WHITEMUD WATERSHED CONSERVATION DISTRICT

WATER MANAGEMENT STRATEGY

INTRODUCTION

This Water Management Strategy is an extension of the Management Plan prepared by the Whitemud Watershed Conservation District in 1990. The intent is to outline the basic directions of the Boards water program over the next ten years.

This strategy is divided into three key parts:

PART 1 A broad picture of the Whitemud Conservation District including water problems and possible solutions.

PART 2 An inventory of the existing man-made drainage system and requirements for maintenance and reconstruction.

PART 3 A description of policies and directions.

Acknowledgement: The Board of the Whitemud Conservation District would like to thank Marshall Thompson, Water Resources Branch and John Buermeyer, Engineering & Construction Branch for their contribution to the Water Management Strategy.

WATER MANAGEMENT CHARACTERISTICS IN THE WHITEMUD CONSERVATION DISTRICT

IN THIS SECTION:

* Background
* Surface Water Features and Physiographic Regions
* Water Management Zones
* Agricultural Drainage Standards
* Conveyance Channels

BACKGROUND

In the Whitemud Watershed Conservation District's Management Plan the Board highlighted their water management priorities. Four key statements were:

* Maintenance of the existing drainage system is the highest water management priority.
* Construction of additional agricultural drains is a low priority.
* Reconstruction of existing drains to an appropriate standard is a priority.
* The drainage standard will match the agricultural capability of the soil. Generally, a high standard of drainage will be provided to lands with high agricultural capability, compared to poorer agricultural land.

Definitions: **Refer to Appendix "A" for definitions of terms including drains, design flow, agricultural standard, flood frequency, maintenance, reconstruction, natural water channel, man-made drain, etc.**

SURFACE WATER FEATURES AND PHYSIOGRAPHIC REGIONS

The obvious questions arising from the key statements include; of the 1017 miles of drain that the Board is responsible for, which drains does the Board maintain; which drains get reconstructed and why; what design standard are drains reconstructed to; and where does the Board get its best value for dollars spent on drain maintenance, reconstruction and construction?

To best answer these questions the Board has to assess the surface water features for each physiographic region in the District. **Figure 1** summarizes the surface water features for each of the eight physiographic regions in the District.

WATER MANAGEMENT ZONES

In order to assess where the Board will allocate its limited drain maintenance and reconstruction dollars, the District has to be divided into water management zones. Water management zones are identified by characterizing areas with similar soil types, topographical features and water problems. **Figure 2** displays ten water management zones. The ten zones are similar to the eight physiographic regions in the District. Zone 5 (Riding Mountain Alluvial Fan) and Zone 8 (Big Grass Marsh) are two variations from the physiographic regions, as their water management circumstances are unique.

Table 1 summarizes water management characteristics of the ten water management zones. All zones have their own unique water problems (internal) and some have problems arising from water originating in another zone (external). **Appendix B** provides a description of internal and external problems in each water management zone as well as recommended solutions to these problems.

WATER MANAGEMENT STRATEGY

WHITEMUD WATERSHED CONSERVATION DISTRICT

NOVEMBER, 1991

TABLE 1: WATER MANAGEMENT CHARACTERISTICS BY ZONE

ZONE	NAME	TOPOGRAPHY	NATURAL DRAINAGE	DRAINAGE REQUIRED?	DRAINAGE STANDARD	CONVEYANCE REQUIRED?	CONVEYANCE IMPORTANCE	RUNWAY STABILIZATION REQUIRED?	SURFACE STORAGE POTENTIAL	ANTICIPATED BENEFIT/COST
1	Lowland Clay Plain	Flat-Mild	Poor-Fair	Yes	Cereal-Special	Yes	High	No	Poor	Medium-High
2	Subescarpment Sand Plain	Mild	Good	Maybe-Maintain Existing System	Ground-water Control	Maybe	Needs Study	No	Fair	Low
3	Subescarpment	Irregular	Variable	Maybe	Needs Study	Yes	Needs Study	No	Excellent	Needs Study
4	Upland Sand Plain	Moderate	Good-Excellent (infiltration)	No	---	No	---	No	Poor-Excellent	Low
5	Riding Mtn. Alluvial Fan	Moderate	Fair	Yes	Cereal	Yes	High	No	Poor	High-Medium
6	Riding Mtn. Escarpment	Steep	Excellent	No	---	No	---	Yes	Poor	Medium
7	Upland Till Plain	Potholes	Excellent (exc. potholes)	No	---	No	---	Yes	Good	Medium
8	Big Grass Marsh	Marsh	Poor	No	---	Yes	High	No	Excellent	Medium
9	Lowland Till Plain	Irregular	Poor	Yes	Forage-Pioneer	No	---	No	Good	Low
10	Manitoba Escarpment	Steep	Excellent	No	---	No	---	No	Poor	Low

AGRICULTURAL DRAINAGE STANDARDS

The Board needs to identify the standard of agricultural drainage or the level of service that can be expected within the water management zones in the District. As a "rule of thumb", four drainage standards are proposed. These are:

Drainage Standards

1. Value Added: High level service. Summer precipitation removed from adjacent agricultural land within 1 to 2 days.

2. Cereal: Agricultural drainage within 2 to 3 days.

3. Forage/Pioneer: Agricultural drainage within 4 to 10 days.

4. No Drainage.

Figure 3 outlines the agricultural drainage standards map for the District.

The purpose of the agricultural drainage standards map is to assist the District to make decisions whether to maintain, reconstruct, or upgrade the existing drainage system in different areas (ie. what level of drainage service one can expect).

The following six statements should be considered in any interpretation of the Agricultural Drainage Standards Map (**Figure 3**).

1. The drains are built to an agricultural standard (ie. they are built below prairie level to allow drainage from adjacent land).

2. The drains are not designed to accommodate flood water.

3. The drain standard applies only to existing District drains. The Board will generally not approve construction of new agricultural drains.

4. In the "No Drainage" area the Board will continue its programs of gully stabilization, grassed runways, shale traps, and gradient controls to minimize erosion.

5. **Figure 3** is general and should be considered as a guide only. There will be site specific discrepancies, particularly within the "Cereal" zone.

6. **Figure 3** does not reflect the design standard for conveyance channels whose main purpose is to convey water through a region as opposed to agricultural drainage which provides local drainage to adjacent lands.

CONVEYANCE CHANNELS

A separate design standard is required for conveyance channels which are constructed to transfer water from one area to another. **Figure 4** indicates the area of priority for conveyance channels as well as highlighting the conveyances which have been constructed to a proper standard and should receive a maintenance priority.

At present the Board will only reconstruct conveyance channels to their original design. Only in exceptional circumstances and in the event that substantially greater funding becomes available, will new conveyance channels be constructed to a modern standard.

MANAGEMENT STRATEGY FOR MAN-MADE DRAINS IN THE WHITEMUD CONSERVATION DISTRICT

IN THIS SECTION:

* Background
* Drain Capacity
* Drain Maintenance
* Drain Reconstruction
* Summary of Drain Maintenance & Reconstruction Strategy

BACKGROUND

There are 1017 miles of man-made drains in the Whitemud Conservation District. This report outlines the current condition and possible strategies for maintaining and reconstructing these drains.

The key goals of this strategy are to:

* ensure that the drainage system does not deteriorate.
* develop a system that can be maintained through normal maintenance.
* eventually reconstruct low capacity drains to a standard compatible with land use and soil types.

BACKGROUND cont'd

This report is strictly concerned with drainage channels. There is no consideration given to the costs of repairing or replacing bridges and culvert crossings. The data is based on the current condition of the system. The evaluation is not based on an intensive engineering study but is based on the knowledge and experience of field staff. No attempt has been made to anticipate damages as a result of floods, erosion, etc.

