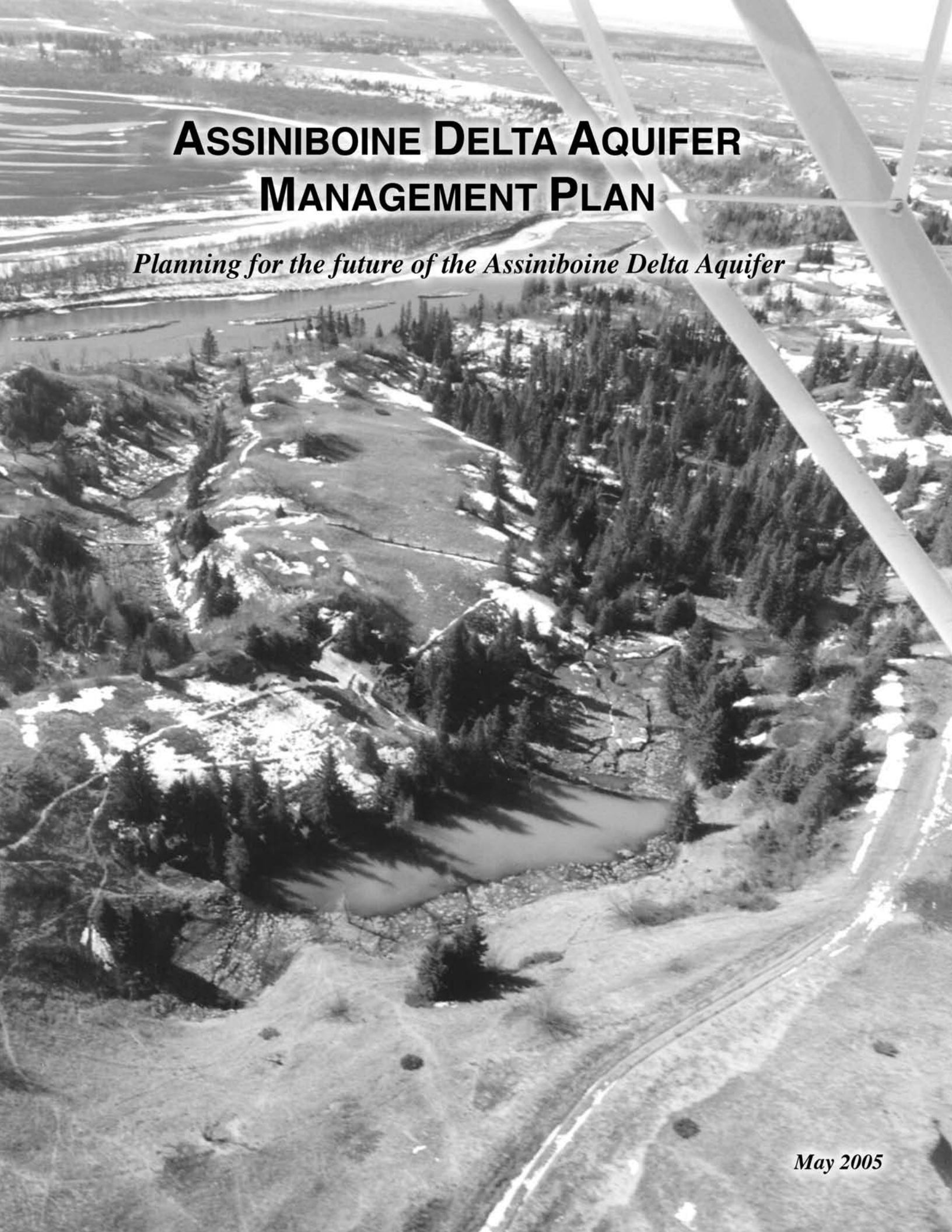


ASSINIBOINE DELTA AQUIFER MANAGEMENT PLAN

Planning for the future of the Assiniboine Delta Aquifer

May 2005

TABLE OF CONTENTS

Logo: the ADA logo derives from the triangular symbol Δ which is the capital form of the fourth letter of the Greek alphabet--delta. A delta is the triangular-shaped deposit of sediments that build up at the mouth of a river as it flows into a body of water.

Δ is used in mathematics and physics to mean 'change'. The flow velocity of a river changes [slows] dramatically as it reaches a lake--resulting in deltaic deposits of gravel, sand and silt. In a broader context, changes and/or improvements in understanding the aquifer and how it should be managed are the ultimate goals of this aquifer management planning process.

The blue and beige colours (darker and lighter shades) within the triangle represent the water and deposits that comprise the aquifer. The vertical blue line extending below the triangle represents the wells that are drilled into the aquifer. The horizontal blue line represents the streams that flow across and through the aquifer.

Cover: Aerial view of Devils Punchbowl in Spruce Woods Provincial Park (March 31, 2004). Water seeps from the aquifer, fills the bowl (foreground) and feeds a small, tree-lined stream that flows to the Assiniboine River.

May 2005

Honourable Steve Ashton
Minister, Manitoba Water Stewardship
Dear Minister:

On behalf of our 45-agency, 43-member Round Table of stakeholder representatives, I am pleased to transmit this management plan for the Assiniboine Delta Aquifer. This plan is the culmination of a three-year, consensus-building process that has been both challenging and rewarding. The success of this plan will largely depend on the continuing support of your department and other key provincial, federal and government-supported agencies--as we move into the implementation phase.

Starting in 2002, the ADA Round Table reviewed extensive information provided by a Technical Advisory Group. The RT supplemented this information with considerable local knowledge and experience. The RT openly discussed many aquifer issues, considered several management options and is recommending the immediate implementation of several action plans focusing on: aquifer monitoring & data analysis; water quantity/quality; irrigation; and awareness education.

As you may recall, in May 2004, a draft management plan was produced. Copies were mailed to approximately 3300 households in the aquifer area. From the outset, the Round Table insisted that the management planning process for the ADA be open and transparent. All stakeholder groups were invited to participate in the process. Every RT meeting was open to the public and videotaped for later broadcast on a local television station. Through RT representatives or via a website, the public could (can) obtain minutes of all meetings, technical reports & presentations and read or download them along with the draft and 'final' plans. This openness and transparency likely contributed to the overall acceptance of the draft plan, with little or no opposition expressed, as had been the case with previous aquifer planning efforts.

During October 2004, two open houses and three public meetings were held in the aquifer area to present the plan and obtain further input from residents. The RT considered this input and incorporated it into the plan. An implementation strategy was developed and is included herein.

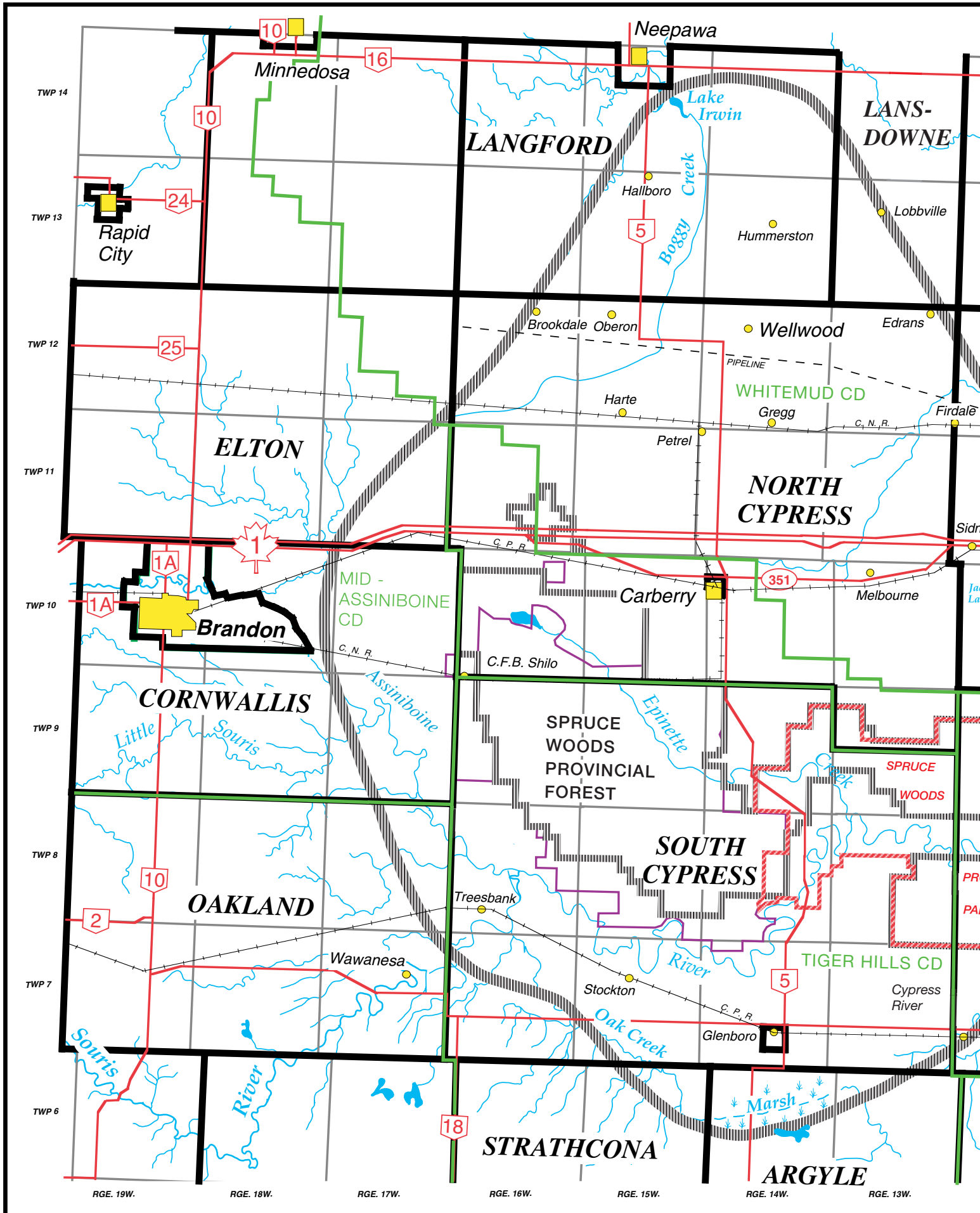
The management plan focuses on keeping aquifer residents informed about aquifer-related water issues and on seeking urban and rural landowner cooperation to protect water quality and quantity. Innovative actions are also being proposed respecting irrigation. We are reassured by your indication that the ADA management plan will be accommodated in future watershed planning under the new Water Protection Act.

