20.9
High	2568	4.4
Organic	0	0.0
Water	0	0.0
Unclassified	0	0.0
Total	58159	100.0

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

Rural Municipality of Daly**Potential Environmental Impact Under Irrigation**

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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.

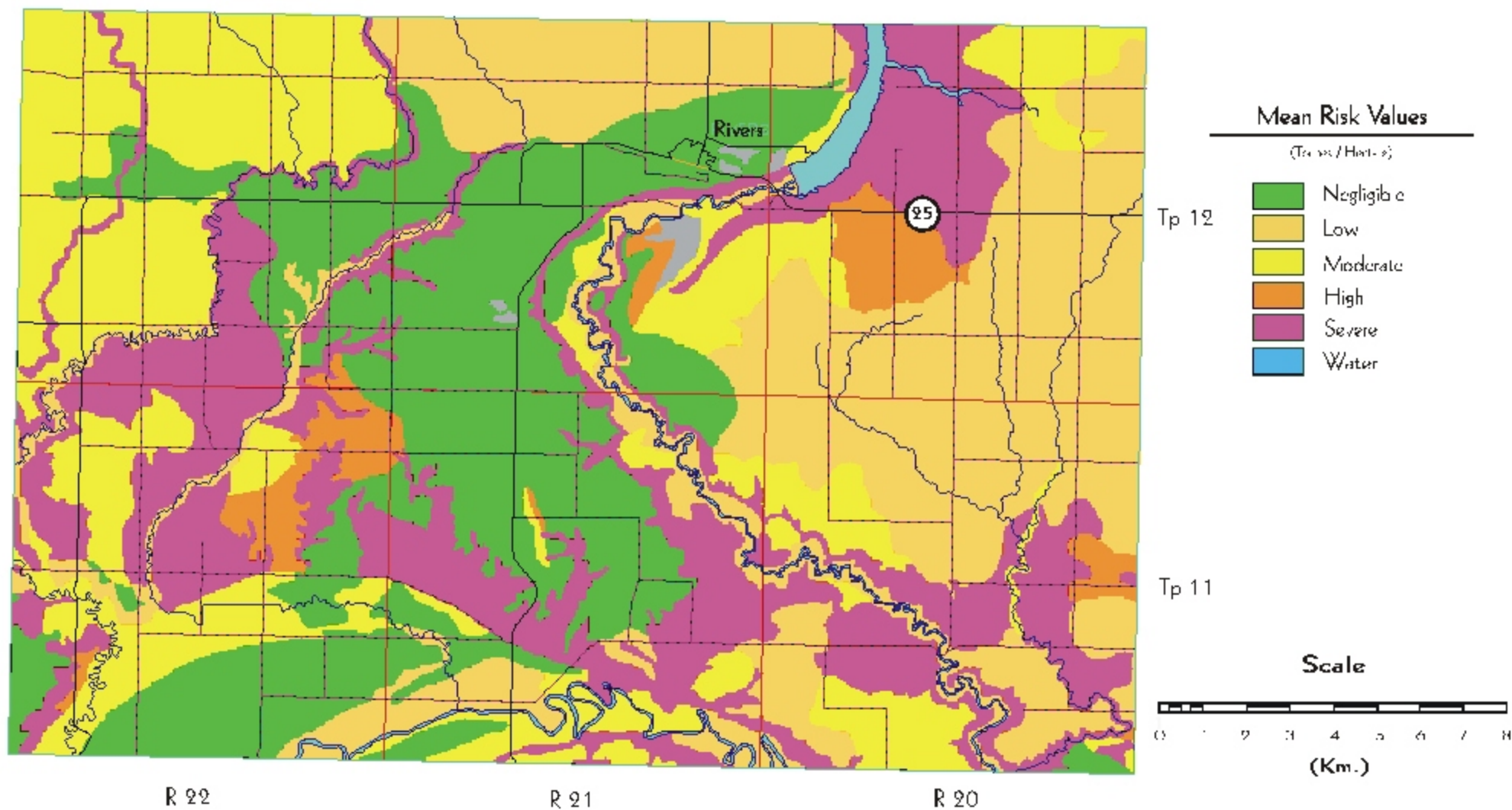
Table 7. Water Erosion Risk¹

Class	Area (ha)	Percent of RM
Negligible	13106	22.6
Low	16106	27.7
Moderate	12929	22.3
High	2028	3.5
Severe	12899	22.2
Water	784	1.4
Unclassified	227	0.4
Total	58079	100.0

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

Rural Municipality of Daly

Water Erosion Risk Map



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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 Use¹

Class	Area (ha)	Percent of RM
Annual Crop Land	34940	59.6
Forage	1689	2.9
Grasslands	14010	23.9
Trees	4535	7.7
Wetlands	781	1.3
Water	674	1.1
Urban and Transportation	2026	3.5
Total	58655	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.