DRAIN CAPACITY

First, the condition of the drainage system was evaluated. Each drain was rated as good, fair, poor, very poor, or non-maintainable depending on its current maintenance status. For example, a "good" drain would have a good capacity to drain water, ie. it has been maintained so that vegetation or silt would not cause a major reduction in the drains capacity to carry water. A note of clarification is important at this point. Maintenance work can improve a drain to its full capacity, however, this does not mean that the drain was built to a sufficient design (or had adequate capacity) in the first place. In fact, most of the District's drains have inadequate hydraulic capacity. Maintenance only allows you to make the best of what you've got.

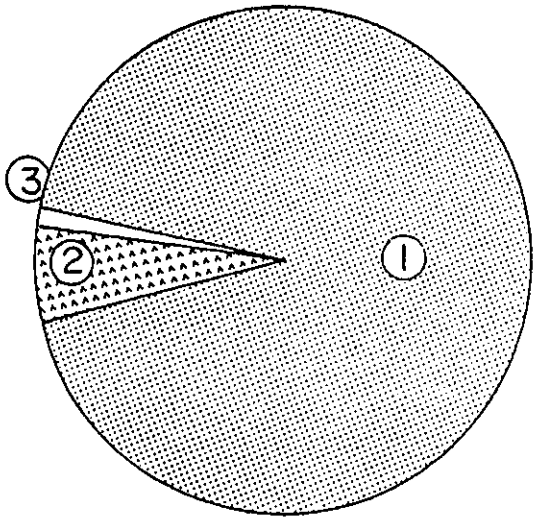
The condition of the drains are outlined in **Figure 5.** The drains are generally in good condition with only about 7% of the drains being in poor or very poor condition due to lack of maintenance.

DRAIN MAINTENANCE

Maintenance is defined as work done to restore the drain to full capacity without significantly altering the size of the channel. This is usually limited to vegetation control and silt removal.

Figure 5.

DRAIN CAPACITY STATUS SUMMARY



CAPACITY STATUS OF
ALL DRAINS
1017 MILES

LEGEND

CATEGORY	CURRENT STATUS
1	GOOD
2	FAIR/POOR
3	VERY POOR NON MAINTAINABLE

The drains were divided into three categories:

* normal maintenance channels
* heavy maintenance channels
* non-maintainable channels

The number of miles of drain in each category was tabulated and multiplied by an average cost per mile to determine overall maintenance costs. Repair costs due to unpredictable events such as flooding were not included. Cost estimates are in constant 1990 dollars.

Normal Maintenance:

* mowing
* spraying
* spot cleanouts

- average cost is $300.00 per mile per year
- 864 total miles
- $345,000. total cost per year

Important factors regarding normal maintenance are:

- work is carried out every one or two years.
- hay permits on well constructed large drains reduce costs.
- ignoring normal maintenance results in expensive drain reconstruction (otherwise stated; an ounce of prevention is worth a pound of cure).

Heavy Maintenance:

* silt removal
* major brushing
* resloping

- average cost is $7,000. per mile.
- 59 total miles
- $472,000. total cost

Important factors regarding heavy maintenance are:

- usually a one time expenditure assuming follow up normal maintenance occurs.

Non-Maintainable Drains:
* maintenance is not possible
* steep side slopes, severe erosion
* requires reconstruction

- 94 miles are presently non-maintainable and require reconstruction before they could be maintained.
- no costs are attributed to these drains.

Important factors regarding non-maintainable drains are:

- virtually all these drains have been abandoned because either they have far more capacity than required (on eroded steep slopes) or reconstruction costs are far beyond the means of the District and likely not justifiable.

- maintenance is limited to minor work such as removing beaver dams.

Ten Year Maintenance Strategy and Budget:

The Board recommends a ten year drain maintenance strategy. The District is responsible for 1017 miles of drain. Of these, 638 are first and second order drains (smaller & minimal drainage area) and 379 are third order or higher drains (larger & big drainage area). Each mile of drain was evaluated as to whether it required normal or heavy maintenance. Cost estimates were determined for normal and heavy maintenance on first and second order drains, and for third or higher order drains. Generally maintenance is less costly on the smaller first and second order drains. Drains beyond maintenance were not included in the costs and were considered abandoned (until such time that considerably more funding becomes available).

A summary of the ten year drain maintenance strategy and budget for first and second order drains is outlined in **Table 2** and for third order and higher drains in **Table 3.**

TABLE 2: TEN-YEAR STRATEGY
FIRST AND SECOND ORDER DRAIN MAINTENANCE COSTS

	No. of Miles	10-Year Average Annual Budget
Normal Maintenance*	595	$175,500
Heavy Maintenance**	36	$ 21,200
Non-Maintainable	7	---
TOTAL	**638**	**$196,700**

*Normal maintenance budget for the first year will be $171,000 for 595 miles. The number of miles of drains requiring normal maintenance will increase each year as heavy maintenance is completed. By the year 2000, 631 miles will require only normal maintenance for a cost of $180,000 per year.

**Total budget for 36 miles of heavy maintenance is $212,000.

TABLE 3: TEN YEAR STRATEGY
THIRD ORDER AND HIGHER DRAIN MAINTENANCE COSTS

	No. of Miles	10 Year Average Annual Budget
Normal Maintenance*	269	$92,000
Heavy Maintenance**	23	$19,000
Non-Maintainable	87	0
TOTAL	**379**	**$111,000**

*The first year normal maintenance budget for 269 miles will cost $87,000. The number of miles of drains requiring normal maintenance will increase each year as heavy maintenance is completed. By year 2000, 292 miles will require normal maintenance for about $97,000 per year.

**Heavy Maintenance total budget for 23 miles is $190,000.

Drain Maintenance Summary:

The ten year maintenance strategy for 1017 miles of drain results in an average cost of $307,700 per year. This estimate does not include any crossing maintenance or replacements. Estimates are in constant 1990 dollars.

DRAIN RECONSTRUCTION

Background:

Reconstruction refers to upgrading an existing channel in order to provide a higher standard of drainage service for an area. The purpose of the District's drain reconstruction program is to improve the efficiency of the existing drainage system. Drain reconstruction costs vary, however, the cost of improving a drain from a forage standard to a cereal standard would be approximately $45,000 per mile.

Drain Reconstruction Strategy And Ten-Year Budget:

Of the 1017 miles of drains in the Whitemud Conservation District, 356 miles are substandard and require reconstruction (**Figure 6**). With a limited budget the Board has to determine which of the 356 miles get priority. As a general rule the Board will priorize drain reconstruction projects as follows:

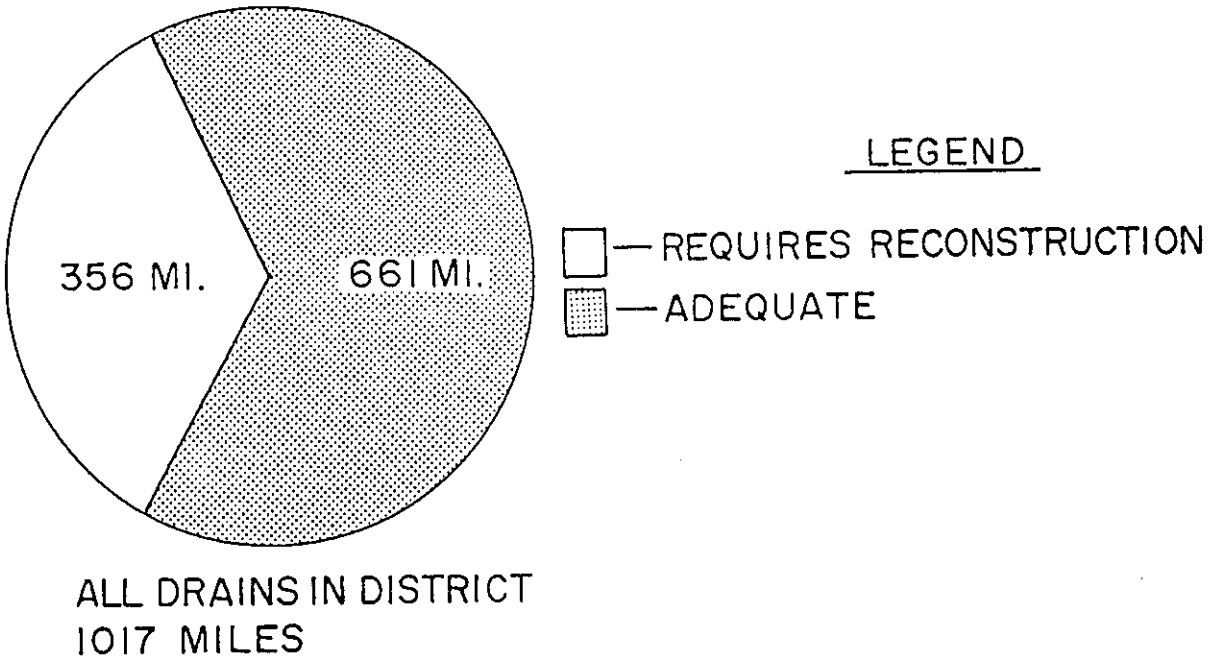
Priority For Drain Reconstruction:

- high agricultural capability land served
- poor drain capacity relative to drainage area
- favourable benefit-cost ratio
- R.M. likely to participate

One additional factor affects a decision to reconstruct a drain. In order to upgrade drainage in an area it must have an adequate outlet channel. It is unacceptable to improve upstream areas where the investment may be warranted without providing an improved outlet. The lack of an adequate outlet is a significant hinderance to drain

Figure 6.

TOTAL DRAINS REQUIRING RECONSTRUCTION
IN WHITEMUD DISTRICT



Drain Reconstruction Strategy and Ten-Year Budget cont'd

reconstruction in the District, particularly in Sub-district #43. Because these outlet improvements exceed the Boards current financial capabilities, the amount of drain reconstruction recommended in the ten-year strategy is far less than what is actually required.

Figure 7 summarizes the number of miles of high and low priority drain reconstruction projects in the District.

The eight Sub-District Committees in the Whitemud Conservation District have recommended upgrading 30 miles of drain from a forage to cereal standard. The average annual cost of a ten-year drain reconstruction plan is $135,000.

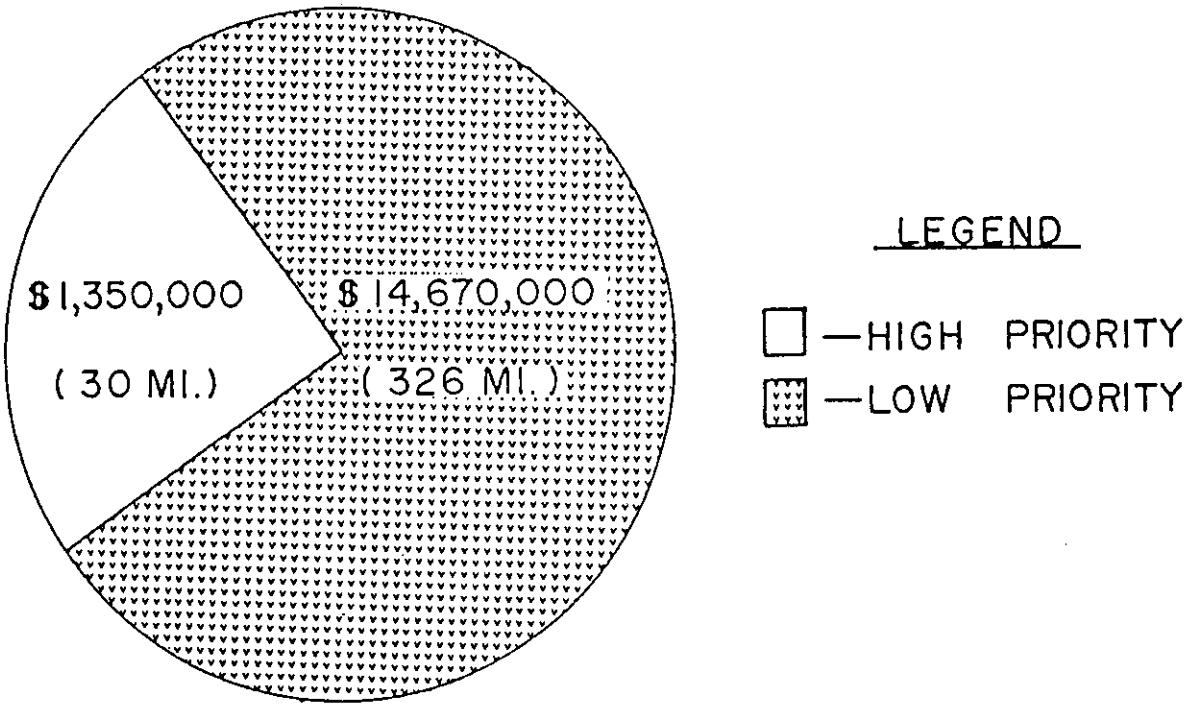
TABLE 4: TEN-YEAR DRAIN RECONSTRUCTION PLAN

Current Standard	Proposed Standard	No. of Mi.	Cost Per Mile	Total Cost	Average Annual Cost
Pioneer	Forage	0	---	---	
Forage	Cereal	30	45,000	1,350,000	135,000
Cereal	Special	0	---	---	---

Note: All estimates are constant 1990 dollars. It is reasonable to assume that costs will rise 3 to 6% annually. No crossings are included in costs.

Figure 7.

PRIORITY DRAIN RECONSTRUCTION PROJECTS SUMMARY AND COSTS IN WHITEMUD DISTRICT



DRAINS REQUIRING RECONSTRUCTION
(356 MILES)

SUMMARY OF DRAIN MAINTENANCE & RECONSTRUCTION STRATEGY

Generally, the drainage system in the Whitemud Conservation District is in reasonable shape. The proposed ten-year plan to invest $442,700 annually into drain maintenance and reconstruction projects will ensure the drainage system does not deteriorate.

The ten-year plan is workable, however, several cautions should be noted. First, a series of flood years with serious erosion will dramatically alter the plan. Second, no crossing repair or replacement costs are considered in the maintenance or reconstruction strategies. Third, substantially greater funding will be required to upgrade outlet channels in certain sub-districts which will allow more drain reconstruction projects.

WATER MANAGEMENT POLICIES

IN THIS SECTION:

* Overall Water Program Policies and Direction
* Channel Maintenance Policy
* Drain Reconstruction Policy
* Drain Design and Construction Guidelines
* Water Storage Program Policy

BACKGROUND

The Board of the Whitemud Conservation District has established water management policies to govern its water program. Policy and direction statements indicated in this section will direct the water management program from 1990 to 2000.

PART 3

OVERALL WATER PROGRAM POLICIES AND DIRECTION

In the Districts Management Plan the Board highlighted seventeen key water program policies and direction. They are:

1. Maintenance of the existing drainage system is the highest water management priority.

2. Upgrading the capacity of existing watershed drains by reconstruction will receive emphasis.

3. As a general rule, the Board will provide higher standards of drainage to lands with higher agricultural capability, compared to poorer agricultural land.

4. The Board will continue its erosion control programs including gully stabilization, grassed runways, shale traps and gradient controls.

5. The Board will generally not approve construction of additional drains whose sole purpose is removing water from agricultural land.

6. The Board will encourage the co-operation of landowners to maintain the drains that serve their lands.

7. The Board will use incentives to promote and encourage water management practices to retain water and prevent erosion.

8. The Board will generally not undertake drainage, snow cleanout, ring dyke, or other construction projects whose primary purpose is to attempt to control spring flooding.

9. The Board places high priority on water storage and controlled release to slow down runoff.

10. The Board will give funding priority to water projects that are multi-purpose.

11. The Board encourages land use management that compliments their water management goals, including lower or removal of taxation on non-productive land, prohibiting clearing of vegetation in erosion prone areas through legislation, and implementing land use education programs.