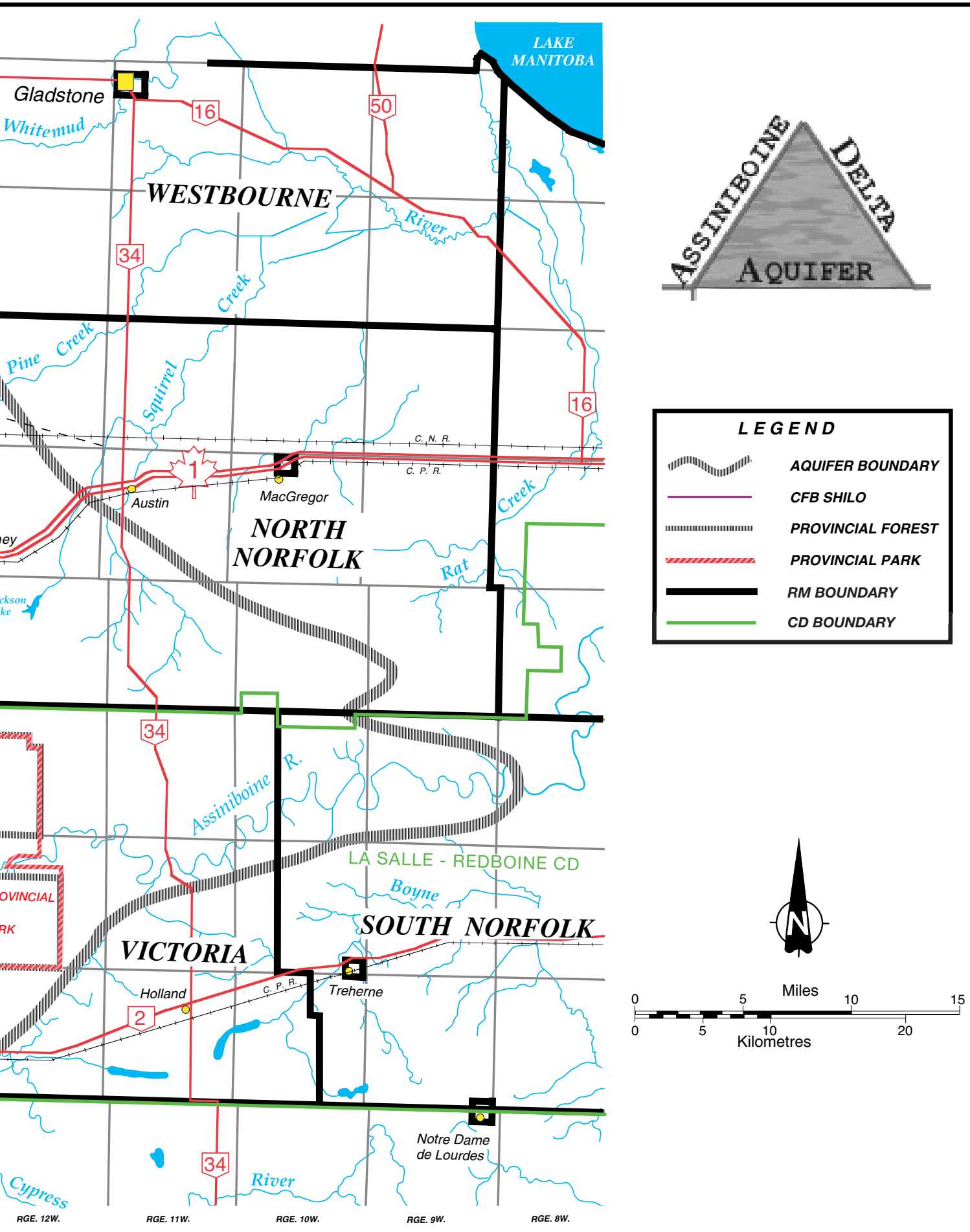
Thank-you for the opportunity to compile this plan and particularly for the coordination by your planning staff who ensured that stakeholder input was adequately and accurately reflected. This has resulted in a plan with approval and support of the aquifer community at large. We also thank the Technical Advisory Group for their dedication, information and advice. The participation by many local organizations, federal, provincial and other agencies should be commended.

Sincerely,

Don Forbes

Round Table Chairperson
Assiniboine Delta Aquifer--Management Planning Process


Minnedosa
Neepawa
Lake Irwin
LANGFORD
LANS-DOWNE
Hallboro
Boggy Creek
Lobbville
Hummerston
Rapid City
Brookdale
Oberon
Wellwood
Edrans
PIPELINE
WHITEMUD CD
Harte
Gregg
Firdale
C. N. R.
Petrel
ELTON
NORTH CYPRESS
C. P. R.
MID - ASSINIBOINE CD
Carberry
Melbourne
Brandon
C. N. R.
C.F.B. Shilo
CORNWALLIS
Little Souris
Assiniboine
SPRUCE WOODS PROVINCIAL FOREST
Epinette Creek
SPRUCE WOODS
SOUTH CYPRESS
OAKLAND
Treesbank
Wawanesa
River
TIGER HILLS CD
Stockton
Cypress River
C. P. R.
Oak Creek
Glenboro
Souris River
Marsh
STRATHCONA
ARGYLE
TWP 14
TWP 13
TWP 12
TWP 11
TWP 10
TWP 9
TWP 8
TWP 7
TWP 6
RGE. 19W.
RGE. 18W.
RGE. 17W.
RGE. 16W.
RGE. 15W.
RGE. 14W.
RGE. 13W.


LAKE MANITOBA
Gladstone
Whitemud
16
50
WESTBOURNE
River
34
Creek
Pine Creek
Squirrel
16
C. N. R.
C. P. R.
1
Austin
MacGregor
NORTH NORFOLK
Creek
Rat
34
Assiniboine R.
LA SALLE - REDBOINE CD
Boyne
SOUTH NORFOLK
VICTORIA
Holland
C. P. R.
Treherne
2
Notre Dame de Lourdes
34
Cypress River
RGE. 12W.
RGE. 11W.
RGE. 10W.
RGE. 9W.
RGE. 8W.
ASSINIBOINE DELTA AQUIFER
LEGEND
AQUIFER BOUNDARY
CFB SHILO
PROVINCIAL FOREST
PROVINCIAL PARK
RM BOUNDARY
CD BOUNDARY
N
0 5 10 15
Miles
0 5 10 20
Kilometres

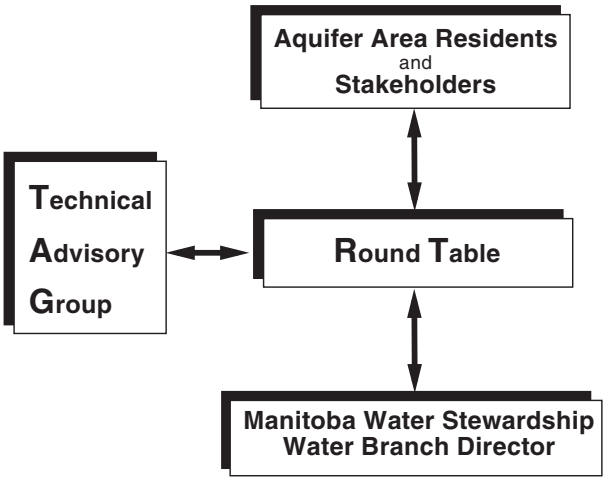
PLAN DEVELOPMENT

A successful aquifer management plan requires the input and support of all stakeholders--individuals and groups.

Through their Round Table members, stakeholders developed the plan.

Using a consensus process, Round Table members:

- considered all data and information related to the aquifer & study area;
- identified, discussed and documented aquifer issues, opportunities & management options;
- developed and recommended aquifer management plans for present and future generations.



Plan Goals:

- aquifer protection
- sustainable use
- sustainable economic development

A successful planning **process** will:

- take account of the land, water and related resources;
- include the interests and participation of all stakeholders.

ROUND TABLE
METHOD OF OPERATION

- **The Round Table (RT) shall request the coordinator to make available such employees of participating agencies, as may be required, to provide technical advice and information on aquifer related issues and opportunities.**
- **The RT shall elect from its membership a chairperson and a vice-chairperson.**
- **RT members shall receive no payment from Manitoba Water Stewardship for out-of-pocket expenses for attending meetings.**

ROUND TABLE
TERMS OF REFERENCE

- **The RT shall work together with the other resource owners, users and managers to formulate a management plan that documents: management guidelines, protection and sustainable use of the land and water resources associated with the Assiniboine Delta Aquifer.**
- **The RT and a technical advisory group (TAG) shall provide local residents with technical and educational information on aquifer issues and opportunities.**
- **The RT in conjunction with the TAG shall obtain and synthesize local inputs respecting aquifer issues and opportunities.**
- **The RT in conjunction with the TAG shall apply the Manitoba water policies during development of the aquifer management plan.**

Manitoba Water Stewardship is assuming a direct leadership role in addressing unresolved water issues, mainly: aquifer water quality protection and water availability limits to support development while protecting sufficient quantities to sustain human and environmental uses--including water in streams on the aquifer.

Manitoba Water Stewardship recognized that a wide variety of stakeholders wanted the support and/or stability that a management plan would provide and also wanted input into such a plan.

In spring 2001, local authorities were consulted and agreement was reached that a Round Table (RT) of stakeholders representing diverse interests in the aquifer area should be established and a consensus-building process used to enable preparation of an aquifer management plan.

A Technical Advisory Group (TAG) was also established to support the efforts of the Round Table and the overall planning process.

It was agreed that: the plan should take account of all resources in the area; the aquifer should be managed in a sustainable manner; previous work should be considered; and most importantly, an implementation strategy should be part of the plan.

In December 2001, representatives of interested organizations registered to participate and by February 2002, the first Round Table meeting was convened.

The 45-agency,43-member Round Table represents:
10 municipalities, 6 communities, 1 First Nation, 2 planning districts, 3 conservation districts and 23 other organizations.