12. The Board intends to promote through incentive programs the planting of trees in sensitive and erosion prone areas.

13. The Board will attempt to assist in maintaining and improving the quality of water in the District.

14. The Board will assist in monitoring the Water Rights Act as it applies to drainage.

15. The Board intends to proceed with completing a Big Grass Marsh Management Plan.

16. The Board will establish and enforce environmental design, construction and maintenance standards for all District water projects.

17. The Board may negotiate cost-sharing agreements with affected landowners or municipalities benefitting from a water project.

CHANNEL MAINTENANCE POLICY

The Districts drain maintenance program shall be guided by the following policies:

Mowing and Brushing:

- Mowing and brushing will be undertaken on an as-needed basis.
- Heavy brush mowing may be limited to one mile stretches to prevent excess debris buildup.

Silt Cleanout:

- Will be undertaken on an as-needed basis.
- Cleanouts will improve the drain to a maintainable condition.
- Cleanouts resulting from adjacent land wind erosion will only be completed with a landowner agreement to leave a minimum 10 foot grass buffer strip. Drain cleanouts from adjacent land erosion may not be completed if the erosion re-occurs.

Hay Permits:

- Will be encouraged and available to the adjacent landowner.
- Release forms will be signed if the adjacent landowner does not want to maintain a permit.
- Permit holders cannot receive a benefit from the permit. Anyone doing so will lose the permit, as stated in the conditions of the permit.
- Hay permits are 3 year contracts and are renewable.

Snow & Ice Removal:

- The Board will not remove snow and ice from drains unless buildings or other real property are threatened.
- Any individual or agency may be liable for damages and costs that result from works they undertake to remove snow or ice from District drains.
- Strategic placement of shelterbelts is encouraged to prevent snow blockage.

Seeding:

- Drains will be seeded as soon as possible after a cleanout to establish a protective cover and reduce erosion.

Spoil Material:

- Spoil material will not be hauled from the channel site. Agreements with landowners or the municipality will be made to spread the spoil material on adjacent land or a road.

Beaver Dams:

- The Board will only remove beaver dams from District drains where the dam is causing serious damage such as flooding crop land.
- The landowner must remove the beavers under permit from the Department of Natural Resources before the Board will remove the dam.

Herbicide Weed Control:

- The Board will only use provincially recommended and registered herbicides.
- All rules and safety practices for herbicide use recommended by the province will be followed.
- The chemical drain maintenance program will be supervised by a licensed applicator.
- Proper environmental licensing will be required.
- No spraying will occur where there is risk to fish, wildlife habitat, or water quality.

Natural Water Channel:

- The Board will not assume maintenance responsibilities for natural water channels.

DRAIN RECONSTRUCTION POLICY

The District's drain reconstruction program shall be guided by the following policies:

Reconstruction Priority:

- As a general rule the Board will reconstruct a drain to a standard that matches the areas agricultural capability ie. the higher the agricultural capability, the higher the drainage standard.
- The Board will consider maximizing the return on their investment dollars when priorizing reconstruction projects.

Buffer Strips and Spoil Banks:

- The Board will consider acquisition of additional land along drains, where feasible, to provide for buffer strips or to place spoil banks.
- The District will seed the berm or spoil bank to grass.
- The District will maintain the berm or spoil bank, however, landowners are encouraged to maintain the grass cover.

Fence Removal:

- The District will move a landowners fence along a drain reconstruction project where the fence interferes with construction of the required side slopes.

DRAIN DESIGN GUIDELINES

General Design Guidelines:

- Works will be designed to provincial standards
- 3 agricultural drainage standards are suggested; value added, cereal, and forage/pioneer. The highest drain standard will be applied to lands of highest capability.
- The system will be designed to provide agricultural drainage only and not to accommodate flood flows.
- Conveyance channel design will vary depending on the location, drainage area, gradient, soil type, etc.

Channel Design:

- Drains will be designed, where feasible, for low maintenance with gentle 4:1 side slopes to allow mowing.
- minimum 3 metre bottom width, 3:1 side slopes.
- maximum water velocity of 3 feet per second with consideration to soil type and susceptibility to erosion.
- gradient control structures to be installed to reduce water velocities where required.
- design criteria will include consideration of downstream impacts, groundwater impacts, and fish and wildlife impacts.
- grassed runways will follow the natural direction of water flow.

Erosion Control Design:

- rock chutes, drop structures and other gradient controls will be installed to minimize erosion along drains.
- shale traps will be installed to prevent downstream sedimentation of drains and costly cleanouts.
- rock drops will be constructed where required on grassed runways and gully stabilization projects.
- buffer strips along drains will be promoted. The District will seed and maintain the buffer strips.

System Design:

- No upstream drainage improvements will be completed without provision of an adequate outlet.
- All drainage projects will be designed in context of the whole drainage system.
- projects will avoid connection of the groundwater table to surface drainage.

Environmental Design:

- There will be no net loss of fish and wildlife habitat as a result of drainage works.
- The Board will incorporate fish and wildlife habitat enhancement features where feasible ie. pool and riffle designs.
- There will be no net loss or degradation of wetlands
- Crossings should adhere to stream crossing guidelines for fish where required.
- Drainage development that degrades a natural undisturbed environment will not be recommended.

WATER STORAGE POLICY

The Districts water storage program shall be guided by the following policies:

- The purpose of the program is to store water in wetlands and natural runways for the benefits of water conservation.
- The Board will approve projects with top priority given to multiple-benefit projects. Single purpose projects such as for stock watering will be low priority.
- Dams cannot exceed 12 feet high or more than 40 acre feet storage. Minimum storage depth is 3 feet.
- Projects require a signed agreement which may be registered by caveat with the title of the land.
- Cattle must be fenced out of the spillway and dam area and access to the water must be limited to specific sites.
- All aspects of the Water Rights Act will be adhered to.

Cost Sharing:

- When a project will have direct benefits for a landowner, the landowner will contribute 15% of the total cost and the Board will contribute 85% of the total cost. If the project is 100% for wildlife or water conservation, or if it is completely initiated by the Board, then the Board will pay 100% of the cost. The Board has approved this policy for 1991 projects.

APPENDIX "A"

The following are definitions of key terms used in the Water Management Strategy:

Conveyances - Channels constructed to transfer water from one area to another. The design flow may be contained within dykes above prairie elevation.

Drains - Channels constructed to remove water from adjacent agricultural land. The design flow will be below prairie level to allow drainage from the adjacent land.

Design Standard (Flow) - This is the chosen level of service or standard chosen for a project. The standard is related to benefits ie., the greater the benefit, the higher the standard.

Agricultural Standard - This is the design flow required to protect or drain agricultural land in a reasonable time. This is normally limited to events that would likely occur during the growing season. This standard does not provide sufficient capacity to handle large spring or summer floods.

Flood Frequency - An estimate of how often a particular event may be exceeded. This is based on available streamflow records.

Drain Maintenance - Work done to maintain or improve the drain capacity without significantly altering the size of the channel eg. mowing, haying, minor silt removal, brushing, spraying.

Drain Reconstruction - Work done to upgrade the channel to provide a higher standard of drainage service for an area.

Natural Water Channel - A channel which exists in its natural location with no improvements to increase its drainage capacity. A channel does not lose its "natural" status because of clearing of vegetation or construction of minor works affecting a minor portion of the channel.

Man-made Drain - A channel constructed to direct water along an artificial route (ie. not natural). The Board has responsibility for the maintenance and repair of 1017 man-made drains outlined on sub-district maps.

APPENDIX "B"

WATER MANAGEMENT ZONES: PROBLEMS AND SOLUTIONS

The District has been divided into ten water management zones (see **Figure 2**). Each zone is identified by key soil and topographic features and by similar water problems, both externally and internally imposed. The problems of each zone are best resolved by implementing similar solutions and water management practices. This concept is summarized as follows:

ZONE 1: **The Lowland Clay Plain** in the east-central part of the Watershed.