TECHNICAL ADVISORY GROUP

Representative	Organization
Bob Eilers / Walter Fraser	Agriculture and Agri-Food Canada - Western Land Resource Group, Wpg.
Bruce Webb	MB Conservation - Environmental Approvals
Daniel Chranowski	MB Conservation - Western Region
Darryl Chudobiak	Fisheries and Oceans Canada - Central and Arctic Region.
David Hay	MB Agriculture, Food & Rural Initiatives, Agri-Environment Branch
Doug Bell	MB Conservation - Environmental Stewardship
Duane Kelln	MB Water Stewardship - Surface Water Management
Garnet Shearer	CFB Shilo - Environment and Property Management
Heather Groom	MB Ind., Economic Dev. & Mines, Geological Services - Mineral Resources
Joel Hunt	MB Water Stewardship - Fisheries Habitat Management
Kevin Teneycke	MB Habitat Heritage Corporation (MHHC)
Laurie Frost	MB Water Stewardship - Groundwater Management
Lorry Broatch	Manitoba Crop Diversification Centre - Carberry
Pat Rakowski	Environment Canada - Canadian Wildlife Service
Perry Stonehouse	MB Water Stewardship - (Western) Regional Operations Division
Peter Haluschak	MB Agriculture, Food & Rural Initiatives - Agri-Environment Branch
Phil Weiss	MB Water Stewardship - Manitoba Water Services Board
Rob Matthews	MB Water Stewardship, Water Licensing
Rod McFadyen	MB Conservation - Parks & Natural Areas
Ron Tompkins	MB Intergovernmental Affairs and Trade - Community Planning Services
Shane Tornblom	MB Conservation - Forestry
Stella Fedeniuk	Agriculture and Agri-Food Canada (PFRA) Brandon

Planning Coordinators:

Alan Skrepnek	MB Water Stewardship - Planning and Coordination Branch
Barry Oswald	MB Water Stewardship - Planning and Coordination Branch

STAKEHOLDERS

ROUND TABLE

Representative	Organization
Rod Waterhouse	Assiniboine Delta Aquifer Irrigators Incorporated
Allan Reynolds	Assiniboine Delta Concerned Citizens
Rod McLaren	Association of Irrigators of Manitoba
Sarah Sobry	Brandon & Area Planning District / City of Brandon
Al Rogosin	Brandon Naturalists Society
Garnet Shearer	Canadian Forces Base - Shilo
Don Forbes (Chair)	Carberry and District Community Development Corporation
Randy Turner	Carberry and District Chamber of Commerce
Brian Drysdale	Carberry Collegiate/Beautiful Plains School Division
Wayne Blair	Cypress Planning District
Dwight Ferguson	Gladstone-Westbourne Economic Development Committee
Dan Mazier	Keystone Agricultural Producers (KAP)
Eric Adriaansen	Keystone Vegetable Producers Association
Claire De'Athe	Manitoba Cattle Producers Association
Darwin Donachuk	Manitoba Water Stewardship - Water Branch
Shelley Buchan	Manitoba Health
Dale Tomasiewicz	Manitoba Horticulture Productivity Enhancement Centre Inc.
Tom Baron	Manitoba Pork Council
Lloyd Lintott	Manitoba Wildlife Federation
Don Rioux	McCain Foods (Canada)
Bob Hyra	McCain Foods (Canada) (Formerly Midwest Food Products Inc.)
Gerry Oliver	Mixed-grass Prairie Stewardship Program / The Seton Centre
Gerry De Smet	Pembina Valley Conservation District
Scotty McIntosh	R.M. of Cornwallis
Ross Farley	R.M. of Elton
Barry Mikkelsen	R.M. of Langford
Leonard Paramor	R.M. of Lansdowne
Ralph Oliver	R.M. of North Cypress
Dennis Jarema	R.M. of North Norfolk
Earl Malyon	R.M. of South Cypress
Tom Kelly	R.M. of South Norfolk
Les Ferris	R.M. of Victoria
David Single (Vice Chair)	R.M. of Westbourne
Larry Soldier	Swan Lake First Nation
Jack Hamilton	Tiger Hills Conservation District
Ed Drabyk	Town of Carberry
Catherine Smith	Town of Gladstone
Bill Stilwell	Town of Neepawa
John McNeily	Trans-Canada Trailboard to Carberry/North Cypress
Bill Kalinowich	United Food & Commercial Workers International Union - Local 798
Bill Shackel	Village of Glenboro
Dean Boyd	Village of Wawanesa
Roy McConnell	Whitemud Watershed Conservation District

STUDY AREA

GEOGRAPHIC SETTING

The study area is located in south central Manitoba—centered on Carberry. The topography is nearly flat to gently rolling. On the eastern side of the study area, there are some deep valleys associated with the Assiniboine and Whitemud Rivers and other streams where there are abrupt and distinct, 100-foot changes in relief.

A wide range of soils and landscapes occur in the area. There are extensive areas of well and imperfectly drained loamy sand to clay loam soils. The cool, subhumid climate of the region provides a suitable environment for grassland vegetation. In some areas, wind action has modified the landscape resulting in areas of sand dunes.

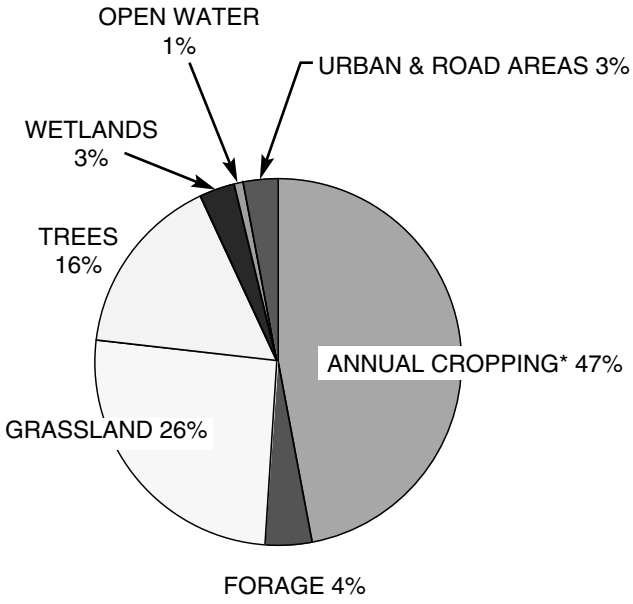
In riparian areas and areas such as the Douglas Marsh and Devils Punch Bowl, species of flora and fauna are particularly dependent on the aquifer's water table which is exposed at the surface.

The major industry of the area is agriculture. Dry land agriculture and livestock operations are quite extensive. Irrigation is essential for growing potatoes and other crops. Based on soil characteristics, about 40% percent of the area is considered to be good to excellent for irrigation, with another 35% considered fair. McCain Foods' processing plant at Carberry, where potatoes are processed into a variety of finished food products, is the major component of this industry.

Canadian Forces Base Shilo in the southwest portion of the study area contributes considerably to the area's economy.

Tourism and recreation in the area are associated mainly with Spruce Woods Provincial Park and Spruce Woods Provincial Forest.

LAND USE



*** Approx. 17% of the annual cropland is irrigated in any given year**

Approximately 2,200 urban and 7,400 rural residents live in the area, all depending on the aquifer for their water supply.

Almost the entire municipalities of North Cypress and South Cypress are within the study area. Significant portions of Cornwallis, Langford, North Norfolk and Victoria are within the study area with small portions of Lansdowne, South Norfolk, Argyle, Strathcona, Oakland and Elton.

The urban population consists mainly of the larger communities of Carberry, Glenboro and CFB Shilo. Smaller communities include: Brookdale, Wellwood, Edrans, Sidney, Cypress River, Stockton, Treesbank, Sprucewoods and Douglas.

There are numerous communities in close proximity to the aquifer including: City of Brandon, towns of Neepawa and Gladstone, villages of MacGregor, Treherne, and Wawanesa, and smaller communities such as Austin and Holland.

In recent years, the populations of these communities have been relatively stable. The communities showing significant population growth over the past several decades are Brandon and Neepawa.

A significant portion of the study area is owned by the Crown--mainly Spruce Woods Provincial Park and Forest--a portion of the latter is utilized as a military training area.

Much of the Crown land has low capability for agriculture and is in a natural condition with rare and distinctive landform, vegetative and wildlife features. There are extensive areas of privately owned lands that are also in a generally natural condition, e.g. the area adjacent to Pine Creek.

AQUIFER AREA POPULATION ESTIMATES

MUNICIPALITY	ESTIMATED AREA [1] (square miles)	ESTIMATED POPULATION (2001 census)
R. M. of Elton	19	280
R. M. of Cornwallis [2]	76	2,250
R. M. of Oakland	23	80
R. M. of Strathcona	13	30
R. M. of Argyle	40	95
R. M. of South Cypress [3]	400	1,426
R. M. of North Cypress [4]	439	3,313
R. M. of Langford	108	400
R. M. of Lansdowne	25	55
R. M. of North Norfolk	145	910
R. M. of Victoria	174	510
R. M. of South Norfolk	64	240
TOTALS	**1,526**	**9,589**

[1] Excludes land in road allowances
[2] Includes CFB Shilo population
[3] Includes Town of Glenboro
[4] Includes Town of Carberry

SURFACE WATER RESOURCES

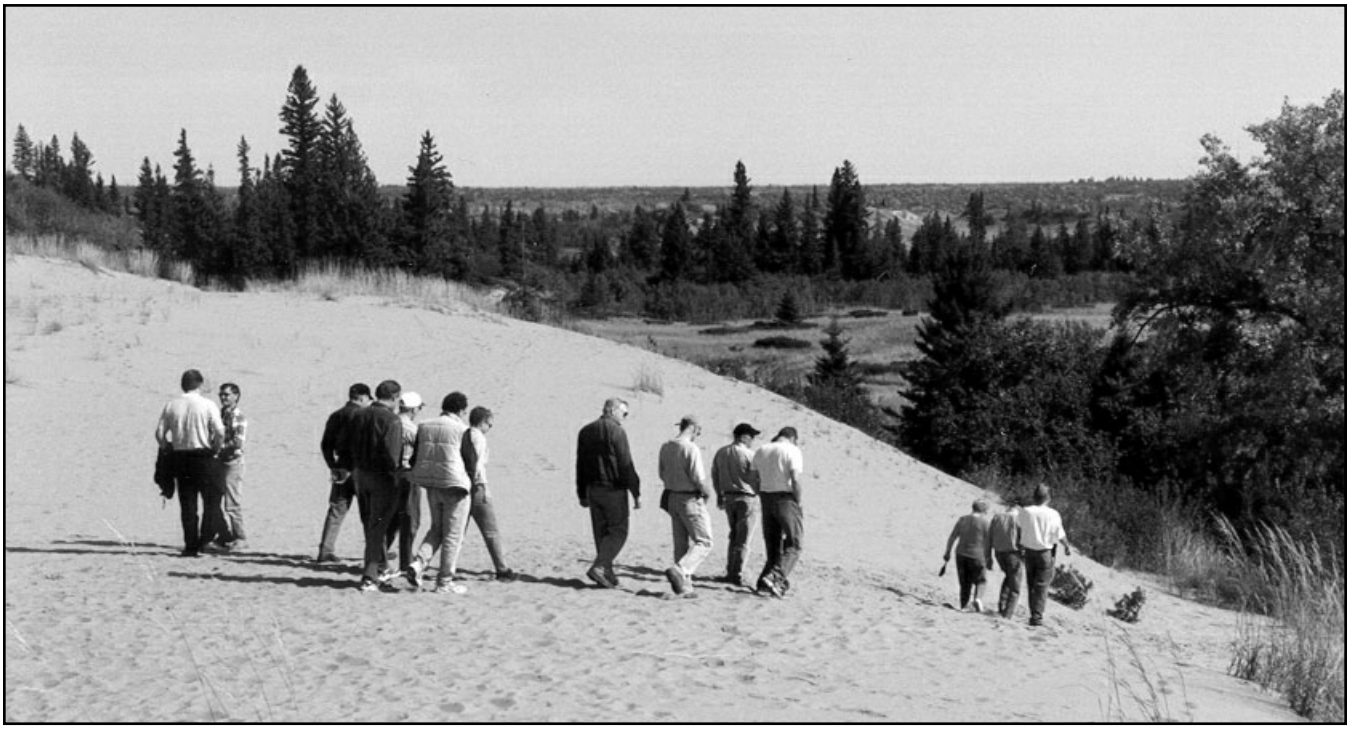
The average annual precipitation in the study area ranges from 18 to 21 inches with growing season amounts ranging from 13 to 15 inches. Annual precipitation varies greatly, much received during summer storms. The average frost-free period ranges from 108 to 117 days.