External Problems:

- flood damages along major outlets caused by excessive inflow runoff in spring and during summer rainstorms from Zones 2, 3, 4, 5, 6, 7 and 10.
- erosion and delayed seeding adjacent to the Dead Lake Drain.
- prolonged spring flooding in area north of P.T.H. 16 and south of Cross Lake Ditch.
- spring flooding and trash/weeds/silt depositing between Westbourne and Lake Manitoba adjacent to the Whitemud River.
- frequent inundation along eastern edge from high water on the Big Grass Marsh.

Solutions:

- increase capacity of Whitemud River from Pine Creek to Dead Lake Drain to about 10,000 c.f.s.
- construct double-dyke floodway with a 6,000-8,000 c.f.s design capacity along Dead Lake Drain.
- improve the outlet capacity of the Big Grass Marsh. Construct dykes and control structure to regulate flows from the Big Grass Marsh.
- investigate feasibility of constructing flood control works along the lower Whitemud River from Westbourne to Lake Manitoba; and/or negotiate flood easements or purchase flood-prone lands for resale with a flooding caveat.
- maintain all conveyances in current good condition; reconstruct if necessary.

Internal Problems:

- excess precipitation causing yield reductions or seeding/harvesting problems.

Solutions:

- construct an extensive network of high standard drains to provide all landowners with an outlet for on-farm drainage, ie., Perch Creek and Youill area program.
- construct or improve local drains and maintain to a moderate standard.
- integrate with Big Grass Marsh project.

ZONE 2: The Sub-Escarpment Sand Plain in the south central part of the Watershed.

External Problems:

- unpredictable overland spring flooding, including farmyards and granaries, caused by excessive runoff from Zone 10.
- traffic disruption due to random flooding.
- erosion damage on light soils.
- crop reductions and channel icing due to near-surface groundwater table; the shallow aquifer is recharged from extensive aquifer underlying Zone 10.
- often insufficient stock water quantities due to unreliable streamflow.

Solutions:

- construct and/or maintain conveyance channels to carry runoff along clearly defined paths.
- extensive local drainage is not required and may in fact cause a long-term reduction in crop yields adjacent to channels.
- keep depth of below-prairie level drains to a minimum even if then above-prairie channels must be dyked, ie., Gillespie Drain.
- alternatively, construct wide, shallow grassed channels, ie., reconstructed one mile of Anderson Drain east of Section 13-11-11W.
- control shallow groundwater levels along the Zone's western boundary.
- find storage sites in Zone 10 to provide consistent streamflows for downstream users.

Internal Problems:

- drain maintenance problems due to wind-borne soil drifting.
- in some years, shallow ground depression areas with near-surface water table cannot be cultivated.
- some areas may benefit from irrigation.

Solutions:

- promote proper land management practices to prevent soil erosion.
- promote shelterbelts and grass buffer strips along drain.
- do not drain shallow depressions wherever negative impacts on local groundwater conditions are possible; consider land-levelling in some cases.
- provide water supply for irrigation purposes where feasible, ie., possibly at Rat Creek reservoir.

Zone 3: **The Sub-Escarpment** in the north central part of the Watershed.

External Problems:

- frequent flood damage adjacent to conveyance channels, caused by excessive spring snowmelt and summer rainstorm inflows from Zones 5 and 6.
- major flow outlets are in generally poor condition and have limited capacity.
- channel reconstruction inhibited by design difficulties and high cost considerations due to the zone's slope and bench topography.
- maintenance of existing conveyances difficult and expensive due to deposition of eroded material from the slopes.

Solutions:

- reduce the number of outlets in the northern half of the Zone and utilize some natural storage areas to moderate peak discharges to lower areas.

Internal Problems:

- conveyance channels built along slopes are erosion-prone due to poor soils.
- channels on the flatter benches difficult to maintain due to poor natural drainage and the variety of soil capabilities.
- inundation of crops in isolated pockets due to intense localized rainstorms.

Solutions:

- develop a Zone-specific water management plan to alleviate conveyance problems, ie.,: map the entire Zone in detail (one meter intervals).
- identify all discrete areas of flat or mildly-sloping land.
- assess the agricultural capability of the soils in these areas to facilitate upgrading through drainage improvements.
- classify each area according to primary water management strategy: improved drainage for crop production, limited drainage for forage and pasture, permanent water storage, or temporary retention.

Zone 4: The Upland Sand Plain in the southwest part of the Watershed.

External Problems:

- no significant surface runoff received from other zones; internally-generated spring runoff contributes to flooding problems in lower zones.
- groundwater discharges from this zone causes problems in Zone 2.

Solutions:

- develop additional potential water storage sites for downstream benefits, ie., stream flow enhancement, irrigation supply and peak flow reductions.
- do not attempt to modify underlying aquifer to reduce groundwater discharge problems in Zone 2.

Internal Problems:

- None

ZONE 5: **The Riding Mountain Alluvial Fan** in the north central part of the Watershed.

External Problems:

- frequent inundation and erosion damage from excessive surface runoff down steep natural water-courses.
- adverse effect on crop production in some areas due to suspected near-surface groundwater levels and poor soil drainage capabilities.

Solutions:

- build a network of interceptor channels along the Zone's western contour to collect and convey surface runoff from the Escarpment to a single large channel through the Zone, ie., the small-scale Award II Drain; this channel if economically justifiable could possibly modify the adverse groundwater conditions in the area.

Internal Problems:

- frequent wet conditions in specific areas caused by local precipitation and possible high groundwater conditions.
- local problems and limitations of the local and on-farm drainage systems are masked by the Zone's conveyance problems.

Solutions:

- Identify those productive lands that have poor natural drainage and inadequate or non-existent artificial drainage.
- provide appropriate-standard local drainage outlets for those lands.
- encourage landowners to construct on-farm drainage systems.
- upgrade collectors in Zone 5 and the conveyance channels in Zone 3 to meet the increased demands imposed by this proposed local drainage system.
- encourage landowners to construct on-farm drainage systems.
- upgrade collectors in Zone E and the conveyance channels in Zone C to meet the increased demands imposed by this proposed local drainage system.

Zone 6: **The Riding Mountain Escarpment** in the northwest part of the Watershed.

External Problems:

- large volumes of snowmelt and rainstorm runoff, carried off by the area's very efficient natural drainage system, adversely affect downstream zones.

Solutions:

- encourage land management practices that maximize percolation of surface water into soil moisture reserves or groundwater.
- identify and investigate additional practical sites for major headwater retention dams with reasonable cost:volume ratios, ie. possibly the Whitemud River between Neepawa and Arden, an enlarged Park Lake south of Neepawa, and the Polonia Valley.

Internal Problems:

- damage to cultivated lands through new channel erosion caused by snowmelt runoff from existing snow-blocked channels.
- sediment and shale load transported further downstream.

Solutions:

- continue current grassed waterway program, ie. rounding out existing channel bottom, removing brush and debris, and seeding to grass.
- reforest lands or leave trash cover on fields adjacent to natural channels to reduce snow blockages and contain snowmelt.
- construct shale traps and gradient control structures.

ZONE 7: **The Upland Till Plain** in the west part of the Watershed.

External Problems:

- surface runoff peaks and volumes sent downstream are increasing as landowners construct drainage outlets from previously non-contributing drainage areas, ie. as they drain the numerous surface depressions or potholes that previously only contributed runoff in extreme events.

Solutions:

- encourage zero runoff farming practices to retain all local snowmelt and rainfall within property boundaries for irrigation use and wildlife habitat.

Internal Problems:

- damage to cultivated lands through new channel erosion caused by snowmelt runoff from existing snow-blocked channels.
- sediment load transported further downstream.

Solutions:

- continue current grassed waterway program, ie. rounding out existing channel bottom, removing brush and debris, and seeding to grass.
- reforest lands or leave trash cover on fields adjacent to natural channels to reduce snow blockages and contain snowmelt.

ZONE 8: **The Big Grass Marsh** in the east part of the Watershed.