There is little surface runoff in the study area and consequently a minimal drainage network and few small lakes and wetlands have developed. This is due to the coarse textured soils that allow most of the rainfall that reaches the ground and most snow melt to infiltrate. The few local waterways that exist have small streamflows and much of their annual runoff volume comes from the aquifer via springs located in their channels and banks where they have eroded beneath the aquifer water table.

Two man-made reservoirs (Jackson Lake and Lake Irwin) have been constructed for water supply and recreation purposes.

Two regional waterways that cross the aquifer (Assiniboine and Souris Rivers) have eroded below the aquifer water table throughout the study area. Consequently, these rivers do not recharge the aquifer; they are spring fed by it. Aquifer discharges to these waterways are estimated on average, to be 145 cubic-feet per second (106,000 acre-feet per year).

It is expected that aquifer discharges to the surface water regime will decrease over time as aquifer water use increases.



THE AQUIFER

ORIGINS

The Assiniboine Delta Aquifer (ADA) is a water bearing deposit of sand and gravel lying below a 1500 square mile area centered around Carberry. The Assiniboine River carried these deposits into a bay of glacial Lake Agassiz. As the river entered the lake and water velocity decreased, sediments were deposited creating a large river delta.

Following the drainage of Lake Agassiz about 10,000 years ago, the delta deposits became embedded into the landscape with the post-glacial Assiniboine River flowing across them. Over time, these deposits were eroded by wind and water and a sparse surface drainage network developed. The Assiniboine and Souris Rivers are continuing to erode into and through these sandy materials. Vegetation has colonized most of the area except for a few square miles of active sand dunes. Fresh water has filled the deltaic materials and this water-filled unit is the Assiniboine Delta Aquifer.

PHYSICAL ENVIRONMENT

The aquifer deposits are about 50 miles across and up to about 140 feet deep. The aquifer has an average saturated thickness of 45 feet and a maximum saturated thickness in excess of 100 feet. The depth from ground surface to the aquifer's water table ranges from zero at Devils Punchbowl and Douglas Marsh to a maximum of about 70 feet.

For this planning process, the outer edge or boundary of the aquifer is defined as the location where its saturated thickness diminishes to five feet.

The aquifer is unconfined by any overlying impermeable layers. Along the western side, the aquifer rests on glacial till. Throughout the remainder of the aquifer, the sands rest on a layer of silt and clay covering the till.

The aquifer body is comprised mainly of sands and in the western portion, some gravel. Given the dynamic deposition history, there can be considerable difference in the sand grain sizes and thicknesses over short distances. In general, as is characteristic of delta aquifers, the larger and heavier sediments were deposited first (near the mouth of the river in the west and central portions of the aquifer) and the smaller and lighter particles were dropped last (further out into the lake, near the northern, eastern and southern edges of the aquifer). As a result, higher pumping rates needed for irrigating are attainable mainly in the west and central portions of the aquifer where the particle sizes are larger.

WATER REGIME

The aquifer contains approximately 12,000,000 acre-feet of water. It is supplied or recharged by precipitation and it supplies water to: 1) waterways running off and through it, 2) surface vegetation (mainly riparian) that can access its water table, and 3) human uses via pumping. Approximately 65% of the aquifer's discharge to streams enters tributaries of the Assiniboine River and 35% enters tributaries of the Whitemud River.

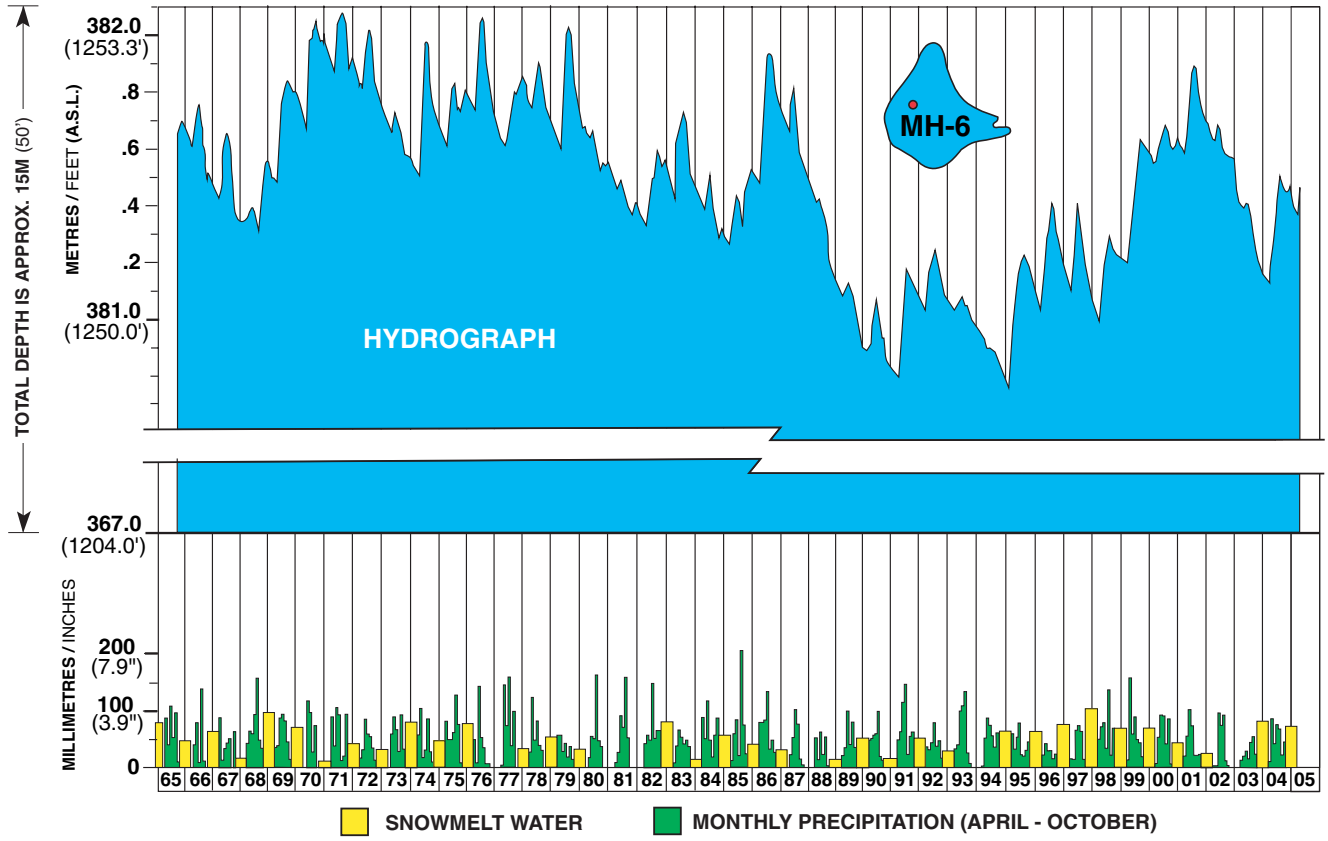
Only about 10% of study area precipitation recharges the aquifer. About 85% evaporates when intercepted by ground or vegetative surfaces and when vegetation roots extract it from the soil profile and transpire it through their leaves. The remaining 5% either runs off in surface waterways before entering the aquifer or is used for water supply purposes.

A graphic illustrating precipitation amounts and groundwater levels recorded at monitoring station/well MH-6 since 1965 is presented below. This well is located in the west central portion of the aquifer, several miles from any development. Data collected at this location provides information on the elevation of the water table and illustrates the long-term influence of climatic conditions on this level.

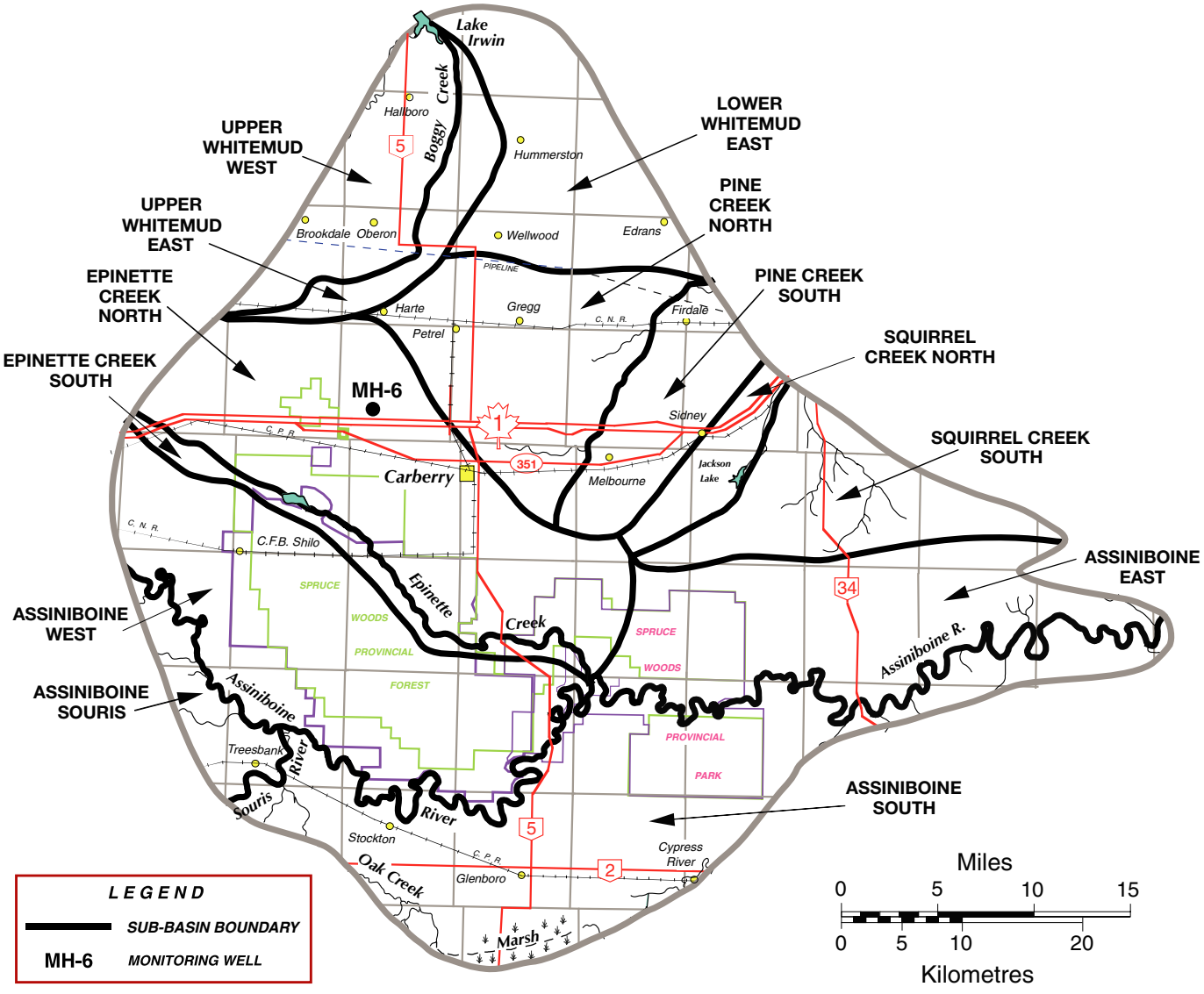
The graph shows that groundwater level changes correlate with snowmelt infiltration and large rainfall events or lack thereof. The peaks indicate that some recharge has occurred in every year since 1965. The groundwater level at this location was highest in 1971 and lowest in 1995. In about 85% of aquifer area wells, water levels fluctuate 1-3 metres on average.

AVERAGE ANNUAL GROUNDWATER LEVELS & PRECIPITATION

Ground Surface Elevation = 388.5 metres (1274.6 feet)



ADA SUB-BASINS



Generally, areas with higher water tables correspond to topographic highs or hills and areas with low water tables correspond to lower elevations or surface waterways. Lateral water movement through the aquifer is from areas with a high water table to those with a low water table. Based on this groundwater flow principle and using available water level information, the aquifer has been divided into 13 sub-basins as illustrated by the map above. Generally, the sub-basins function independently--groundwater does not move from one sub-basin to the other.

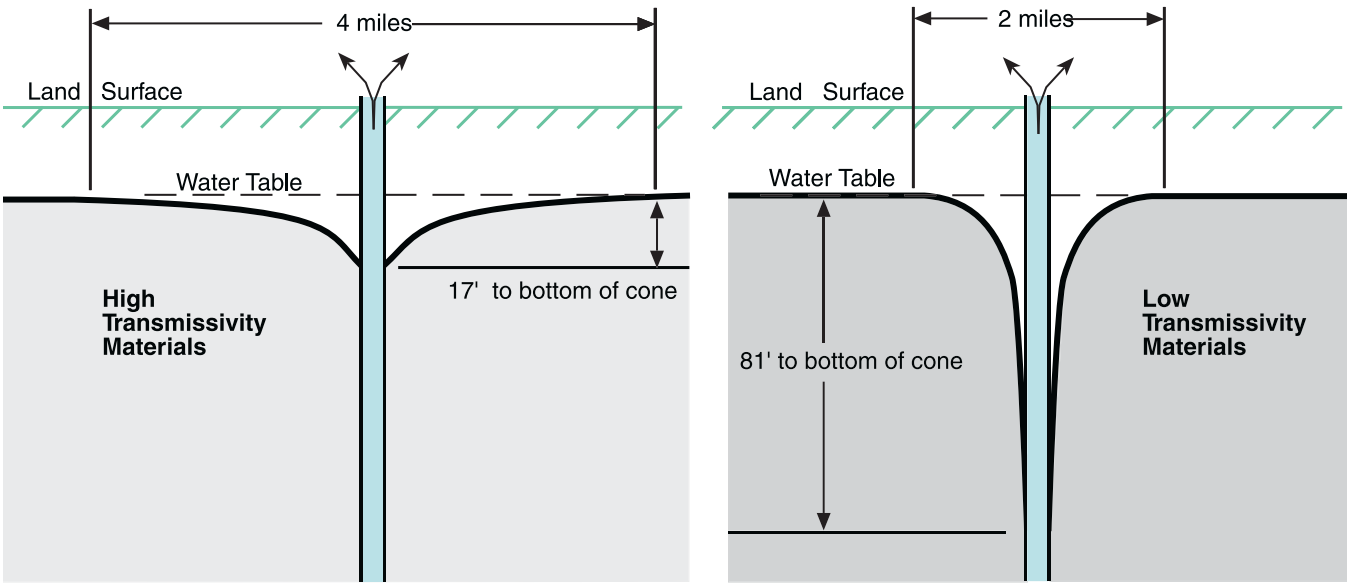
When a well is installed and water is pumped from the aquifer, the local water table is altered. A depression cone forms as water moves slowly through the soil to replace the groundwater removed. This cone of de-watered soil is centered around the well. The depth and width of the cone is dependent on the *rate that the aquifer materials transmit water* (transmissivity) and on the pumping rate.

The figure below illustrates typical depression cones in aquifer materials with high and low rates of groundwater movement. This figure represents typical irrigation wells being pumped at 583 (700 US) gallons per minute. In materials having high transmissivity, the cone is relatively shallow (17' at the well) with a wide top (4 miles) and in materials having low transmissivity, the cone is relatively deep (81' at the well) with a narrow top (2 miles).

There are not many locations north of Hummerston, east of Firdale, Cypress River or south of PTH #2 where a well can provide water at the rate needed for irrigation.

Before granting a water rights licence, the potential for a depression cone to impact other wells is carefully considered.

WATER TABLE DEPRESSION CONES



Note: both wells being pumped at 583 gpm

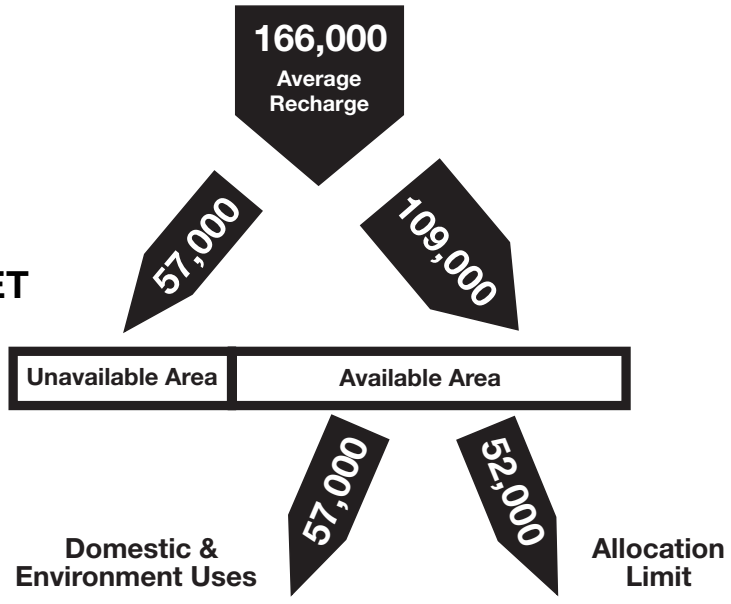
WATER BUDGET

An aquifer's sustainable yield is equal to its average annual recharge. This is the maximum rate at which water can be continuously discharged from the aquifer without causing a permanent lowering of the aquifer's water levels. The sustainable yield for the Assiniboine Delta Aquifer is estimated to be 166,000 acre-feet per year. Annual discharges in excess of this amount would, over the long term, deplete water stored in the aquifer.

The provincial government sets allocation limits for licensed water use from the aquifer and its sub-basins according to the following two-step rationalization process. The average annual recharge is 166,000 acre-feet. Of the total 1,500 sq. mi. above the aquifer, 500 are considered unavailable for development. This area is mainly provincial park, provincial forest and CFB Shilo as well as riparian areas and wetlands where the surface vegetation depends on the aquifer water table for survival. The 57,000 acre-feet of the annual recharge that infiltrates in these areas is currently considered unavailable for licensed use. This reduces the available portion of the aquifer's sustainable yield to 109,000 acre-feet per year.

Manitoba allocates, for licensed use, up to 50% of the aquifer's available yield. This portioning was established in 1991 with input from a previous ADA stakeholder group. The remaining 50% is reserved for environment (streamflows, wetlands, riparian vegetation) and domestic users. This "50% rule" is followed in 11 of the aquifer's sub-basins. In two of the sub-basins (Upper Whitemud East and West) the allocation limits have been reduced to 15% and 30% respectively to ensure additional protection of aquifer-fed streamflows for downstream uses. Consequently, the total allocation limit for the aquifer is 52,000 acre-feet per year. (See Annual Water Budget figure below).

ANNUAL WATER BUDGET
(acre-feet/year)



WATER USE AND DEMAND

Prior to 1960, water demand from the aquifer was primarily for domestic and farm use: Canadian Forces Base Shilo and Towns of Carberry and Glenboro. There was little demand for licensable water use. In the mid-1960s and early 1970s, a potato processing plant and two irrigated seed potato sites were developed near Carberry. In the late 1980s, following a hot, dry period, water demand for irrigated potato production increased significantly. Over the last two decades, there has been a marked increase in demand for irrigation and industrial water uses.

As of May 1/05, allocation for 241 licensable projects on the aquifer is approximately 30,000 acre-feet/year. Project details are as follows:

USE	AC-FT PER YR.	NO. OF PROJECTS
Irrigation	24,500	220
Industrial	3,800	5
Municipal	1,550	8
Other Agricul.	150	8

This leaves about 22,000 acre-feet of water that could still be licensed before the aquifer reaches full allocation. (See Allocation Status table below).