External Problems:

- inundation of hay and pasture land within the Zone and of private agricultural lands in surrounding zones when Marsh water levels are high due to excessive inflows from virtually all other zones in the Watershed.

Solutions:

- construct a dyke along the southern boundary of Big Grass Marsh to prevent inundation of adjacent private agricultural land.
- install a control structure at the outlet through the south dyke to limit outflows during flood periods and to retain and regulate optimum water levels for wildlife and forage production during low to moderate runoff periods.
- increase the capacity of the existing channel from the outlet control to the Whitemud River at Woodside.

Internal Problems:

- reconciliation of agricultural interests and wildlife interests with respect to water levels.

Solutions:

- establish the perimeter as a first step in reducing conflicts and develop a land and water plan within the boundary.
- design and install a system of internal drains, dykes and control structures to control water levels within discrete areas of the marsh to maximize forage production in some areas and wildlife production in others.
- land acquisition or flood easements could be obtained for flood prone lands and subsequent management plan be developed for these lands.

ZONE 9: **The Lowland Till Plain** in the northeast part of the Watershed.

External Problems:

- flooding and associated problems adjacent to and downstream of Zone H accentuated by runoff from this zone during extreme events.

Solutions:

- possibly develop some short-term retention storage areas in inter-ridge depressions.

Internal Problems:

- adverse effects on hay and pasture land during periods of excess precipitation due to very poor drainage in the Zone.

Solutions:

- possibly install a modest drainage and control system to gradually draw down water stored in the inter-ridge depressions after excessive precipitation or spring snowmelt events.

ZONE 10: **The Manitoba Escarpment** in the south central part of the Watershed.

External Problems:

- snowmelt and rainstorm runoff down the steep slopes adversely affects downstream zones.

Solutions:

- encourage land management practices to maximize percolation of surface water into the soil, and promote preservation of natural forest vegetation on the steep slopes.

Internal Problems:

- land clearing in the upland escarpment region creating severe gully erosion.
- land clearing at the base of the escarpment creating erosion and downstream siltation of drainage channels.

Solutions:

- promotion of residue management and cover on steep sloped upland areas.
- encourage preservation of natural forest vegetation at the base of the escarpment.

Figure 3.

AGRICULTURAL DRAINAGE STANDARDS

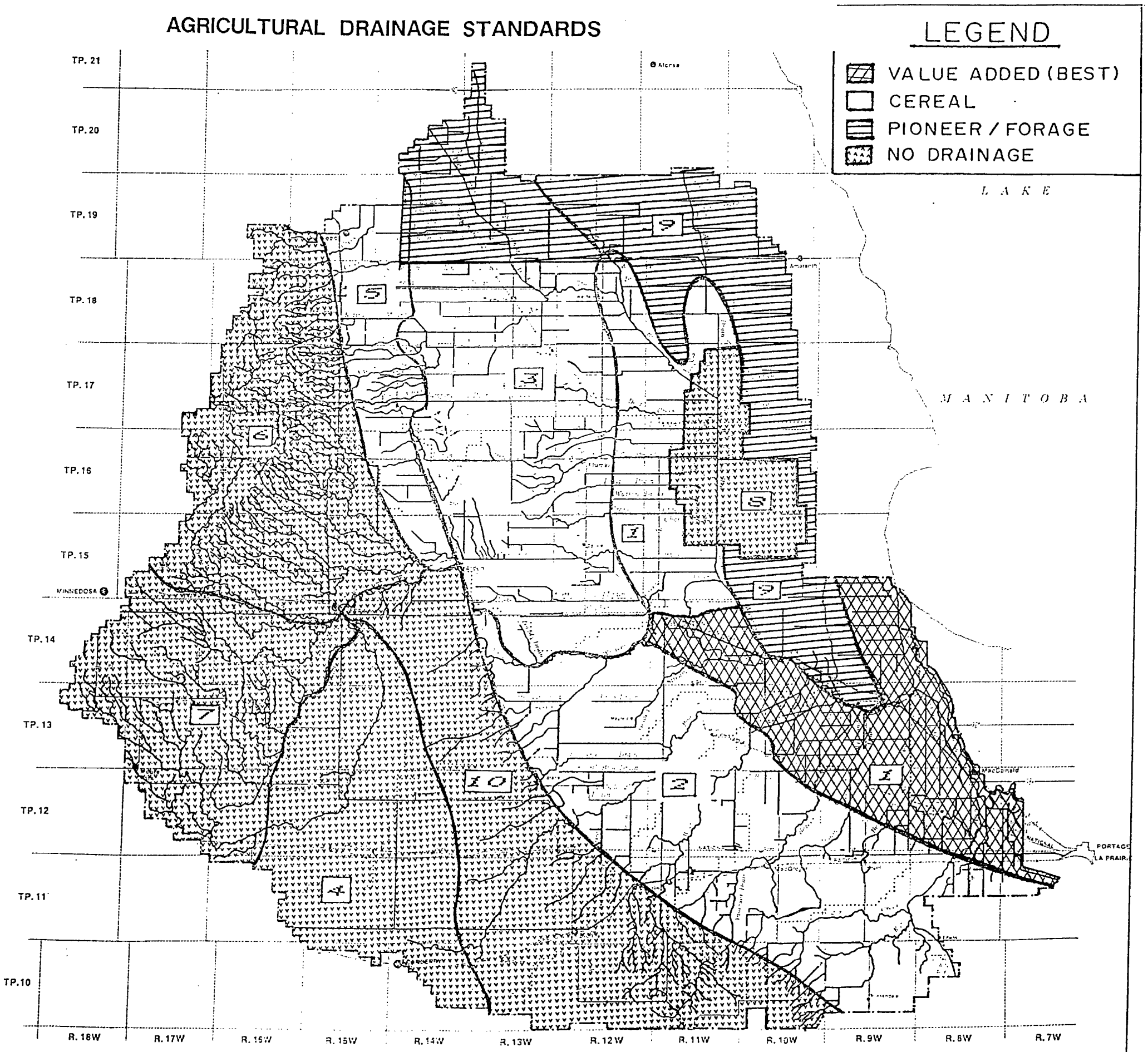
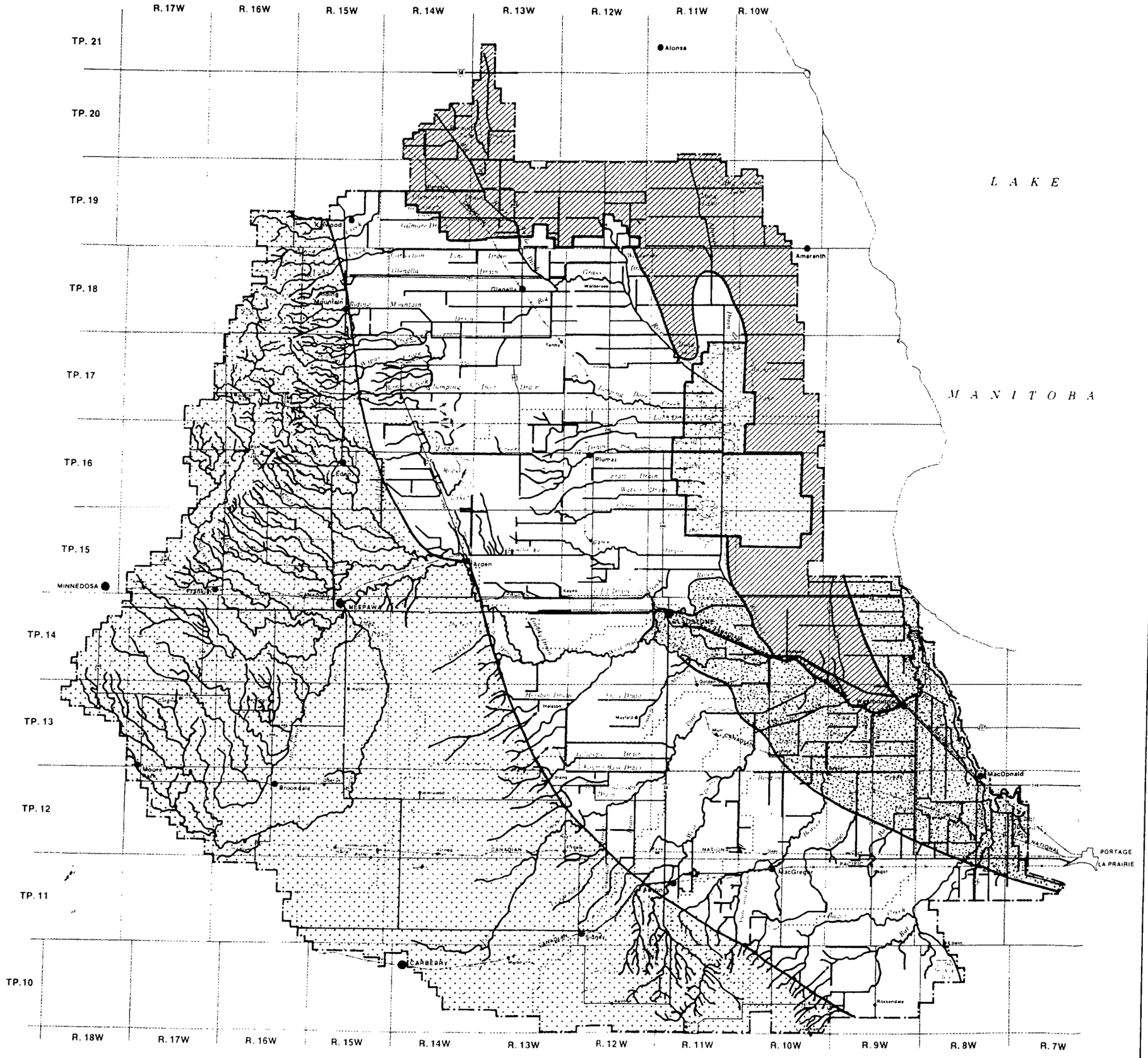