Domestic water use up to 5500 gallons per day (7.4 acre-feet/year) for household and livestock watering is exempt from requiring a water rights licence. All other water uses do require a licence. The domestic exemption

ALLOCATION STATUS (acre-feet/year)

SUB-BASIN (See Map on p. 14)	AVAILABLE YIELD	ALLOCATION LIMIT	ANNUAL ALLOCATION	AVAILABLE ALLOCATION
WHITEMUD				
Upper Whitemud West	6519	2063*	1973*	90
Upper Whitemud East	4236	636	637	0
Lower Whitemud East	8521	4260**	3183**	1077
Pine Creek North	11000	5500	5602	0
Pine Creek South	5692	2846	1836	1010
Squirrel Creek North	3015	1507	233	1274
Squirrel Creek South	7126	3563	347	3216
SUB TOTAL	**46109**	**20375**	**13811**	**6667**
ASSINIBOINE				
Epinette Creek North	18000	9000	8953	47
Epinette Creek South	335	167	128	39
Assiniboine East	15900	7950	256	7694
Assiniboine South	17754	8877	2815	6062
Assiniboine West	8256	4128	4148	0
Assiniboine Souris	2866	1433	21	1412
SUB TOTAL	**63111**	**31555**	**16321**	**15254**
TOTAL	**109220**	**51930**	**30132**	**21921**

* includes proposed well near Oberon
** includes proposed well near Hummerston

applies to most rural residents and to community residents who are not connected to a community water distribution system but have their own wells. The sustainability of these domestic supplies is protected by the 50% rule.

In 1997, aquifer water consumption for municipal and domestic purposes was estimated at 2,300 acre-feet per year. It is projected that in 50 years, water demand will increase to about 3,500 acre-feet per year. (See Municipal and Domestic Water Use and Projected Demand table below).

MANAGEMENT

Current aquifer management is based on Manitoba Water Policies and on Manitoba Water Stewardship procedures.

The general hydrogeological framework for the aquifer was investigated by Manitoba in the mid-1960s and several groundwater monitoring stations were established. Manitoba conducted detailed aquifer capacity studies in the early 1980s, with funding support from the federal government (Prairie Farm Rehabilitation Administration).

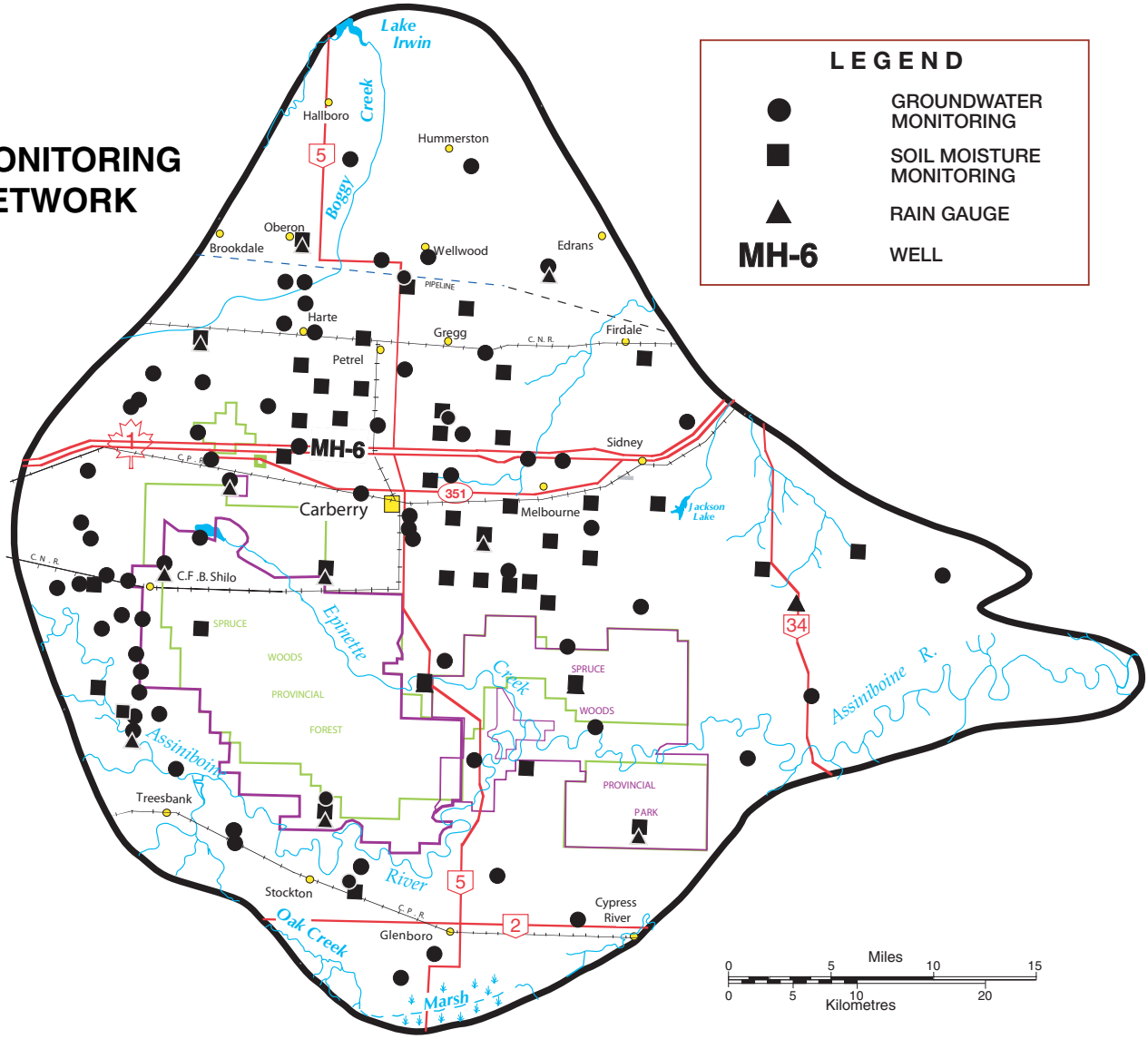
Field investigations included: drilling 103 test holes, collecting and analyzing 2,000 soil samples, installing 62 monitoring stations, conducting 20 single well pumping tests at monitoring stations, and 18 at farm irrigation wells, contracting for nine standard multi-day pumping tests, establishing and operating precipitation monitoring networks, metering streamflow, measuring soil moisture, and satellite investigations of ground cover. Manitoba conducted additional investigations in the mid-1990s when 25 monitoring stations were established for collecting water level and soil moisture data and six for collecting precipitation information.

MUNICIPAL / DOMESTIC WATER USE AND PROJECTED DEMAND *
(acre-feet/year)

1997 USE			20-YEAR DEMAND		40-YEAR DEMAND		50-YEAR DEMAND	
Location	**Population**	**Demand**	**Population**	**Demand**	**Population**	**Demand**	**Population**	**Demand**
Neepawa	3258	415	3970	637	4840	860	5324	944
Gladstone	928	115	1122	132	1356	160	1491	176
Glenboro	674	55	817	76	986	103	1084	114
Austin/MacGregor	1475	121	2070	170	2840	232	3124	256
Carberry	1481	120	1811	168	2200	230	2420	254
Plumas	308	25	355	34	426	45	468	49
Shilo (CFB)	3300	672	3300	672	3300	672	3300	739
Subtotals (urban)	**11424**	**1523**	**13445**	**1889**	**15948**	**2302**	**17211**	**2532**
Rural	2200	753	2200	808	2200	900	2200	991
Totals	**13624**	**2276**	**15645**	**2697**	**18148**	**3202**	**19203**	**3523**

*Some of this use does not require licensing

MONITORING NETWORK



The existing aquifer monitoring network is displayed above. Data is collected from this network and evaluated on a regular basis.

Existing investigative work has allowed for detailed mapping of the aquifer water table, defining of the aquifer sub-basins and estimates of the aquifer's sustainable yield. The upper Pine Creek sub-basin is considered ideal for estimating the aquifer's hydrologic budget. This area has land cover and land use representative of the rest of the aquifer. The data and evaluation of this area was used as the basis from which to estimate the sustainable yield for the aquifer's sub-basins and for Manitoba's other two major sand and gravel aquifers, namely Winkler and Oak Lake.

Water licensing allocation limits have been set for each sub-basin based on consideration for the environment and for domestic users (as discussed in the previous, WATER BUDGET section). Additional water licensing requests are evaluated based on the sub-basin's allocation status and on the potential for additional groundwater withdrawal to impact surrounding water users (as discussed in the previous, WATER REGIME section).

AQUIFER ISSUES

A management plan must address issues and concerns of stakeholders. Throughout this management planning process, many previous but continuing issues and concerns were discussed. Other issues and concerns evolved during meetings that included presentations of extensive technical information by the TAG and by other individuals and group representatives. Representatives of RT member organizations brought extensive local knowledge, experience and expertise to the table. In the following section, the key aquifer issues and concerns are summarized.

Generally, main issues and concerns relate to accommodating increasing water demands on the aquifer while maintaining and protecting the ability of the aquifer to support human and environmental needs in a sustainable manner. The porous nature of the soils over the aquifer and proximity of water table to land surface in some areas make the aquifer highly susceptible to contamination from sources such as, but not limited to: sewage, petroleum products, fertilizers, manure and pesticides.

SUSTAINABLE YIELD ESTIMATION

In the 1990's, the water budget of the Pine Creek area was studied. This area was chosen because it was considered representative of the entire aquifer. The area was instrumented and data was collected and analyzed to evaluate sustainable yield. The results were subsequently applied to the entire aquifer.

Some question arose respecting the validity of these determinations of the sustainable yield of the ADA. However, these results were subsequently supported by an analysis of streamflow records on the Assiniboine River.

50%, 30% & 15% ALLOCATION LIMITS

Questions arise from time to time about whether or not the 50%, 30% and 15% allocation limits are still appropriate. That is, should these allocation limits be increased or decreased?

There have been expressed desires to increase these limits so as to increase opportunities for water using developments. Others emphasize that adequate amounts of groundwater must be reserved for domestic and environmental needs.

WATER DEMANDS INCREASING

Over the last several decades, water demands have been increasing and it is anticipated that this trend will continue. In contrast, the sustainable yield of the aquifer (as calculated) is a fixed amount. Concern exists, particularly among local residents, about dependability of water supplies for domestic and municipal purposes--for uses related to economic growth as well as for sustainability of base flows.

While the aquifer has ability to recover from short term pressures, it is recognized that as local economy expands and as supplies and/or quality diminishes, further pressures will be placed on the aquifer over the long term.

INADEQUATE WATER USE RECORDS

Irrigation licensees are required by legislation to submit annual water use data--but few licensees have complied with this requirement. In several sub-basins, this data is an essential component of aquifer water budget computations and analysis. Several approaches have been tried to obtain this information but historically, only about 20% of irrigators have submitted this data.