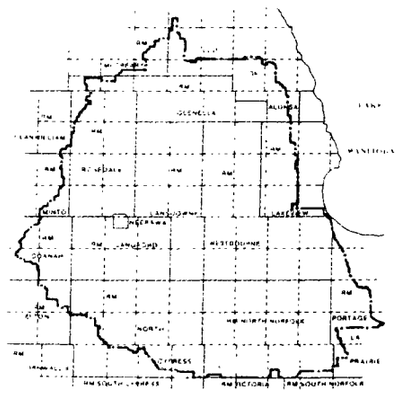
Figure 3

AGRICULTURAL DRAINAGE STANDARDS



LEGEND

- Value Added (Best)
- Cereal
- Pioneer/Forage
- No Drainage



Key Map

Boundaries:

- Conservation District
- Sub District
- Provincial Park

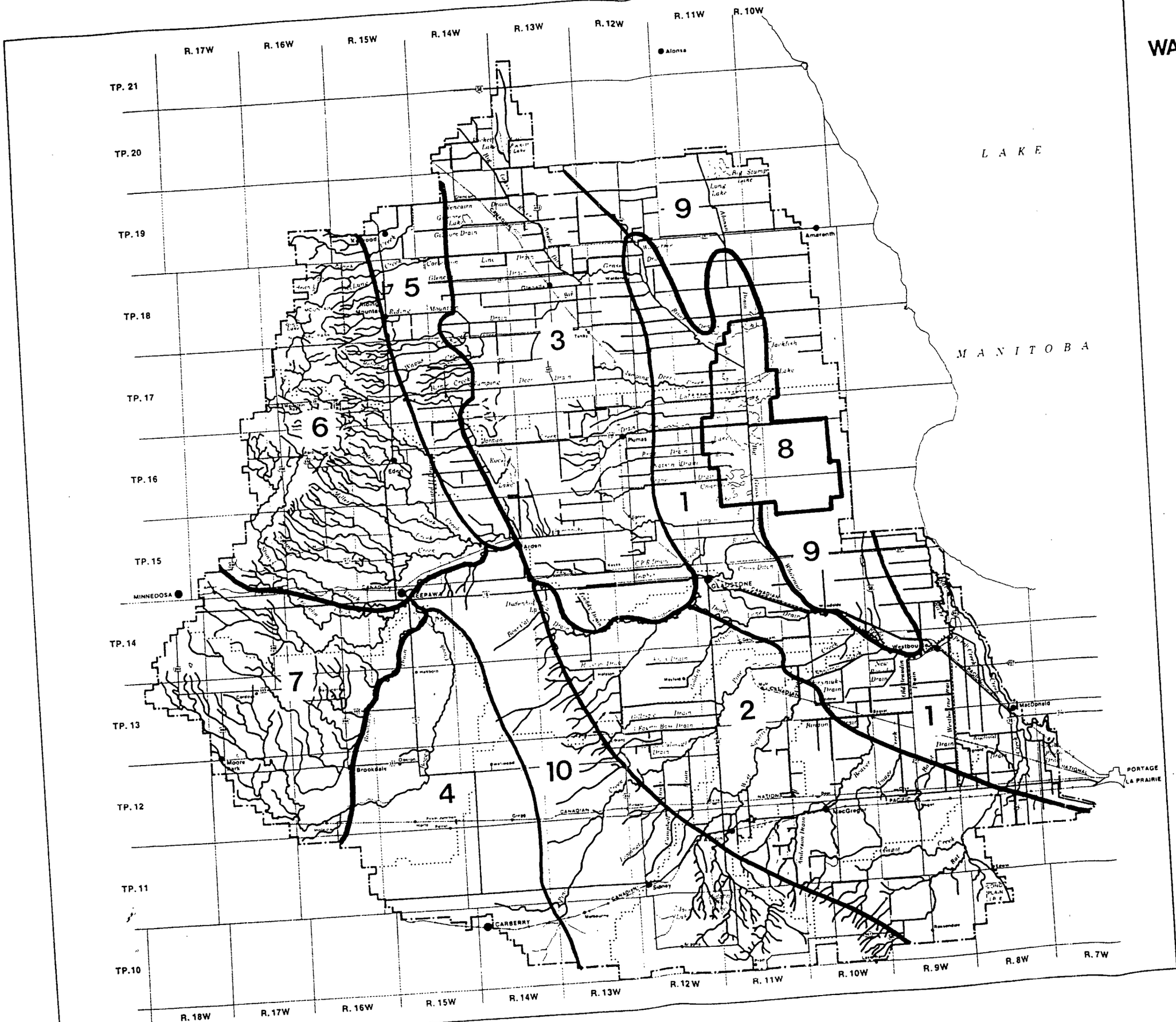
Existing Drains / Watercourses

Manitoba Natural Resources

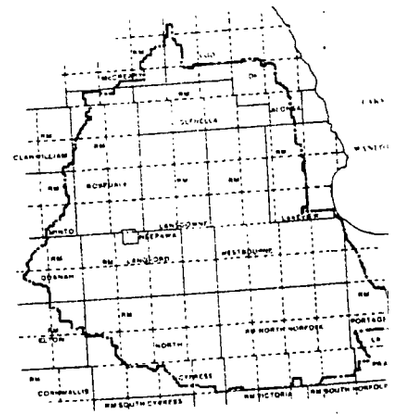
MAP

Figure 2

WATER MANAGEMENT ZONE



ZONE	NAME
1	Lowland Clay Plain
2	Subescarpment Sand Plain
3	Subescarpment
4	Upland Sand Plain
5	Riding Mountain Alluvial Fan
6	Riding Mountain Escarpment
7	Upland Till Plain
8	Big Grass Marsh
9	Lowland Till Plain
10	Manitoba Escarpment



Key Map

Boundaries:
- Conservation District
- Sub District
- Provincial Park

Existing Drains / Watercourses

Figure 1.