OFF-AQUIFER REQUESTS

From time to time, requests for water from the aquifer are made to supply areas beyond the aquifer. This has raised concerns about how water should be allocated, for what purposes, and how water supply requests would affect: the aquifer, current aquifer users and future uses. Under current water legislation, available water supplies are allocated in the interests of all Manitobans on a first come, first serve basis. Requests are not denied just because they are off-aquifer.

Off-aquifer requests for water are also subject to Manitoba's environmental licensing review process. This process incorporates public input, includes public hearings if needed and requires consideration and mitigation of local impacts.

Furthermore, off-aquifer requests have been relatively small water volumes for domestic and municipal supplies for nearby towns and surrounding areas. Neepawa, Gladstone, Austin and MacGregor currently rely on surface waterways that receive discharge from the aquifer. Two pipeline proposals would alter this situation somewhat.

The Yellowhead West proposal is to supply water directly from the aquifer to Neepawa via a well near Oberon; and to Arden, Plumas, Ogilvie and surrounding rural areas via a well near Hummerston. (The aquifer currently supplies water to Neepawa indirectly via Boggy Creek and Lake Irwin.) The Yellowhead East proposal is to service Gladstone, Austin and MacGregor from the Assiniboine River.

WATER SUPPLY AUGMENTATION

Additional supplies have been requested to meet increasing demands--particularly for irrigation and industrial purposes. There have been various suggestions to augment supplies: increase the 50% allocation limit, access water in undeveloped areas, develop water sharing among licensed users, increase natural recharge, and recharge the aquifer using water from the Assiniboine River. These suggestions are discussed below.

The 50% allocation limit seems to have provided adequate environmental protection and allowed for significant water development. It is possible that the full range of climate conditions has not yet been experienced and that this limit has yet to be fully tested. However, it is also possible that an increased allocation limit would still provide sufficient water table protection.

Water could be extracted, in accordance with the 50% limit, from beneath some portions of Spruce Woods Provincial Park, Spruce Woods Provincial Forest and Canadian Forces Base Shilo without negative effects on surface vegetation. This could be the case in areas where the water table lies far enough below the surface that surface vegetation is not dependent on it.

It could also be true in areas where, subsequent to a limited lowering of the water table, vegetation could extend root systems to continue accessing it.

Annual water allocations for irrigation are not always used in their entirety due to operational considerations (e.g. different field sizes, crop rotation needs). Current licensing restrictions preclude sharing of such unused water allocations with other producers. Some form of provincial government-approved water sharing could allow this allocation to be used on a regular basis.

Natural recharge could be enhanced by trapping snow and/or by slowing or detaining runoff in areas where infiltration would be increased.

Artificial recharge could be done by pumping water from the Assiniboine River and allowing it to infiltrate into the aquifer near an irrigation well. Such pumping (at less than typical irrigation pumping rates) for extended periods prior to the irrigation season, could be economical and could build a water table mound centered on an irrigation well which could subsequently be available to supply water during the irrigation season.

WATER QUALITY

Protecting the aquifer's water quality is of paramount importance. The main concern is leaching of potentially harmful contaminants. Allowing contaminants to be introduced could degrade the quality of water used each year as well as the much larger volume of water in storage. Restoration of such a large aquifer's water quality could be a very long and expensive task and might not even be possible.

Based on monitoring and analysis to date, the quality of water within the aquifer is considered, in general, to be good to excellent. However, concern exists where nitrate concentrations are becoming elevated above baseline levels.

IRRIGATION ALLOCATION VOLUMES

The amount of water allocated for irrigation licences in the Assiniboine Delta Aquifer area is approximately 8". This guideline is based on an estimate of usage on an average annual basis. This guideline is one that needs to be reviewed from time to time and possibly revised. If licence allocation amounts could be reduced, additional licences could be granted without exceeding allocation limits on any sub-basin.

OPTIONS CONSIDERED

Long-term sustainability of the aquifer to support water demands is of paramount importance and needs to be addressed. The aquifer is considered extremely valuable and worth additional effort to manage, sustain and protect. Given numerous users of, diverse interests in, and increasing water demands--developing and implementing a management plan for the aquifer is considered essential to help ensure adequate water quantity and quality for present and future generations.

The livelihoods of many Manitobans, on and off the aquifer, depend on direct and indirect benefits of the aquifer. A safe and secure water supply must be sustained for drinking and for maintenance of the environment upon which people depend. It is also important that the aquifer can continue to support local and regional economies.

Several aquifer issue and management considerations are documented below. Some options are considered desirable and some undesirable. An attempt is made to briefly document the reasoning.

SUSTAINABLE YIELD ESTIMATION

Additional analysis could be conducted on another sub-basin to verify the Pine Creek analysis. However, this option is considered undesirable because the approach used in this analysis seems reasonable and the application of the results throughout this and other aquifers has been successful.

Computerized modeling of groundwater flow regimes has been continuing to develop. It might be possible to better understand the ADA using the latest techniques in this respect. Researching and evaluating such models with a view to modeling the ADA is considered a desirable option. Such a model would provide additional information on the aquifer's sustainable yield and allocation limits. It would also more easily assess the effects of land use changes.

50%, 30% & 15% ALLOCATION LIMITS

In order to satisfy increasing water demands, some consideration was given to raising the 50% allocation limit in the hope that there would be no adverse environmental impacts. However, this option was considered undesirable. It is considered necessary to ensure that surface environment and domestic water user needs are protected as stipulated by the Water Rights Act and by the provincial water policies.

Some consideration was also given to raising the 15% and 30% allocation limits in the Upper Whitemud East and West sub-basins. This option is considered undesirable because these special limits protect licensed users downstream including Neepawa, Springhill Farms hog processing plant and Gladstone as well as environment needs.

The Yellowhead East and West regional pipeline projects could result in some adjustment of these limits but the overall

availability of water in these two sub-basins is not expected to change significantly.

WATER SUPPLY AUGMENTATION

A higher (60%, for example) allocation limit could be established in an agreed upon area on a trial basis, for an appropriate period of time to try and assess sustainability of increased water use. However, this is considered an undesirable option at this time. Firstly, a full range of climatic extremes has not been experienced since the 50% allocation limits were reached. Secondly, because of the lack of water use records, there is considerable uncertainty about what portion of allocations are actually used.

There may be areas within Spruce Woods Provincial Park, Spruce Woods Provincial Forest and Canadian Forces Base Shilo beneath which groundwater could be extracted without compromising the environment. A working group (membership decided by the Round Table and TAG) could be formed for a fixed duration to determine if and where such areas exist. This is considered a desirable option because the water beneath these areas is largely undeveloped (currently considered unavailable).

A working group (membership decided by the Round Table and TAG) could be formed for a fixed duration to develop and submit a proposal whereby unused portions of individual licensees' allocations could be shared among other licensed irrigators. This option is considered desirable because productive potential of this licensed water is currently lost.

The previous two options would require an increased level of cooperation among irrigators and provincial water licensing authorities. A coordinated development plan would have to be established, approved and followed. Such projects would require, on behalf of irrigators, a shared infrastructure: cooperatively designed, constructed and maintained. These options would complicate provincial licensing and monitoring responsibilities and require establishment of new licensing agreements and procedures.

Technically, the aquifer could be artificially recharged in the vicinity of an irrigation well using Assiniboine River water. This water could then be used during the subsequent irrigation season. However, Manitoba Water Stewardship's policy is to prohibit such artificial recharge because of risk to aquifer water quality--Assiniboine River water generally being poorer in quality than aquifer water.

INADEQUATE WATER USE RECORDS

Irrigation water use records could be collected by a newly formed agency acting on behalf of irrigators in the area and submitted annually to Manitoba Water Stewardship. This is considered a desirable option because this data is necessary for analysis of the aquifer's current and future functioning. Provincial efforts to obtain this data have been unsuccessful. This data would also allow a determination of the appropriate amount of water to allocate to an irrigation licence.

ENHANCE NATURAL RECHARGE

Land and water management practices that detain runoff and consequently enhance infiltration and groundwater recharge could be encouraged. Such practices include snow trapping, establishing shelterbelts, and contour cultivation.

Constructing surface water impoundments along streams for recharge purposes might be beneficial and feasible in some areas.

Wetlands and riparian zones could be protected and native vegetation could be retained to enhance infiltration while reducing soil erosion and enhancing wildlife habitat and biodiversity.

Options enhancing natural recharge and environmental conditions are considered desirable.

OFF-AQUIFER REQUESTS

New legislation could be sought to deny future requests for off-aquifer uses and to cancel such licences. This is considered an undesirable option because it would likely be unsuccessful. Provincial legislation in this respect has been in place since 1930. Furthermore, licensable, off-aquifer water volumes for critical domestic and municipal uses are small compared to total irrigation and industrial water use volumes.

Draft **PLAN DISTRIBUTION, PUBLIC PARTICIPATION & INPUT**

In May 2004, a draft management plan was completed and published. During the latter part of May, copies were made available for the public through RT representatives or TAG members and copies were placed in local municipal offices, libraries and agency offices with an interest in land and water issues. An electronic copy was posted on the Town of Carberry website. In mid-September, copies were provided to area schools and *a copy was mailed to each of approximately 3300 households* (houses, apartments & farms) in the aquifer area including CFB Shilo.

Aquifer residents were invited to provide comments and ideas in several ways: via RT and TAG members; by completing and returning a postage-paid survey form in the draft report; by participating at advertised public meetings; or through the Town of Carberry website. The website pages with ADA information were 'visited' quite frequently. Between July and October 2004, there were over 900 'hits' on the draft plan and 6600 'hits' on the various background documents and reports that are also posted.

From the outset, the RT insisted that the management planning process for the ADA be open and transparent. All stakeholder groups were invited to participate in this process. Every RT meeting was open to the public and videotaped for later broadcast on a local television station. Through RT representatives or the website, the public could (can) obtain minutes of all meetings, technical reports or presentations.

Several RT representatives indicated their membership was satisfied with the process. The public at the evening meetings raised a few pertinent questions and generally, complimentary and supportive comments on the plan and process were received. Overall, the survey respondents were complimentary and very much in favour of the management plan; collectively, the recommended actions were given an agreement rating of 84%.

- Almost all survey respondents wanted additional action by government and/or a designated agency to ensure the amount of water used for irrigation is reported as required by licence and/or legislation.

- Several survey respondents indicated that operators and industries should be required to report the types and amounts of chemicals they apply as well as details on amount and quality of any discharge water. The main concern expressed was to ensure that nitrates and other contaminants are not put into the aquifer.

- Several survey respondents stressed the importance of "awareness education". A representative comment was: "…if people realize where their water comes from and how it may become contaminated, then they will become concerned and involved individuals."

RECOMMENDED ACTION PLANS

The following actions are recommended after considering: previous studies and reports; updated technical information; key aquifer issues; management options; and public input.

MONITORING & DATA ANALYSIS PLAN

A good understanding of the aquifer by area residents and decision-makers will help ensure its long-term sustainability. Continual monitoring and data analysis are essential aspects of an aquifer management plan. Judicious management requires a look at what has occurred and what is occurring.

Goals and objectives:

- ensure data collection & analysis continues across the entire aquifer.
- utilize water usage data to evaluate adequacy of the 50% allocation limit.
- support management recommendations and proposed initiatives on the aquifer.
- prepare reports (every 3-5 years) on status of water quantity and quality.
- support additional research to help understand long term trends e.g. impacts of climate change.
- ensure adequate testing for nitrates and other potentially harmful contaminants--to identify long-term trends impacting water quality.
- analyze water usage data to determine appropriate water allocation amounts for irrigation licences.
- investigate the development of a computerized model to better understand the ADA, its sustainable yield and allocation limits.

WATER QUALITY / QUANTITY PLAN

A secure supply of water is essential for the viability of the study area. Protecting the aquifer supply requires that water use be less than, or balanced with, recharge capabilities over the long term.

Due to the porous nature of soils over the aquifer, susceptibility to contamination is high. Protecting water quality requires prevention of potential contaminants from infiltrating or leaching into the aquifer.

Goals and objectives:

- promote water conservation to reduce demands--especially as allocation limits are approached.
- review the allocation limits periodically and ensure that appropriate changes to limits are made.
- identify and encourage by education and/or incentives, land and water management practices that enhance or maintain water quantity & quality.
- discourage, by communication, regulation or bylaw, practices and activities that are known to compromise water quantity or quality.
- identify areas where water quality is of particular concern and ensure monitoring in such areas is adequate to identify potential long-term impacts or trends.
- review and adjust plan to ensure that it accommodates changing regulations or local concerns.
- inventory areas within Spruce Woods Provincial Park, Spruce Woods Provincial Forest and Canadian Forces Base Shilo beneath which groundwater could be extracted without compromising the environment. Determine access conditions and infrastructure requirements for developing water resources under these areas.

IRRIGATION CO-MANAGEMENT PLAN

The irrigation industry over significant parts of the aquifer has reached its development limit under current operating rules and procedures. Efficiency of the current 50% limit could be increased if cooperation among irrigators and the provincial government could be enhanced.

Goals and objectives:

- identify/establish an agency (e.g. irrigation district) that would function on behalf of irrigators' mutual interests by ensuring that irrigation water use records are collected and submitted annually to Manitoba Water Stewardship.
- establish and implement a procedure to allow water-sharing among licensed irrigators that would attempt to fully utilze and remain within water allocation limits.

AWARENESS EDUCATION PLAN

Implementation of a management plan depends on understanding and cooperation of a large group of people with various interests in, and uses of, the aquifer. It is more likely that the aquifer will be valued, protected and sustained if more people have a better understanding of how it works.

Goals and objectives:

- inform people throughout the study area and beyond about the aquifer.
- distribute information to encourage use of beneficial management practices affecting water quality and quantity including information respecting the sealing of abandoned wells.
- facilitate compilation and distribution of periodic status reports on water quality and quantity and related water resource issues to councils and other organizations.

ACTION PLAN IMPLEMENTATION

As outlined in the previous section, the Round Table reached consensus on four action plans. Associated with each action plan is a set of goals and objectives--goals generally requiring more time to achieve than objectives.

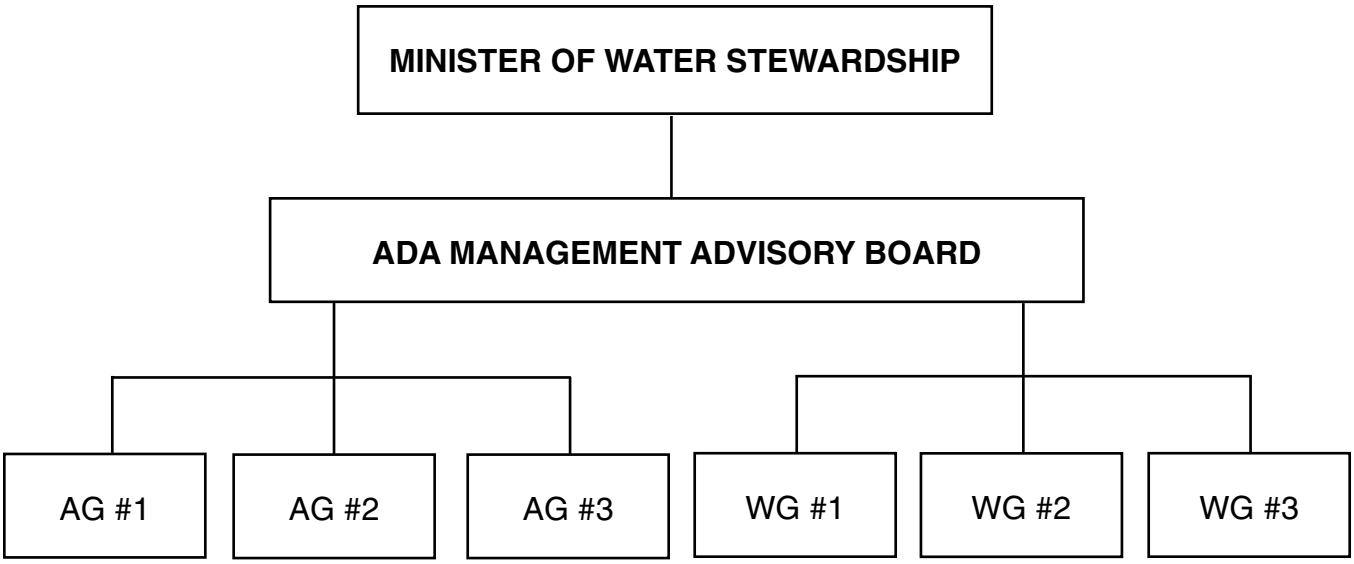
Continuing participation and cooperation of several dedicated groups of representatives will be needed to carry out the work associated with each action plan. These groups will draw their members from both RT and TAG organizations.

The RT agreed that an **ADA Management Advisory Board** be established to:

- coordinate action group (AG) and work group (WG) activities;
- report on plan implementation progress; and
- advise provincial authorities on aquifer-related conditions, management issues and opportunities.

As early as February 2005, several RT organizations began indicating their willingness to have a representative actively participate on the new board. The RT and TAG disbanded after the last RT meeting on March 23/05.

The board will likely meet 1-2 times per year and prepare a report every 1-2 years. The following reporting lines are envisaged:



Three action groups (AGs) comprised mainly of representatives from the former TAG and RT will carry out the work associated with three action plans, respectively:

1) monitoring & data analysis (AG #1);
2) water quantity/quality (AG #2); and
3) awareness education (AG #3).

The above activities are long-term, ongoing tasks. Therefore, the AGs are expected to be long-term, ongoing groups.

Three ad hoc work groups (WGs) also comprised mainly of representatives from the former TAG and RT will carry out specific tasks associated with the water quantity/quality plan and with the irrigation co-management plan as follows:

1) complete an inventory of undeveloped areas where groundwater could be safely extracted and determine the related access conditions and infrastructure implications (WG #1);

2) collect and submit water use records (WG #2); and

3) establish and implement a water allocation sharing procedure (WG #3).

The WGs are expected to set their respective target completion dates at their initial meetings.

Both the AGs and WGs will regularly report to the board on their activities and progress and suggest to the board if any changes should be made to their mandates.

Membership and participation on the board, action groups and work groups will remain flexible to accommodate advice and inputs from all interested organizations.

Some Aquifer Facts

	IMPERIAL	METRIC
Area	1500 sq. mi.	3900 sq. km
Average Saturated Thickness	45 feet	14 m
Maximum Saturated Thickness	100 feet	30 m
Storage Capacity	12,000,000 ac-ft	15,000,000 dam^3
Average Recharge (Sustainable Yield)	166,000 ac-ft/yr	205,000 dam^3/yr
Available Yield	109,000 ac-ft/yr	134,000 dam^3/yr
Allocation Limit (licensable)	52,000 ac-ft/yr	64,000 dam^3/yr
Current Allocation	29,000 ac-ft/yr	36,000 dam^3/yr
Average Annual Precipitation	18-21 inches	460-530 mm
Average Annual Frost-Free Period	108-117 days	

An acre-foot of water is the volume of water that would cover one acre to a depth of one foot. It is a common imperial unit of measure for water. Its advantages include being based on commonly understood units of measure and being a large enough unit of volume to conveniently keep water planning numbers more manageable.

Water use of 5,500 imperial gallons (25,000 litres) per day for one year is equal to 2,007,500 gallons or 7.4 acre-feet--no licence being required for domestic use below this limit as per The Water Rights Act.

The aquifer's average annual recharge (166,000 ac-ft/yr) is $^1/_{72}$ of its total storage capacity (12,000,000 ac-ft).

Equivalents of Measure

1 acre-foot = 271,379 imperial gallons = 1.23 cubic decametres (dam^3)
1 imperial gallon = 4.55 litres = 1.2 US gallons
1 sq. mi. = 640 acres = 259 hectares = 2.59 sq. km
1 ft. = 0.3048 metres (304.8 mm)
1 in. = 25.4 mm

ASSINIBOINE DELTA AQUIFER

Summary of **ACTION PLAN GOALS & OBJECTIVES**

Monitoring & Data Analysis Plan

- ensure continued collection and analysis of quantity & quality data
- evaluate adequacy of allocation limits using water usage data
- prepare and distribute reports on both of the above on a regular basis
- support additional aquifer research including computerized modelling

Water Quantity/Quality Plan

- ensure long-term sustainability of water quantity and quality
- promote water conserving ideas and methods
- evaluate and report on appropriateness of licensed allocation limits
- discourage activities that compromise water quantity or quality
- identify any areas 'of particular concern' and ensure adequate monitoring
- investigate opportunities for obtaining water from undeveloped areas

Irrigation Co-Management Plan

- improve the submission and collection of water use records
- develop a water allocation sharing procedure

Awareness Education Plan

- facilitate aquifer awareness and understanding
- prepare and distribute periodic reports on the aquifer

View this plan with full-colour maps, charts, photos and supplemental information at:
www.townofcarberry.ca