SURFACE WATER FEATURES BY PHYSIOGRAPHIC REGION

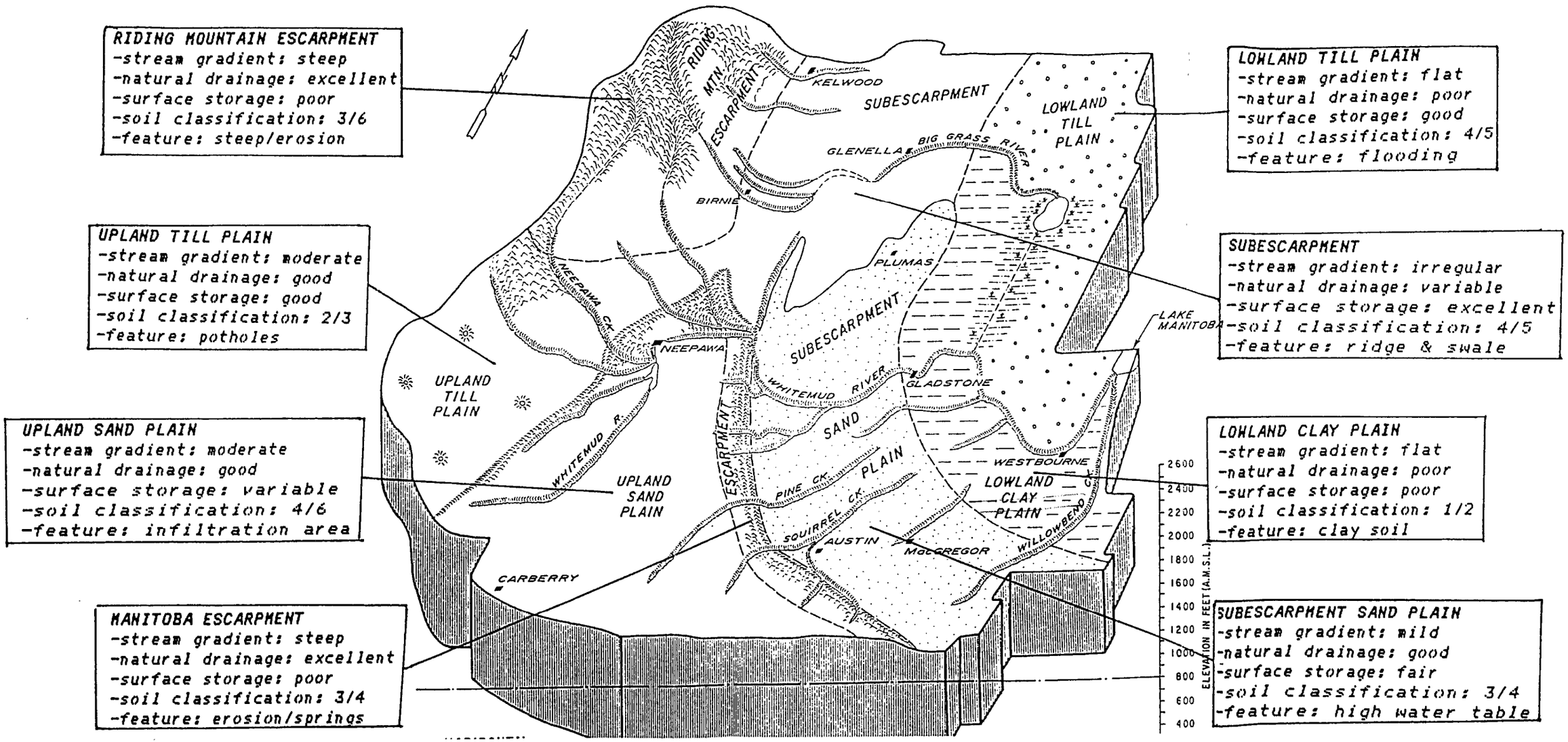


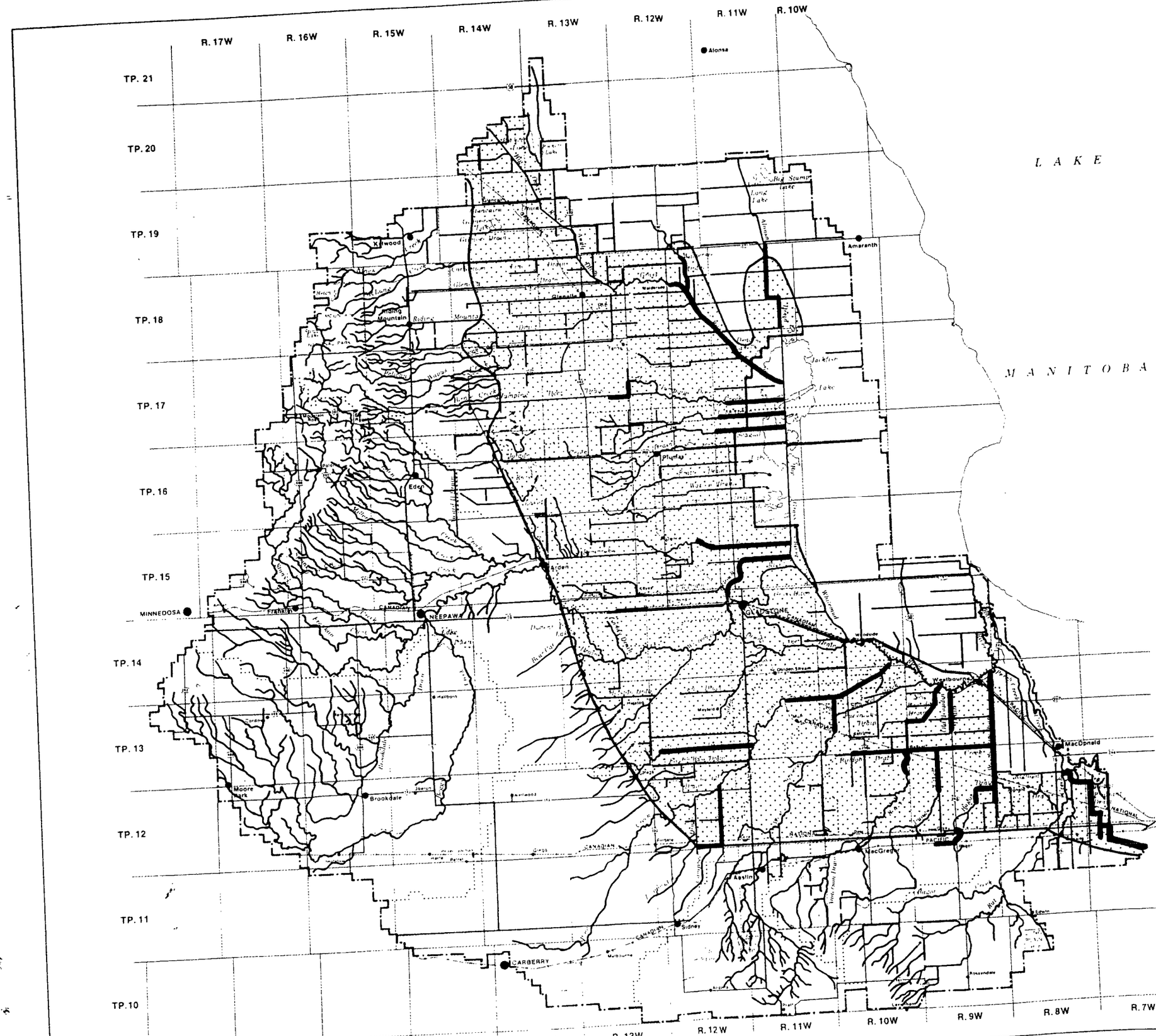
Figure 4

CONVEYANCE CHANNEL PRIORITY AREA

LEGEND

Conveyance Priority

Conveyance Channels Built To Modern Standards



Key Map

Boundaries

Conservation District

Sub District

Provincial Park

Existing Drains / Watercourses

Manitoba Natural Resources

MI 5 0 5 10 MI

Km 5 0 5 10 15 20 Km

MA